Pseudoexfoliation in a Rural Population of Southern India: The Aravind Comprehensive Eye Survey

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OBJECTIVE: To determine the prevalence and risk factors for pseudoexfoliation in a rural population of southern India.

DESIGN: A population-based cross-sectional study of pseudoexfoliation with and without glaucoma in rural southern India.

PARTICIPANTS: A total of 5,150 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 minimal angle of resolution (logMAR) illiterate E charts and refraction, slit-lamp biomicroscopy, gonioscopy, applanation tonometry, dilated fundus examinations, and automated central 24-2 full-threshold perimetry. Pseudoexfoliation (PXF) was diagnosed by the presence of typical white deposits on the anterior lens surface; additional sites included the cornea, iris, anterior vitreous face, posterior capsule, and intraocular lens in cataract-operated eyes and changes in the angle determined through gonioscopy, including increased pigmentation, PXF deposition, and PXF material within the angle.

RESULTS: The prevalence (95% confidence interval) of PXF was 6.0% (5.3, 6.6). The prevalence increased with age (\( P < .001 \)) and was greater in males (\( P = .01 \)). Of subjects with PXF, 25.7% remained bilaterally blind after best correction; 89.3% of this bilateral blindness was the result of cataracts. The prevalence of glucoma among subjects with PXF was 7.5%; exfoliation was present in 26.7% of those identified as primary open-angle glaucoma. On multivariate analysis, increasing age and male gender were significantly associated with PXF.

CONCLUSIONS: Pseudoexfoliation appears to be a relatively common disorder in older individuals in southern India. Ophthalmologists in India may wish to focus on the detection of PXF, especially considering the relatively large burden of cataracts in this population, the risks for operative complications related to PXF, and the fact that PXF may be used as a marker to aid in the detection of glaucoma. (Am J Ophthalmol 2003;135:830–837. © 2003 by Elsevier Inc. All rights reserved.)

PSEUDOEXFOLIATION (PXF) IS CHARACTERIZED BY THE accumulation of extracellular fibrillar material in many ocular and systemic tissues and is often associated with glaucoma. In fact, it is now considered one of the most identifiable forms of open-angle glaucoma. The accumulation of fibrillar material is bilateral, even if the disease appears in only one eye, and has been identified as a cause for increased trabecular outflow resistance. Pseudoexfoliation is an age-related syndrome with wide geographic variations in prevalence, even in populations studied by the same examiner. The differences in prevalence have not been well explained. These variations may be either a true genetic difference related to ethnicity or may even be differences related to examination techniques and diagnostic abilities.

Although it seems obvious that PXF should be a systemic disorder, strong evidence supporting this has only recently been forthcoming. Typical exfoliative material has been found to be deposited in many organs of the body, including the heart, liver, lung, kidneys, and meninges, suggesting abnormal connective tissue metabolism. Recent work from the Blue Mountains prevalence study has
found an association between PXF and cardiovascular disease.\textsuperscript{12}

The finding of PXF in a developing country with many visually disabled or blind from cataract is potentially important for three reasons. The first is that both PXF and cataracts are age related, and in a population with cataract as a major cause of treatable blindness, the identification of PXF is critical. Pseudoexfoliation is associated with weak zonules and an increased risk for complications during cataract surgery.\textsuperscript{13} Additionally, both PXF and glaucoma are age related; the slit-lamp observation of PXF may become a marker to identify some of those who currently have or might later develop glaucoma. Finally, an association between pseudoexfoliation and angle-closure glaucoma\textsuperscript{14,15} has been found in some ethnic groups; PXF may act as a marker to identify those with this potentially curable form of glaucoma.

There are relatively few studies evaluating the true prevalence of PXF. Increased data on PXF are important to better define its global distribution and have a better understanding of its potential genetic influences. This study reports the prevalence of PXF in a rural population of southern India.

METHODS

THE ARAVIND COMPREHENSIVE EYE SURVEY (ACES) IS A population-based prevalence study of glaucoma and other visually impairing ocular disorders conducted among a rural population aged 40 years or older from three districts: Madurai, Tirunelveli, and Tuticorin of the state of Tamil Nadu in southern India. The study design and methods have been described elsewhere.\textsuperscript{16}

The sampling frame for this study consisted of a sample of typical rural districts (equivalent to a county in the United States) that are accessible to the Aravind Eye Hospitals located in Madurai and Tirunelveli to best reflect the rural population in the southern part of India. These are typical of southern India in terms of age, gender, and socioeconomic status. These districts are representative in terms of standard demographics and health-care use in south India but may or may not be representative of northern or other Indian states. A total of 14 rural blocks (the administrative unit directly below a district) were chosen at random in three districts (Madurai, Tirunelveli, and Tuticorin) to find 5,000 subjects older than the age of 40 years. Tirunelveli and Tuticorin were combined for the purposes of this study into one “study district” (because they were originally two districts that were geopolitically combined into one district during the time course of the study). Lists of villages for these blocks were obtained based on data from the 1991 Indian national census.\textsuperscript{17} Villages with population below 350 were excluded, because a minimum of 100 persons 40 years or older were desired from each selected village, and these smaller villages are not representative of the catchment area. Twenty-five villages from each of the two study districts were selected from the list of sectors with probability proportionate to size and stratified by district.

Data collection in the field started from November 1995 and was completed by February 1997. A detailed map was prepared for each village noting the location of all households in each sector and other important landmarks. Each village was divided into sectors of approximately 100 households, and for those villages with more than one sector, one sector was randomly chosen so that only one sector in any village was included in the sample. This provided a final sample of 50 sectors, 25 from each of the two study districts.

Within the geographic boundaries of each selected sector, all residential dwelling units were screened to identify eligible subjects. Each household received a complete household census, and a brief interview was conducted with the head of the household regarding demographic and socioeconomic characteristics of the household. All personnel used for the study were certified after standardization procedures.

A project field worker and an ophthalmic assistant conducted a basic screening examination on all members of each household. Visual acuity was measured under standardized conditions at 4 m with the subjects’ presentation in place, separately for each eye. A logarithm of minimal angle of resolution (logMAR) E chart, originally developed for use in the Baltimore Eye Survey\textsuperscript{18} and equivalent to the letter charts developed for the Early Treatment Diabetic Retinopathy Study,\textsuperscript{19} was placed in full daylight and protected from glare and shadow. Subjects were given credit for a line on the chart if they correctly read three or more of the five letters on that line. Pinhole visual acuity was measured in those eyes with presenting visual acuity worse than 6/18.

All subjects 40 years and older were transported to the Aravind Eye Hospitals in either Madurai or Tirunelveli for a comprehensive ophthalmologic examination. This examination 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, California, USA), evaluation of pupillary response, external and anterior segment examination at the slit-lamp biomicroscope, measurement of intraocular pressure with a Goldmann application 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{20}; stereoscopic examination of the vitreous, retina and optic nerve was done at the slit lamp with a 78-diopter lens and with an indirect ophthalmoscope using a 20-diopter lens. We defined cataract as nuclear opalescence greater than 3.0...
and/or posterior subcapsular cataract greater than 2.0.

We conducted a detailed interview during the wait accompanying pupillary dilation. The interview included an ophthalmic and general medical history, information on medication and tobacco use, a history of exposure to the outdoors, and a quality-of-life and visual functional status instrument designed specifically for the South Indian context. In addition, we collected anthropometric data on height, weight, waist and hip circumference, mid-upper arm circumference, and triceps skinfold thickness. Blood pressure was measured twice using a modified version of the Hypertension Detection and Follow-Up Study protocol, and laboratory studies of postprandial blood glucose, hemoglobin, and serum cholesterol were measured. Hemo-
globin A1c was not used, because it was not then available in Madurai. We did not collect medications but assessed the use of diabetic and antihypertensive medications from a questionnaire.

Participants who had dilation deferred because of oc-
ccludable/narrow angles had dilated examinations per-
formed after laser iridotomy either on the same day or on a subsequent day. The vertical and horizontal cup-to-disk ratios were measured and recorded. Asymmetry of the disks, notching, bayoneting, disk hemorrhages, nerve fiber layer defects, peripapillary atrophy, tilted disks, and atro-
phy of the disk were looked for and recorded. The width and location of the thinnest neuroretinal rim in clock hours was also recorded. A standard set of photographs of disks from 0.0 to 1.0 was used to grade cup-to-disk ratios.

After the completion of the examination, all ophthal-
mic diagnoses were recorded and coded according to the International Classification of Diseases, 9th revision. Three visual acuity measures are reported herein. In the village and the clinic, presenting visual acuity was defined as the visual acuity in the better eye with whatever correction was worn by the subject to the examination. Best village-based visual acuity was de-

• ASSESSMENT OF PXF: Before dilation, the corneal endothelium, iris, and iris margins were evaluated for PXF deposits using a detailed high-magnification slit-lamp assess-
ment. After dilation, the anterior lens surface was examined using a narrow slit-lamp beam under full illumination and high magnification. The lens was scanned from left to right, focusing on the detection of early signs of PXF, including pregranular radial lines and established granular deposits. Pseudoexfoliation was diagnosed by the presence of typical white deposits on the anterior lens surface; additional sites where we looked for PXF included the cornea, iris, anterior vitreous face, posterior capsule, and intraocular lens in cataract-operated eyes. We used gonioprisms to evaluate the angle for increased pigmentation, PXF deposition, and PXF material within the angle.

• ASSESSMENT OF OPEN-ANGLE GLAUCOMA AND OCU-
LAR HYPERTENSION: Glaucoma was defined by the presence of corresponding optic disk and visual field changes, independent of intraocular pressure (IOP) with open angles using the Shaffer system of gonioscopic classification. Definite glaucoma was defined as both a vertical and horizontal cup-to-disk ratio 0.8 or greater with neuroreti-
nal rim of 0.2 or less or asymmetry of 0.2 between eyes with matching visual field changes, excluding rubeotic, angle-
closure, or secondary glaucoma with gonioscopy. Visual field analysis was performed using the central 24-2 full-

threshold test (stimulus size III) on a Humphrey automated perimeter (Humphrey Instruments, Inc., Dublin, Califor-

nia, USA) for all participants. If the visual field was determined to be abnormal 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 \( P < .05 \). Criteria used to determine unreliability of the visual fields included false positives 50\% or greater, false negatives 33\% or greater, and fixation losses 50\% or greater. Ocular hypertension was defined as IOP greater than 21 mm Hg in either eye on applanation tonometry without any diagnostic visual field or disk signs of glaucoma.

- **OTHER FACTORS:** Systemic hypertension was defined either as a measured systolic blood pressure 160 mm Hg and/or a diastolic blood pressure 90 mm Hg or greater or current use of systemic antihypertensive medications. Diabetes was defined in this study as a measured postprandial blood sugar of 180 mg/dl or greater or current use of antidiabetic medications. The use of medications was determined by a questionnaire for both diseases, and we did not collect any medications. Blood samples were drawn for blood sugar. However, hemoglobin A1C was not available in Madurai at the time of the survey. Myopia was defined for this study as a spherical equivalent more negative than 1 diopter in either phakic eye, with nuclear opalescence less than grade 4.0.

All slit-lamp and fundus examinations were performed by residency-trained ophthalmologists. Examinations were performed according to a formalized study protocol. Quality assurance was constantly monitored. Cases of pseudoexfoliation were confirmed by either a glaucoma or anterior segment senior staff faculty member.

- **STATISTICAL ANALYSIS:** Statistical analysis was performed using Stata Version 7.0 software package (College Station, Texas, USA). Univariate and multivariate analysis was used to look separately for associations with PXF. Odds ratios (OR) and 95\% confidence intervals (CI) are presented. We did not perform stepwise regression and included variables if they were potential confounders, that is, associated with PXF and with other variables potentially thought to be associated with PXF in the model. Confidence intervals of the prevalence estimates have been calculated using the Poisson distribution. \( P \) values less than .05 have been taken to indicate statistical significance.

## RESULTS

WE ENUMERATED 5,539 ELIGIBLE PERSONS OLDER THAN 40 years. Among subjects 40 years or older, 5,337 persons (96.4\%) received the village-based screening examination, and 202 persons (3.6\%) refused screening but did provide demographic data. Data on 38 individuals (0.7\%) were incomplete. Of those enumerated, 5,150 were examined, a response rate of 93.0\%. The median age of those examined was 51 years, and 55.1\% were women. The response rate to examination, both in the field and in the hospital, was high, and there was no association of response to examination with age, gender, religion, caste, occupation, or literacy.

Pseudoexfoliation was determined to be present in one or both eyes of 308 participants after clinical examination, a prevalence of 6.0\% (95\% CI, 5.3–6.6). The median age for participants with PXF was 63.0 years (age range, 46–85 years), and 57.8\% were men. Of the 308 participants, 216 (70.1\%) had visible exfoliative material present in both eyes. Among the 470 eyes with PXF, 123 eyes (26.2\%) were aphakic, and 9 (1.9\%) pseudophakic. The prevalence of PXF showed a significant age-related increase (chi-squared \( P < .001 \)): PXF in one or both eyes was detected in 2.1\% (95\% CI, 1.6\%–2.6\%) of those younger than 60 years, 12.5\% (95\% CI, 10.6\%–14.4\%) of those aged 60 to 69 years, and 20.1\% (95\% CI, 16.3\%–24.0\%) of those 70 years and older (Table 1). Pseudoexfoliation was less prevalent in women (4.6\%) than men (7.7\%) after adjusting for age (\( P = .01 \)).

Of the 211 persons with PXF who had natural lenses in both eyes, 99 (46.9\%) had exfoliative material present on both iris and lens of the same eye; 67 eyes had exfoliation material visible only on the lens. Bilateral ocular involvement was visible in 216 persons (70.1\%) with PXF.

Of the subjects with PXF, 91\% (\( n = 265 \)) had visual impairment on measuring presenting vision with available spectacles, and 60.2\% (\( n = 176 \)) remained visually impaired after measuring best-corrected vision. Of subjects with PXF, 51\% (\( n = 149 \)) had bilateral visual acuity blindness on measuring presenting vision; after best-correction 25.7\% (\( n = 75 \)) remained bilaterally blind. A large proportion (\( n = 67, 89.3\% \)) of this bilateral blindness persisting after best correction was the result of cataracts; 9.3\% (\( n = 7 \)) was the result of glaucoma. Differences in visual impairment for eyes with and without PXF remained at significant levels for both presenting and best-corrected vision after adjusting for age (chi-squared test, \( P < .001 \)). This difference remained statistically significant, even after adjusting for the presence of cataract and glaucoma (chi-squared test, \( P < .001 \)).

### Table 1. Prevalence of Pseudoexfoliation by Age and Gender; Subjects Aged 40 Years and Older

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Women</th>
<th>Men</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( N )</td>
<td>( n ) (%)</td>
</tr>
<tr>
<td>40–49</td>
<td>1,280</td>
<td>4 (0.31)</td>
</tr>
<tr>
<td>50–59</td>
<td>795</td>
<td>32 (4.03)</td>
</tr>
<tr>
<td>60–69</td>
<td>607</td>
<td>65 (10.71)</td>
</tr>
<tr>
<td>( \geq 70 )</td>
<td>154</td>
<td>29 (18.83)</td>
</tr>
</tbody>
</table>

*\( N \) = the number of subjects of a specific gender in an age group.

†\( n \) = the number of affected individuals of a specific gender in an age group.
Definite glaucoma was diagnosed in 23 of the 308 persons (7.5%) with PXF. Of the 23 persons with glaucoma, 22 had open angles on gonioscopy; the remaining person had anatomically narrow angles with no signs of secondary involvement. The mean age of men with PXF and glaucoma was 63.7 years (95% CI, 58.3–69.1) compared with 58.1 years (95% CI, 52.1–64.0) for women. Table 2 shows the age and gender prevalence of glaucoma in subjects with PXF. Ocular hypertension was diagnosed in 13 additional participants (4.22%). (The odds ratio for the presence of different lens opacities in the regression model. Potential associations for PXF were explored using multiple logistic regression (Table 5). Increasing age and male gender were found to be significantly associated with PXF on multivariate analysis. However, only increasing age was significantly associated with PXF on multivariate analysis that included the interaction between age and sex as a covariant in the model. Neither hypertension nor diabetes was associated with PXF.

### TABLE 2. Prevalence of Glaucoma in Subjects With Pseudoexfoliation by Age and Gender

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>With Glaucoma, N (%)</th>
<th>Without Glaucoma but With PXF, N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>W</td>
<td>M</td>
</tr>
<tr>
<td>40–49</td>
<td>0 (0.00)</td>
<td>1 (0.81)</td>
</tr>
<tr>
<td>50–59</td>
<td>4 (2.19)</td>
<td>4 (3.23)</td>
</tr>
<tr>
<td>60–69</td>
<td>4 (2.19)</td>
<td>5 (4.03)</td>
</tr>
<tr>
<td>≥70</td>
<td>4 (2.19)</td>
<td>1 (0.81)</td>
</tr>
<tr>
<td>Total</td>
<td>12 (6.56)</td>
<td>11 (8.87)</td>
</tr>
</tbody>
</table>

M = men; n = number of subjects; PXF = pseudoexfoliation; W = women.

### TABLE 3. Mean Intraocular Pressure in Eyes With Pseudoexfoliation by Age and Gender

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Mean IOP* in Eyes With Glaucoma, IOP (SD)</th>
<th>Mean IOP* in Eyes Without Glaucoma, IOP (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>40–49</td>
<td>17.00†</td>
<td>13.8 (2.6)</td>
</tr>
<tr>
<td>50–59</td>
<td>19.4 (7.7)</td>
<td>15.5 (8.1)</td>
</tr>
<tr>
<td>60–69</td>
<td>19.3 (9.4)</td>
<td>16.0 (7.0)</td>
</tr>
<tr>
<td>≥70</td>
<td>19.8 (7.8)</td>
<td>15.5 (5.1)</td>
</tr>
</tbody>
</table>

*M = mean of three measures of intraocular pressure measurement by applanation tonometry.
†Only one observation.
IOP = intraocular pressure.

The mean IOP in subjects with PXF determined by applanation tonometry was 15.9 mm Hg (95% CI, 15.2–16.7) compared with 14.5 mm Hg (95% CI, 14.4–14.6) in subjects without PXF. The mean IOP among glaucomatous eyes with PXF was 19.4 (95% CI, 15.9–22.8) and 23.9 mm Hg (95% CI, 22.2–25.8) in glaucomatous eyes without PXF. Table 3 shows the age and gender distribution of mean IOP among eyes with PXF. Figure 1 compares the mean IOP among four different study groups: normal subjects without glaucoma, PXF without glaucoma, PXF with glaucoma, and primary open-angle glaucoma without PXF.

Of the 308 subjects with PXF, 96.9% of the phakic right eyes (219 of 226) and 95.6% of the phakic left eyes (218 of 228) had lens opacities, 132 eyes had prior cataract surgery, 123 eyes were aphakic, and 9 eyes were pseudophakic.

Recent studies from India have reported the prevalence of open-angle glaucoma in urban populations but contained no information on the proportion of PXF. A previous hospital-based report from India estimated the prevalence of pseudoexfoliation to be 7.4% in subjects older than 45 years. We do not know whether these findings in our study can be extrapolated to other populations within India. It could be that there are racial, ethnic, environmental, or cultural factors linked to PXF that our study was not designed to evaluate.

Previously published reports of PXF have shown an age-related increase, with PXF typically being less common below the age of 60 years and increasing thereafter. We found similar results. There have been conflicting results as to a gender predilection for PXF. We found no significant association between sexes after adjusting for age. Pseudoexfoliation has been reported previously as the most common identifiable cause for open-angle glaucoma. Pseudoexfoliation was present in 26.7% of open-angle glaucoma cases in our study. However, the cross-sectional nature of our study does not allow us to ascertain whether the PXF actually preceded glaucoma in this population. This is higher than the 13.4% reported from the Blue Mountains Eye Study but much lower than the close to 50% reported from Scandinavia and Turkey.

Contrary to previously published reports, we did not find significant differences in the mean IOP of eyes with PXF and those without PXF. However, our measurements of
IOP were not reflective of either peak IOP or duration of any elevation, because this was a cross-sectional study. This finding, however, is important, because most Indian ophthalmologists still primarily rely on IOP measurements as primary testing for glaucoma. If routine slit-lamp and dilated examinations are not practiced for all patients but only for those with suspected pathology, a substantial number of cases with exfoliation will be missed. The burden of cataract blindness is high in this population, and detection of PXF preoperatively may reduce the risks for operative complications of cataract surgery.

Pseudoexfoliation may also serve as a marker for glaucoma in this population; early detection of glaucoma may help reduce the burden of preventable blindness resulting from glaucoma. The 7.5% prevalence of glaucoma in subjects with PXF in this population assumes particular significance, considering that over 25% of the open-angle glaucoma was accompanied by PXF. The mean IOP was higher in glaucomatous eyes without PXF compared with glaucomatous eyes with PXF. Previous reports have hypothesized a possible nonpressure mechanism for optic nerve damage, and elastotic changes in the lamina cribrosa in patients with PXF and glaucoma have also been reported.

We included eyes operated for cataract in our analysis; the diagnosis of exfoliation in such eyes was based primarily on the presence of exfoliative material on the iris, and cornea and/or anterior vitreous face and/or posterior capsule and/or intraocular lens implants. However, our estimates of the prevalence of PXF may be an underestimate, considering that 67 eyes in our study had exfoliative material present on the lens but not on the iris. It is possible that some of the operated cataracts may have had exfoliative material present only on their lenses before surgery with no postoperative clinical evidence for PXF. The possibility of PXF material being clinically visible only on the lens emphasizes the need for dilated lens examinations preoperatively. The lack of lens photographs may mean that some of the cases with early PXF only on the lens may also have been missed.

Both PXF and lens opacities are considered age related; over 95% of the phakic eyes with PXF in our study had some lens opacity. Eyes with PXF had more visual impairment when compared with uninvolved fellow eyes. We found PXF to be significantly associated with two types of lens opacities: posterior subcapsular and cortical. Higher

### TABLE 4. Lens Opacities Classification System III Lens Status in Subjects With Pseudoexfoliation

<table>
<thead>
<tr>
<th>Status</th>
<th>Right Eye, n (%)</th>
<th>Left Eye, n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No cataract</td>
<td>7 (2.4)</td>
<td>10 (3.4)</td>
</tr>
<tr>
<td>Nuclear cataract</td>
<td>1 (0.3)</td>
<td>1 (0.3)</td>
</tr>
<tr>
<td>Cortical cataract</td>
<td>4 (1.4)</td>
<td>5 (1.7)</td>
</tr>
<tr>
<td>PSC</td>
<td>0 (0.0)</td>
<td>1 (0.3)</td>
</tr>
<tr>
<td>Mixed</td>
<td>214 (73.5)</td>
<td>211 (71.5)</td>
</tr>
<tr>
<td>Aphakia</td>
<td>62 (21.3)</td>
<td>61 (20.7)</td>
</tr>
<tr>
<td>Pseudophakia</td>
<td>3 (1.0)</td>
<td>6 (2.0)</td>
</tr>
</tbody>
</table>

Data presented as number of subjects (%). Mixed cataract includes a combination of nuclear, cortical, or posterior subcapsular cataract. Nuclear, cortical, and posterior subcapsular cataract subgroups are isolated cataracts without the presence of the other subgroups.

PSC = posterior subcapsular cataract.
TABLE 5. Associations for Pseudoexfoliation Using Multiple Logistic Regression Analysis

<table>
<thead>
<tr>
<th>Age (Years)</th>
<th>Unadjusted Odds Ratio (95% CI)</th>
<th>Adjusted Odds Ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>40–49</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>50–59</td>
<td>15.7 (6.8, 36.3)*</td>
<td>8.03 (1.85, 34.78)*</td>
</tr>
<tr>
<td>60–69</td>
<td>48.3 (21.3, 109.6)*</td>
<td>15.69 (3.71, 66.38)*</td>
</tr>
<tr>
<td>≥70</td>
<td>84.1 (36.4, 194.3)*</td>
<td>28.79 (6.26, 132.28)*</td>
</tr>
</tbody>
</table>

Gender
- Female 1.0 1.0
- Male 1.8 (1.45, 2.32)* 1.05 (0.95, 1.167)*

Hypertension
- No hypertension 1.0 1.0
- Hypertension 1.0 (0.8, 1.4) 0.77 (0.49, 1.21)

Diabetes
- No diabetes 1.0 1.00
- Diabetes 1.4 (0.8, 2.3) 0.86 (0.40, 1.84)

Myopia
- No myopia 1.0 1.00
- Myopia 1.4 (1.1, 1.8)* 1.05 (0.65, 1.56)

*P < .05.
CI = confidence interval.

rates of subcapsular lens opacities with PXF have been reported previously. There has been a previous report from Australia on a potential association between global radiation and PXF; this may possibly explain the association between cortical lens opacities and PXF in our study. However, our study was not designed to look at ocular exposures of radiation, including ultraviolet B radiation. The possible association between cataracts and PXF has been previously hypothesized to be the result of ocular ischemia; however, our study was not designed to evaluate this relationship.

Cataract surgery is associated with more complications in eyes with PXF. Pseudoexfoliation is considered a risk factor for both vitreous loss and insufficient mydriasis. There have been reports of an increased incidence of zonular dialyses, lens dislocation, and capsular rupture in subjects with PXF. Over 93% of the eyes with PXF that had been operated on in our study were aphakic, predominantly intracapsular cataract extractions; only nine operated eyes were pseudophakic. The study was conducted during a period of transition from conventional intracapsular to extracapsular cataract extraction with intraocular lens, and we were unable to tell whether a proportion of this aphakia was the result of intraoperative complications. We were unable to explore further the possible differences in complications between eyes with and without PXF that had undergone cataract surgery. For example, it was not possible for us to distinguish whether the vitreous visible in the anterior chamber in aphakic eyes was the result of an intraoperative loss or occurred postoperatively. We did not have enough pseudophakic eyes to make comparisons regarding complications in eyes with intraocular lenses.

The presence of PXF may have a bearing on the type of intraocular lens implant used. Surgeons should also be aware of the possibility of decentration of the intraocular lens, even if placed in the bag. These patients are also at greater risk for a postoperative immediate elevation of IOP. Cataract programs in India are focusing on increasing the number of cataract surgeries and moving from intracapsular to extracapsular types of cataract surgery. Preoperative detection of PXF will help better prepare the operating surgeon and will reduce the risks for operative and postoperative complications, improving the outcomes of cataract surgery.

The prevalence of PXF increases with age, and we expect to see more exfoliative glaucoma and cataract as life expectancies increase in India. The diagnosis of PXF has been reported to be examiner dependent. Early clinical signs are often subtle in nature and require slit-lamp biomicroscopy and dilated examinations for detection. Clinical examination practices must focus on slit-lamp biomicroscopy for anterior segment examination and dilated lens and fundus examinations for all patients unless otherwise contraindicated. The high prevalence of exfoliation in this population suggests that adequate training in the identification of exfoliation has to be imparted in residency programs and postgraduate training programs.

Despite the fact that our sample was taken at random, we do not presume to project estimates for the entire large and diverse country. It may be that the current available local means are sufficient to allow implementation of the proposed program. However, the level of training oriented toward optimally using slit-lamp and fundus examination skills could be a significant limiting factor.

REFERENCES