

# Pseudoexfoliation Syndrome and Associated Factors Among Adults at Gondar University Comprehensive Specialized Hospital Tertiary Eye Care and Training Center: A Cross-Sectional Study

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**Background:** Pseudoexfoliation syndrome is an age-related disorder characterized by the deposition of a distinct fibrillar extracellular material in various tissues and organs of the body. Glaucoma and cataract are the consistently reported clinical consequences of Pseudoexfoliation syndrome on the eye. This study aimed to estimate the proportion of pseudo-exfoliation syndrome and associated factors in Gondar university comprehensive specialized hospital tertiary eye care and training center.

**Methods and Materials:** Institution-based cross-sectional study was conducted from January to March 2019 at Gondar university comprehensive specialized hospital tertiary eye care and training center among 295 patients. Consecutive 295 participants aged above 40 years were involved in the study. A structured questionnaire and ocular examination were used to collect the data. Data were entered into EPI-INFO 3.5.1 and exported to SPSS version 20 for analysis. Factors associated with pseudoexfoliation syndrome were ascertained by chi-square and independent *t*-test. Statistical significance was considered when *p*-value <0.05.

**Results:** A total of 295 adults participated in the study with a response rate of 92.8%. The median ( $\pm$ IQR) age of study respondents was 64( $\pm$ 9) years and 67.8% were males. The proportion pseudoexfoliation syndrome was 34.6% [95% CI: 29.2–40.7%]. The mean IOP and mean age were significantly higher among patients with pseudoexfoliation syndrome. Age, sex, high IOP, glaucoma, outdoor work, and rural residence were significantly associated with the proportion of pseudoexfoliation syndrome.

**Conclusion:** The proportion of pseudoexfoliation syndrome among participants aged  $\geq$ 40 years was high. Age, sex, high IOP, glaucoma, outdoor work, and rural residence were factors having a significant association with the proportion of pseudoexfoliation syndrome.

**Keywords:** pseudoexfoliation syndrome, Ethiopia, Gondar

## Introduction

Pseudoexfoliation syndrome (PXF) is an age-related disorder characterized by the deposition of a distinct fibrillar extracellular material in various tissues and organs of the body.<sup>1</sup> Glaucoma and cataract are the most consistently reported clinical consequences of PXF on the eye.

The proportion of PXF has been investigated in different countries and it ranges from 1.5% to 40.9% worldwide.<sup>2,3</sup> Literatures show in European countries the proportion is found to be 3.6% to 34.2%,<sup>4,5</sup> in Asian countries 1.5% to 22.1%,<sup>2,6</sup>

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in Africa 1.5% to 40.9%.<sup>3,7</sup> Whereas, in Ethiopia, it is reported as to 12% to 13.2%.<sup>8,9</sup>

Pseudoexfoliation syndrome has different impacts on the eye. Pseudoexfoliation syndrome is the most common identifiable cause of glaucoma worldwide, accounting for the majority of cases in some countries, and causing both open and angle-closure glaucoma.<sup>9</sup> Pseudoexfoliation glaucoma has a much worse visual field and higher optic nerve damage during diagnosis than primary open-angle glaucoma. This may be due to higher and greater fluctuations in pseudoexfoliation glaucoma.<sup>10</sup> There are risks of complications such as lens subluxation, zonular dialyses or breaks, posterior capsular rupture, vitreous loss, subluxated intraocular lens, uveitis, hemorrhage, the formation of posterior synechiae, and corneal endothelial decompensation when performing cataract surgery in patients with PXF.<sup>7,10</sup>

However, studies on the magnitude of PXF and associated factors in our country are limited. Studying the magnitude of PXF and its associated factors is helpful for the early evidence-based intervention of the consequence of PXF on the eye. This study is designed to provide institution-based epidemiological information on pseudoexfoliation syndrome in the population older than 40 years at Gondar university comprehensive specialized hospital tertiary eye care and training center, Ethiopia.

## Methods and Materials

### Study Design and Period

A hospital-based cross-sectional study was done from January–March 2019.

### Study Area

The research was carried out in Gondar university comprehensive specialized hospital tertiary eye care and training center, Gondar city, Northwest of Ethiopia. University of Gondar tertiary eye care and training center provides eye care services in a different specialty for 14 million people of northwest Ethiopia and training for eye care professionals such as optometrists, ophthalmic nurses, and ophthalmologists.

### Source/Study Population

All adults who visit Gondar university comprehensive specialized hospital tertiary eye care and training center during the study period.

### Inclusion Criteria and Exclusion Criteria

Adult ophthalmic patients age above 40 years who attended Gondar university comprehensive specialized hospital tertiary eye care and training center during the study period were included in the study. Whereas, adult ophthalmic patients age above 40 with cornea opacity which can hinder the anterior segment examination, aphakia, and angle-closure glaucoma were excluded from the study.

### Sample Size Determination

The sample size was calculated using the single population proportion formula considering the proportion of PXF,  $p=39.3\%$  which is taken from a study done in Addis Ababa Ethiopia,<sup>11</sup> 95% confidence interval and margin of error=5%. Then the calculated sample size was found to be  $N=368$ . Since the total number of source population was less than 10,000 the reduction formula was used. Considering a 5% non-response rate, the final sample size was found to be 318.

### Sampling Technique

All consecutive new patients who came to Gondar University comprehensive specialized hospital during the study period age  $\geq 40$  years were included in the study until the required sample is obtained.

### Operational Definitions

Diagnosis of glaucoma was made if IOP  $> 21$  mmHg with glaucomatous optic disc damage and/or any characteristic visual field defect and if the patient had a history of glaucoma surgery or use of anti-glaucoma eye drops in either eye.<sup>12</sup>

Participants were classified as having PXF if any pseudoexfoliation material was present on the iris or lens capsule on dilated slit-lamp examination in either eye.<sup>13</sup>

A participant who drunk  $>14$  units of alcohol with a frequency of once weekly or more was ascertained as an alcohol consumer. Whereas a person who smokes any tobacco product either daily or occasionally is categorized as a smoker.<sup>14</sup>

A subject was considered to have diabetes if he or she had been diagnosed by a physician, was treated with insulin or oral hypoglycemic agents, findings of diabetic retinopathy in at least one eye during dilated fundus examination, or a combination of the above. Study participants were deemed to have hypertension if they reported being

told by a physician that they had hypertension, they were taking antihypertensive medications, findings of hypertensive retinopathy in at least one eye during dilated fundus examination, or a combination thereof.<sup>14</sup>

## Data Collection Tools and Procedures

A pre-tested and structured questionnaire consisting of questions for socio-demographic factors, clinical factors, behavioral factors, and systemic conditions was used to collect the data. Face to face interview was used to assess socio-demographic factors, behavioral factors, and systemic conditions. All participants underwent a complete ocular examination including intraocular pressure measurement, slit-lamp biomicroscope, and dilated fundus examination to obtain clinical factors. All patients' visual acuity was tested using a standard illuminated Snellen's chart with illiterate E-optotype. Complete anterior segment examination including pseudoexfoliation identification was held with a slit lamp biomicroscope. The posterior segment was assessed with slit lamp biomicroscope and Volk lens 90D after pupillary dilation with tropicamide 1%. Tonopen applanation tonometer and Goldman visual field analyzer were used to measure intraocular pressure and visual field, respectively.

For IOP measurement only one eye of each person was considered. In people with unilateral PXF, the eye with PXF was considered. In those with bilateral PXF and the patients without PXF, one eye was chosen randomly. Any IOP of more than 21mm Hg was considered as high.

## Data Quality Assurance

Questions for socio-demographic factors, behavioral factors, and systemic conditions were translated into the local language Amharic and then translated back into English by language experts to check consistencies in meaning. Pretest was done on 5%<sup>16</sup> of the sample size at Felege Hiwot Referral Hospital Bahir Dar.

Training on how to collect the data, the purpose of the study, and how to approach respondents to obtain consent was given for data collectors.

Four data collectors (optometrists) were assigned to administer the questionnaire after getting written informed consent from each participant and to review the chart. The principal investigator and supervisor were strictly engaged in the supervision during the data collection to assure the completeness and consistency of the data.

## Data Processing and Analysis

Data were coded, checked, cleaned, and entered into Epi Info 3.5.1. After exporting the cleaned data analysis was performed with SPSS version 20. Frequencies, percentages, and mean were used to describe study results. Chi-square test was used to compare the frequencies and Student's *t*-test was used to compare the means of the continuous quantitative variables. Variables with a *p*-value <0.05 were considered statistically significant.

## Results

### Sociodemographic Characteristics of Study Participants

In this study, 295 patients age >40 years and above were included in the study with a response rate of 92.8%. The median age ( $\pm$ IQR) was 64  $\pm$ 9 years. From study participants two hundred (67.8%) were males. More than half of the study participants (56.9%) came from rural residents (Table 1).

**Table 1** Sociodemographic Characteristics of Study Participants at Gondar University Comprehensive Specialized Hospital Tertiary Eye Care and Training Center, Ethiopia 2019

Variables	Frequency	Percentage
<b>Age(years)</b>		
40–50	75	25.4
51–60	59	20.0
61–70	72	24.4
>71	89	30.2
<b>Sex</b>		
Male	200	67.8
Female	95	32.2
<b>Residence</b>		
Rural	168	56.9
Urban	127	43.1
<b>Educational level</b>		
Unable to read and write	150	50.8
Only able to read and write	66	22.4
Primary education	35	11.9
Secondary education	20	6.8
College/University	24	8.1
<b>Religion</b>		
Christian	268	90.8
Muslim	27	9.2
<b>Occupation</b>		
Indoor	146	49.5
Outdoor	149	50.5

## Ocular, Systemic, and Behavioral Characteristics of Study Participants

Thirty-eight percent of participants had high IOP. Ninety-three (31.5%) participants had glaucoma and 161 (54.6) participants had cataract (Table 2).

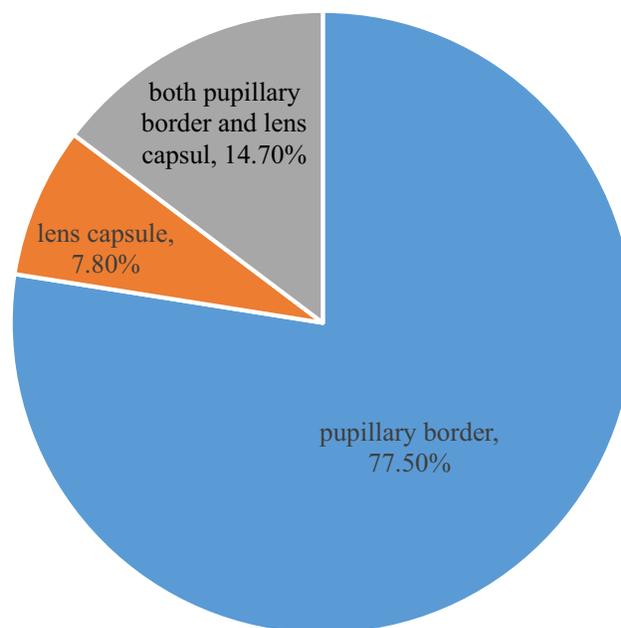
## Proportion of Pseudo Exfoliation Syndrome

Pseudoexfoliation syndrome was found among 102 (34.6%) study participants (95% CI, 29.2–40.7). Among patients with PXF 79 (77.5%) had PXF at the pupillary border, 8(7.8%) had PXF at lens capsule and 15 (14.7%) had PXF at both pupillary border and lens capsule (Figure 1).

Regarding laterality among patients with PXF 81 (50.4%) had PXF bilaterally and 21 (49.6%) had PXF unilaterally.

## Factors Associated with Proportion of Pseudoexfoliation Syndrome Among Study Participants

The mean IOP in patients with PXF (26.4 ±11.4mmHg) was significantly higher than in participants without PXF



**Figure 1** A pie chart showing the location of pseudoexfoliation among study participants at Gondar University comprehensive specialized Hospital Tertiary Eye Care and Training Center, Ethiopia 2019.

(19.6 ± 8.3mmHg). The proportion of PXF among patients with IOP >21mmHg (50.9%) was significantly higher than those having IOP ≤ 21mmHg (24.6%). The proportion of PXF was significantly higher in patients with glaucoma (54.8%) than those without (25.2%).

The mean age among patients with PXF and those without PXF was significantly different (66.2± 11.8 years) and (60.1±12.6 years), respectively. The proportion of PXF significantly increased as the age increases. The proportion of PXF was 18.7% among patients less than 50 years whereas in patients aged greater than 70 years found to be 43.8%.

The proportion of PXF was significantly higher among males than females with the proportion of PXF 39% vs 25.3%, respectively. Similarly, there was a significant difference in the proportion of PXF among urban (17.3%) and rural (47.6%) residents. Moreover, the proportion of PXF was significantly higher in participants who had outdoor occupation (48.3%) than those who have indoor occupations (20.9%) (Table 3).

## Discussion

In this study, the proportion of PXF among adults aged ≥40 years was found to be 34.6 (95% CI, 29.2–40.7). This finding is comparable with other study done in Addis Ababa, Ethiopia (39.3%).<sup>11</sup> This similarity may be due to a similar study setting since both studies are hospital-based studies. Nevertheless, the result of this study is higher than

**Table 2** Systemic and Behavioral Characteristics of Study Participants at Gondar University Comprehensive Specialized Hospital Tertiary Eye Care and Training Center, Ethiopia 2019

Variables	Frequency	Percentage
<b>IOP</b>		
≤21	183	62.0
>21	112	38.0
<b>Ocular conditions</b>		
Glaucoma	93	31.5
Cataract	161	54.6
<b>Hypertension</b>		
Yes	28	9.5
No	267	90.5
<b>DM</b>		
Yes	13	4.4
No	282	95.6
<b>Smoking</b>		
Yes	20	6.8
No	275	93.2
<b>Alcohol consumption</b>		
Yes	79	26.8
No	216	73.2

**Table 3** Factors Associated with the Proportion of Pseudoexfoliation Syndrome Among Adults at Gondar University Comprehensive Specialized Hospital, Gondar, Ethiopia, 2019

Variable	PXF Group n (%)	No PXF Group n(%)	p-value
<b>Age(in years)</b>			
40–50	14 (18.7)	61 (81.3)	0.002
51–60	18 (30.5)	41 (69.5)	
61–70	31 (43.0)	41 (56.9)	
>70	39 (43.8)	50 (56.2)	
<b>Mean age (in years)</b>	66.2±11.8	60.1±12.6	<0.001
<b>Sex</b>			
Male	78 (39.0)	122 (61.0)	0.02
Female	24 (25.3)	71 (74.7)	
<b>Occupation</b>			
Indoor work	30 (20.9)	116 (79.5)	<0.001
Outdoor work	72 (48.3)	77 (51.7)	
<b>Residence</b>			
Urban	22 (17.3)	105 (82.7)	<0.001
Rural	80 (47.6)	88 (52.4)	
<b>IOP</b>			
≤21mmHg	45 (24.6)	138 (75.4)	<0.001
>21 mmHg	57 (50.9)	55 (49.1)	
<b>Mean IOP (mmHg)</b>	26.4± 11.4	19.6± 8.3	<0.001
<b>Glaucoma</b>			
Yes	51 (54.8)	42 (45.2)	<0.001
No	51 (25.2)	151 (74.8)	
<b>Cataract</b>			
Yes	63 (39.1)	98 (60.9)	0.071
No	39 (29.1)	95 (70.9)	
<b>Hypertension</b>			
Yes	11 (39.3)	17 (60.7)	0.582
No	98 (35.8)	176 (64.2)	
<b>DM</b>			
Yes	5 (38.5)	8 (61.5)	0.763
No	99 (34.9)	185 (65.1)	
<b>Smoking</b>			
Yes	6 (30.0)	14 (70.0)	0.656
No	100 (35.8)	179 (64.2)	
<b>Drinking alcohol</b>			
Yes	24 (30.4)	55 (69.6)	0.359
No	78 (36.1)	138 (63.9)	

studies done in Japan (1.5%),<sup>2</sup> India (22.1%),<sup>6</sup> Jordan (4.9%),<sup>15</sup> Latvia (21.6%),<sup>16</sup> Turkey (11%),<sup>17</sup> Russia (3.6%),<sup>4</sup> Nigeria (1.5%),<sup>7</sup> and Ethiopia (13.2%).<sup>9</sup> One reason for this may be the different study setting, as this study was hospital-based while others were community-based studies. This might also be because of the sample size and age range difference among the study participants.

In this study, the proportion of PXF significantly increases as the age increases. It is well-recognized PXF increases with age since the PXF is considered an age-related disease.<sup>18</sup> This result is in agreement with previous studies.<sup>3,8,19</sup> Though the explanation for this is indefinite, some speculate that advancing in age results in variation in gene expression which in turn leads to PXF.<sup>20</sup>

Even though there was no significant gender predominance in previous studies, there was significantly male predominance in the proportion of PXF (39% and 25.3%) in the current study. This finding is in agreement with the Nigerian study.<sup>7</sup> This may perhaps be due to men spending most of their time carrying out more outdoor activities compared with women. But it is different from other study done in Sweden<sup>21</sup> which shows female predominance. This could be due to the higher proportion of female study participants in Sweden's study.

The result of this study showed that the mean IOP was significantly high among patients with PXF and the proportion of PXF among study participants with IOP >21mmHg (55.9%) was significantly higher than those having IOP ≤21mmHg (44.1%). This result is consistent with other studies.<sup>3,9,17</sup> It was proposed that the accumulation of PXF material clumps may block normal drainage of aqueous humor, which leads to increment of intraocular pressure.<sup>22</sup>

As glaucoma has a well-established association with PXF in previous studies,<sup>3,9,23</sup> this study also found a significantly higher proportion of glaucoma among study participants with PXF (54.8%) than those without it (45.2%). Early identification of these associated disorders is vital because of the more aggressive nature of this type of glaucoma.

Participants who had outdoor occupations had a high proportion of PXF syndrome as compared to those having indoor work. This finding is in harmony with a study done in south India.<sup>24</sup> This might be due to that outdoor occupational activities make them have high exposure to solar radiation which is a probable environmental factor for the development of PXF.<sup>25</sup>

Participants who were rural residents had a high frequency of PXF syndrome as compared to urban residents. The majority of study participants (almost 57%) highly depend on agricultural work and their routine activities were outdoor that may create a significant risk factor for the occurrence of PXF in this population.

Since this study is conducted in a single hospital and focused on ophthalmic patients, a conclusion for the community at large is impossible. Hence, further large-scale population-based studies are necessary to assess the prevalence of PXF and associated risk factors.

## Conclusions

Pseudoexfoliation syndrome is high among adults at Gondar University comprehensive specialized eye hospital. It is evidenced that glaucoma is significantly high among participants with PXF. Age, sex, residence, and occupation were significantly associated with PXF.

## Data Sharing Statement

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

## Ethical Approval and Informed Consent

The study was conducted in accordance with the Declaration of Helsinki and approved by the institutional review board of the University of Gondar, college of medicine, and health science school of medicine ethical review committee. Participants were informed that participation is voluntary and were given the right to refuse to take part in the study as well as to withdraw at any time during the interview process. Written informed consent was obtained from every participant. No names or identifying information were indicated on the questionnaires, and all subjects were assured of confidentiality.

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## Author Contributions

All authors made substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; took part in drafting the article or revising it

critically for important intellectual content; agreed to submit to the current journal; gave final approval of the version to be published; and agree to be accountable for all aspects of the work.

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## Disclosure

The authors declare that they have no conflicts of interest for this work.

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