

Primary open angle glaucoma as seen at the University Teaching Hospital, Lusaka, Zambia

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ABSTRACT

Objective: To determine the prevalence of Primary Open-Angle Glaucoma (POAG) among patients attending eye clinic at University Teaching Hospital (UTH).

Design: A cross sectional survey.

Methods: The POAG survey was carried out at the eye clinic of the University Teaching Hospital (UTH), Lusaka from January to December 2013. The clients ($n = 1,625$) had a full ocular examination and their demographic information (specifically age, sex, residence and ethnicity) was captured. The ocular examination included visual acuity and intraocular pressure (IOP) among others. Multivariate logistic regression, stratified by age group and gender, was used to determine the association between demographic factors and POAG.

Results: Of the 1,714 patients randomly sampled for the study, 89 (5.2%) declined to participate in the study; hence the response rate of 94.8%. The ages ranged from 20 to 98 years, with a median age of 51 years (IQR 45, 59). The prevalence of POAG was 19.0% (95% CI, 14.6%, 23.8%), distributed as 5.7% (95% CI 3.2, 9.1) in males and 13.3% (95% CI 11.7, 21.3) for females. Females were more likely to have POAG than males (72.9% vs. 27.1%; OR 2.78, 95% CI 2.1, 5.8). Surprisingly, age groups younger than 40 years had higher proportion of POAG compared to the older population (61.6% vs. 38.4%, $P < 0.001$). The main determinants of POAG were age, sex and Diabetic Retinopathy (DR). There was a significant negative correlation between POAG and HIV infection ($r^2 = 0.0269$; $p < 0.001$).

Conclusion: The prevalence of POAG in this population of 19.0% was higher and certainly not comparable to those in black populations in Barbados, St. Lucia, Nigeria, Ghana and South Africa. The striking finding of this study was that 40.7% of all the identified POAG cases were below the age of 40 years. There was no association between POAG and HIV infection.

Key words: Glaucoma, Prevalence, Primary open-angle glaucoma, Determinants, Intraocular pressure

INTRODUCTION

Preventable blindness has continued to be a significant contributor to disease burden and morbidity in eye health despite the fact that most blindness is avoidable¹. Glaucoma, which is a group of non-communicable eye diseases leading to optic neuropathies, is one of the causes of preventable blindness. Primary Open Angle Glaucoma (POAG) is the most common form and significantly affects the general population more than other forms of glaucoma². In Zambia, a previous retrospective study looking at the hospital records found that all the glaucoma patients had POAG³.

Several studies conducted in various continents have demonstrated that POAG varies with age, sex and race⁴⁻¹⁰. According to Friedman *et al*¹⁰, the prevalence POAG in the Caucasian population aged 40 years and older is around 1.69%. In similar environments the black population race were 3 times more likely to have POAG compared with white subjects¹⁰. This certainly suggests that POAG may be a significant problem in black African populations¹⁰. Despite this, there is limited research and data on factors that are

associated with this public health problem in black African communities^{1,2}.

Ntim-Amponsah *et al*⁸ found the overall prevalence of glaucoma in the Ghana population of 8.4% (8.2% in females, 8.6% in males). This was similar to what Adeyinka *et al*¹¹ found in Nigeria at 7.3%. These two findings were comparable to the findings in black populations in Barbados and St. Lucia⁷. In South Africa the prevalence was significantly lower at 4.5%¹². Although these studies were mostly population based, they were cited for this study because of lack of hospital based studies. This hospital study was conducted because of affordable cost as compared to population studies.

A retrospective study performed by Muma *et al*³ in Lusaka, Zambia, showed POAG prevalence of 4.2% providing a glimpse on the glaucoma situation in the country. A number of determinants were noted ranging from gender to diabetic retinopathy³. This study demonstrated that glaucoma was actually a public health problem in Zambia. The findings of this retrospective study, despite the known limitations of a retrospective study, inspired this cross sectional survey

at the same facility. In addition, the upgrade of the facility with modern diagnostic equipment enabled improved diagnostic capability for this study.

The objectives of this study were to determine the prevalence of POAG at University Teaching Hospital (UTH) and evaluate differences in prevalence among different age groups.

MATERIALS AND METHODS

Study area and population: A cross sectional survey of 1,714 participants aged 20 to 98 years old was conducted at the UTH eye clinic in Lusaka, Zambia. The UTH is the national referral hospital with a bed capacity of more than 3,000 and provides both surgical and clinical services, including ophthalmological services. The UTH's eye clinic is estimated to cater for more than 21,000 clients annually for both routine and morbidity driven health care. The clients that attend this clinic come from across the country for both self- and system-referrals, representing all age groups and all ethnic groups. A systematic random sampling using 50% time sampling was employed which meant that of the 220 (on average) eye patients seen in the outpatient eye clinic every month, 110 were to be picked to participate in the study. This translated to a minimum 1320 participants recruited into the study for a period of twelve months. To cater for attrition and assuming a response rate of 80%, the sample size of the study was then 1,714 participants. Those that met the inclusion criteria (1,625) were enrolled for the study. This gave a response rate of 94.8%.

Study design and selection: UTH was selected for the study on the basis of the high number of eye patients seen at the facility. All the patients recruited for the study had a full ocular and their demographic data (specifically age, sex, and residence) was captured. The Intra-Ocular Pressure (IOP) was also measured and entered. A total of 89 clients declined to be part of the study, giving a final sample size of 1,625 adult eye patients aged 20 to 98 years old. The visual acuity was measured using the Snellen's chart or the tumbling E chart depending on the level of literacy of the participant. Poor vision was defined as visual acuity worse than 6/18 in the better eye.

Diagnosis of POAG: Case definitions were based on the European Glaucoma Study Guidelines. The diagnosis of glaucoma was based on glaucomatous optic nerve damage, including abnormal visual fields and/or optic disc cupping with or without elevated IOP (by Goldman applanation tonometre).

Definition of glaucoma suspects: IOP >21mmHg, IOP of difference >4mmHg between the two eyes, or a glaucomatous visual field defect. The optic disc was referred to as suspicious when the cup/disc ratio

was greater than 0.5, or there was an unequal cup/disc ratio with a difference of more than 0.1 between the two eyes. Glaucoma cases were subjects on treatment for POAG or newly diagnosed during the survey. The major diagnostic criterion was evidence of structural optic nerve damage. Additional criteria were visual field defect and/or raised IOP.

The indicators of POAG were therefore:

- (a) *Optic disc status:* The optic disc was examined using a 78D Volks lens (Volks Optical, Inc., Mentor, OH) at X16 magnification after adequate pupillary dilation. When there was evidence of glaucomatous optic nerve damage, that is, cupping of >0.5 with or without notching supported by visual field changes, it was referred to as glaucomatous. When there was no such evidence of glaucoma, it was referred to as non-glaucomatous.
- (b) *IOP:* IOPs were considered normal if it was <22mmHg. Values >21mmHg or a difference of 4mmHg or more between the two eyes were considered abnormal.
- (c) *Gonioscopy:* This was performed with a Volk 3-Mirror Gonio Lens. Grade 3 and 4 were considered as open angles.
- (d) *Visual fields:* Visual fields were plotted for all participants declared as suspects of glaucoma using Humphrey's Visual Field Analyser at full threshold 24-2. Subjects with visual field defects suggestive of glaucoma were confirmed as glaucoma if there were either glaucomatous optic disc changes or high IOP. The presence of one or more absolute defects in the central 30° was acceptable as glaucomatous. Field changes that were considered typically glaucomatous included defects >5° diameter centrally and of shape and distribution typical of optic nerve damage, paracentral or arcuate scotomas and nasal steps. In advanced cases, central or temporal islands were found. The presence of abnormal repeatable field defect with or without elevated IOP in one or both eyes or visual loss so advanced that visual field testing is impossible was classified as glaucomatous. Fixation loss, false-positive and false-negative responses were also monitored to ensure reliability. Those with no visual field defect that could be attributed to glaucoma were labelled as non-glaucomatous field changes.

This standard of care is considered routine at UTH, and the data was examined to ascertain that these criteria were used in identifying patients with glaucoma. Based on these inclusion and exclusion criteria, only 1,625 were included in the study.

Analysis: Collected data was entered in Microsoft Excel version 2007 and transferred to Stata version 12.0 for further storage and analysis. Prevalence was standardized for age using the national census (2010)

in order to control for changes in the age structure between years. Binomial and multiple logistic regression analyses were used to assess and estimate the association of sex, age and gender with POAG. The distribution of age as a continuous variable conformed to normality as assessed by probability plots.

The variables in the model were age, residence, and stratification was done by sex and age group. Multivariate logistical regression results were adjusted for age as continuous variable.

Ethical statement: The University of Zambia Biomedical Research Ethics Committee approved the study (reference number 013-08-12). Further approval was obtained from Ministry of Health of Zambia through the UTH.

RESULTS

Participation and distribution: Of the 1,714 patients, 89 (5.2%) did not accept to be in the study due to various reasons. Therefore, a total of 1,625 people were screened giving a 94.8% response rate. Of the 1,625 patients recruited for the study, 871 (53.6%) were females and 754 (46.4%) were males (Table 1). The age range of participants was 20 to 98 years with a mean age being 51 years.

At the final evaluation, a total of 309 cases of glaucoma were diagnosed. All the 309 cases of glaucoma were of the primary open-angle type. Included in the POAG were 151 cases (48.9%) of normal tension glaucoma. In all, 77.6% were newly diagnosed, while the rest were known glaucoma patients. A total of 109 (35.3%) had poor vision of 6/60 and less, out of which 60 (19.4%) were new cases. There were 98 (31.7%) with positive family history of glaucoma in first degree relations. None of the normal non-glaucomatous participants had visual field defects that are characteristic of glaucoma. Prevalence of glaucoma by age is summarized in Table 2 and plotted in Figure 1.

The overall prevalence of POAG was 19.0% (95% CI, 14.6%, 23.8%), distributed as 5.7% (95% CI 3.2, 9.1) in males and 13.3% (95% CI 11.7, 21.3) for females. Females were more likely to have POAG than males (72.9% vs. 27.1%; OR 2.78, 95% CI 2.1, 5.8).

There was a statistical difference in gender prevalence of POAG at any age (χ^2 test, $P < 0.0001$). The standardized age-specific prevalence was 23.5% for ages below 40 years old and 21.2% for ages 40 years and above. Prevalence was unusually high in the age group of below 40 years.

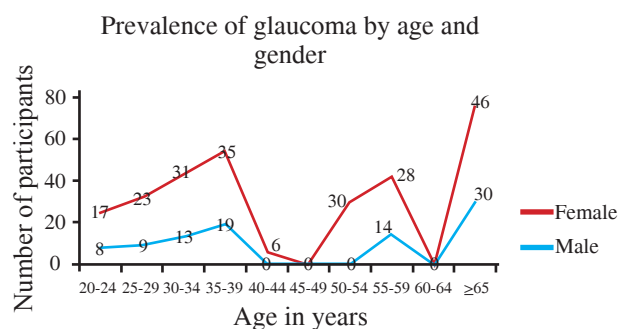
Table 1: Determinants of glaucoma at University Teaching Hospital's eye clinic in Lusaka, Zambia (2012 to 2015)

Factor	Description	Proportion (%)	Odds Ratio (95% CI)
Sex	Male	46.4	1
	Female	53.6	4.2 (2.1, 7.2)
Age (years)	<40	40.7	1
	40 – 44	4.5	0.5 (0.3, 0.8)
	45 – 49	6.5	0.7 (0.4, 0.9)
	50 – 54	13.3	0.6 (0.5, 0.9)
	55 – 59	8.1	0.3 (0.2, 0.7)
	60 – 64	1.1	0.1 (0.1, 0.3)
	≥65	25.7	1.2 (1.1, 1.5)
Diabetic retinopathy	No glaucoma	81.3	1
	Glaucoma	18.7	2.1 (1.7, 2.8)
HIV	No Glaucoma	78.9	1
	Glaucoma	21.1	2.21 (0.9, 2.1)
Blindness	No glaucoma	89.5	1
	Glaucoma	10.5	1.5 (1.1, 2.1)
Family History	No glaucoma	77	1
	Glaucoma	12.8	5.2 (3.2, 9.5)

Table 2: Prevalence of POAG among patients according to age groups and gender

Age group (years)		No. of POAG cases	Total population	Prevalence (%)
<40	Male	49	273	17.4
	Female	106	365	29.0
40 - 44	Male	0	11	0
	Female	6	71	8.4
45 - 49	Male	0	73	0
	Female	0	21	0
50 - 54	Male	0	71	0
	Female	30	130	23.1
55 - 59	Male	14	60	23.3
	Female	28	72	38.9
60 - 64	Male	0	18	0
	Female	0	0	0
≥ 65	Male	30	239	12.6
	Female	46	221	20.8
Grand Total		309	1,625	19.0

The number of glaucoma cases by age and gender is summarised in Figure 1. The number of cases increased with age, and women appeared to be more affected than men.

**Figure 1:** Number of glaucoma cases (n=309) by age and gender seen at UTH

Of the participants who were diagnosed with glaucoma, 77 (23.8%) were blind due to this condition. This was found to be associated with a high comorbidity with diabetic retinopathy.

DISCUSSION

The study represents one of the few studies that have been conducted to determine the prevalence of POAG and evaluate differences in prevalence among different age groups.

The prevalence of POAG at UTH was remarkably higher (19.0%) than what has been reported in African-derived persons in East Baltimore, Barbados and other African indigenous surveys in West, East and Southern Africa^{7,9,11-14}. The higher prevalence in this study compared with other studies could probably be attributed to the very high prevalence of POAG in the participants aged 20 to 39 years old in the study (Table 2) and also due to the fact that this was a hospital based study. Slightly more than 40.7% of all the identified

POAG cases were below the age of 40 years (Table 1). To our knowledge, this was the first study that has looked at prevalence of POAG in adult patients aged 20 to 39 years⁸. All the other studies have been reporting on the patients aged 40 years and above. The inclusion of this age group in our study was inspired by a lot of glaucoma patients below the age of 40 years who have been attending the UTH eye clinic. Similarly, Ntim-Amponsah *et al*⁸ reported a slightly higher prevalence of POAG at 8.4% in the Akwapim–South district of Ghana because their survey included those aged 30 to 39 years. These two findings could probably explain the prediction by Quigley *et al*¹⁵ that the number of people with open angle glaucoma and angle closure glaucoma in Africa will be over 10 million and the African continent will have the highest ratio of glaucoma to adult population. The finding in this study is a clear demonstration that glaucoma should no longer be considered to be the disease affecting only those aged 40 years and above, but a condition affecting all age groups in significant proportions.

The observed prevalence of POAG in this study population was 19.0%. The result of this cross-sectional survey strongly reaffirms the reports that the prevalence of glaucoma is much higher in people of African descent (black race) than in other racial groups, and that the predominant form of glaucoma is the primary open angle type.

The high prevalence of POAG in the population aged below 40 years of age prompted us to look for other possible causes or associations. Hence we looked at the association of POAG with HIV infection in all age groups though our main interest was those below 40 years of age. We found that there was no association between POAG and HIV infection. This finding from the study suggests that HIV could be protective and this suggests further studies on the relationship between POAG and HIV infection. To our knowledge, it is also the first study that has looked at the association between POAG and HIV infection or at the prevalence of POAG in patients below 40 years of age.

Although our study found a high prevalence of POAG, other studies involving black populations in Barbados, Baltimore, St. Lucia, Nigeria, Ghana, Tanzania and South Africa where prevalence was found to be 7.1%, 4.74%, 8.8%, 7.3%, 8.4%, 3.1% and 4.5% respectively.^{7,8,9,11-14}

CONCLUSION

This study confirms speculations among clinicians that onset of glaucoma is earlier and the prevalence of POAG was higher than that reported for Hispanic, American and European (Caucasians) populations and for Africans in East, Southern and West Africa.

In addition, our study shows no association between POAG and HIV. Finally, this study finds that

family history of glaucoma increases the likelihood of someone having glaucoma.

RECOMMENDATIONS

There is still a need for a larger population study involving populations in the different regions of Zambia (representing the different ethnic groups) to provide more complete data on the national prevalence and any tribal differences that may exist in the prevalence of POAG in Zambia. Hopefully, this study will stimulate further research in glaucoma in the Africa sub-region.

We recommend policy consideration to commence glaucoma screening in an integrated manner with other primary care programmes like cervical and prostate cancer screening programmes. If this is done, complimented with the addition of appropriate and continued health awareness messages to younger groups in schools as well as policy makers, this has the potential to diffuse down to the most at-risk communities as well. Such health promotion messages should include informing the communities the consequences of delayed diagnosis and treatment.

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