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Demographic and clinical characteristics of patients with glaucoma in a tertiary eye facility in Ghana

Authors:
Doreen Nelson-Ayifah[1]
Khathutshelo P. Mashige[1]

Affiliations:
[1]Department of Optometry, University of KwaZulu-Natal, Durban, South Africa

Corresponding author:
Khathutshelo Mashige,
mashigek@ukzn.ac.za

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Background: Ghana has been reported to have the second highest prevalence of glaucoma worldwide.

Aim: Because of glaucoma causing numerous cases of irreversible blindness, there is the need for baseline data for glaucoma characteristics among Ghanaians. This study was conducted to determine the demographic and clinical characteristics of glaucoma patients in a tertiary eye centre.

Setting: The setting for this study is the eye clinic of the Agogo Presbyterian Hospital, which is situated in the Ashanti Region of Ghana.

Methods: The medical records of patients who attended the eye centre from January 2013 to December 2017 were reviewed. The data collected included the demographic variables and clinical characteristics of patients diagnosed with glaucoma.

Results: Of the 1100 medical records reviewed, 311 were diagnosed with glaucoma. Of the 311 patients, 159 (51.1%) were males and 152 (48.9%) were females, with their ages ranging from 11 to 104 years (mean = 60 ± 18.1 years). Primary open-angle, secondary, juvenile and primary angle-closure glaucomas accounted for 81.6%, 11%, 3.8% and 3.6%, respectively, of all cases of glaucoma. The average intra-ocular pressure was 28.2 ± 11 mmHg. The cup-to-disc ratio and visual acuity varied significantly among the various ethnic groups ($p < 0.05$), while the average intra-ocular pressure did not ($p > 0.05$). Timolol was the first line of treatment for 91.4% cases of glaucoma.

Conclusion: Primary open-angle glaucoma is the predominant type in this population, with the clinical characteristics of visual acuity and cup-to-disc ratio varying among the different Ghanaian ethnic groups. There is a need for population-based epidemiologic studies to validate the data collected in this hospital-based study.

Keywords: glaucoma; Ghana; demographic and clinical characteristics for glaucoma.

Introduction

Glaucoma is defined as a multifactorial optic neuropathy, which is characterised by progressive damage of the retinal ganglion cells and axons, and a thinning of the nerve fibre layer and neuroretinal rim.[1] The classical clinical presentation of the condition includes optic nerve head features such as enlargement of the cup, laminar dot sign, peripapillary atrophy, nasal shifting of central vessels and correlating visual field changes.[1] Glaucoma is the leading cause of irreversible blindness worldwide and the second leading cause of global blindness.[1,2] Its prevalence and subtypes vary across different ages, races and geographical locations.[2] It is estimated that over 67 million people worldwide have glaucoma, of which over 4.5 million are blind,[2] with reports indicating that this will increase from 67 to 79.6 million by the year 2020.[2]

Older age is one of the major risk factors for both primary open-angle glaucoma (POAG) and primary angle-closure glaucoma (PACG).[2] Primary open-angle glaucoma, normal tension glaucoma (NTG) and secondary glaucoma (SG) have been reported to be more prevalent in males, whereas PACG and developmental glaucoma have a higher prevalence in females.[3] Asians have a higher prevalence of angle closure compared to Caucasians or Africans, in

whom open-angle glaucoma is more prevalent.[3] Persons of African ethnicity have been reported to be five times more at risk of developing POAG compared to other ethnicities. Africans also have a more severe course of the disease with a higher risk of blindness.[4] In addition, a higher prevalence of POAG has been found among West Africans, more specifically, Ghanaians.[4] Managing glaucoma has many challenges worldwide but specifically in developing countries where because of lower numbers of eye care professionals and low levels of patient awareness, there are frequently late presentations and non-compliance with treatment.[3]

Kyari et al.[5] reported a high prevalence of glaucoma in Ghana,[5] with public tertiary hospital-based cross-sectional studies having shown differing epidemiological profiles of affected patients. Gyasi et al.[6] conducted a retrospective case series involving a review of clinical records of all first-time attendants diagnosed with glaucoma at the Bawku Hospital in northeastern Ghana between October 2003 and December 2005. The study reported that of the 446 glaucoma patients reviewed, POAG was diagnosed in 98.4% of the cases, with the majority (65%) being males, the median age being 56 years, with 23.6% being younger than 40 years. The majority (70.2%) had a cup-to-disc ratio (CDR) of > 0.8, while for 54.9% it was 1. In a similar investigation, Gyasi et al.[7] conducted a retrospective case review of 455 POAG glaucoma patients at the Emmanuel Eye Clinic, a large ophthalmology referral centre in Accra, South Ghana. The authors[7] reported that approximately 24% of the patients presented blind in at least one eye with their mean age being 56.7 ± 16.7 years. The average recorded intraocular pressure (IOP) was 33.9 ± 12.7 mmHg for the right eyes and 33.5 ±12.0 mmHg for the left eyes, while the mean vertical CDRs were 0.83 and 0.82 for right and left eyes, respectively. Otabil et al.[8] conducted a retrospective study of the outpatient department morbidity of glaucoma at the Emmavick Eye Clinic in Sunyani, Ghana. Of the 5828 patients, 460 (7.89%) presented with glaucoma, with the prevalence being 9.52%, 8.77% and 1.41% in female adults, male adults and children, respectively.

These studies showed that the presentation patterns of POAG vary across different regions of Ghana. Considering the burden and impact of glaucoma on society and the economy, there is a need to collect more data on the epidemiological profiles of glaucoma patients seen in other settings in Ghana. The findings will contribute to a better understanding of the aetiology and risk factors of the disease, and will enable the development of appropriate intervention strategies to address the disease. In light of this need, this study assessed the demographic and clinical characteristics of glaucoma patients seen at a tertiary eye facility of Agogo Presbyterian Hospital, in the Ashanti Region in Southern Ghana.

Methods

This study reviewed and analysed the clinical records of 311 glaucoma patients who attended the eye clinic of the Agogo Presbyterian Hospital from January 2013 to December 2017, and their demographic, clinical diagnosis and therapeutic data were recorded. The data collected from the medical records included age at presentation, gender, ethnic group, occupation, clinical characteristics such as visual acuity (VA) at presentation, IOP, CDR, type of glaucoma and mode of management. Visual acuity results were converted from Snellen to logMAR notation for the purpose of analysis.

All data were entered into a standard Microsoft Excel 2010 spreadsheet (Microsoft Corporation, Washington, WA, United States [US]), and statistical analyses were conducted using the Statistical Package for Social Sciences (SPSS) version 24 (IBM Corporation, New York, NY, US). For the categorical variables, the data were presented as frequencies and percentages, and comparisons between the groups were performed using Chi-square tests. Continuous variables were reported as mean ± standard deviation, and the one-way analysis of variance (ANOVA) was used to determine the significance of demographic and clinical characteristics of the various glaucoma subgroups. A p-value of ≤ 0.05 was considered statistically significant.

Ethical considerations

Ethical approval to conduct the study was obtained from the University of KwaZulu-Natal's Biomedical Research Ethics Committee (Reference Number: BE373/18). Permission to access the clinical records was obtained from the Research and Development Unit of the Agogo Presbyterian Hospital, Ghana. The study was conducted in accordance with national and international resolutions on ethics and good clinical practice. All data obtained in the study were kept confidential and only accessed by the researchers involved in the project.

Results

Data were collected from the medical records of 311 glaucoma patients. Their mean age was 60 ± 18.1 years (range: 11–104 years), of whom 159 (51.1%) were males and 152 (48.9%) were females. The distribution of the different ethnic groups was as follows: Akan (32.7%), Gonja (13%), Ewe (12.7%), Ga-Adangbe (10.5%), Frafra (8.9%), Ga (7.9%), Mamprusi (7.3%) and Dagomba (7%). The number of patients with bilateral and unilateral glaucoma were 250 (80.4%) and 61 (19.6%) respectively. Primary open-angle glaucoma was the most common type of glaucoma (81.6%), followed by SG (11%), juvenile glaucoma (JG) (3.8%) and PACG (3.6%). The main causes of SG were trauma during agricultural work (61.1%) and sources other than agricultural work such as domestic injuries (19.4%), uveitis (16.7%) and in 2.8% cases, the causes were not recorded. The average recorded IOP was 28.2 ± 11 mmHg, with the distribution of the types of glaucoma according to gender being shown in Table 1. There was no statistically significant association between glaucoma and gender ($p = 0.35$) as shown in Table 6.

With regard to occupational groups, many patients with glaucoma were agricultural workers (41.8%), 24.8% were

unemployed, 15.2% were traders, 5.1% were artisans, 3.8% were students, 3.5% were teachers, 2.9% were civil servants, 1.9% were members of the clergy and 1% was from the mining industry (Table 2). Although many of the POAG (40.5%) and SG (77.8%) cases were agricultural workers, there was no statistically significance between their occupation and the type of glaucoma ($p = 0.21$).

All the types of glaucoma, with the exception of JG, presented at the age of approximately 61 years while the average age of JG presentation was 20.1 ± 13.6 years. Analysis of IOP, CDR and VA was therefore performed for the right eyes only. Table 3 shows the clinical characteristics of the types of glaucoma. There were no statistically significant differences for IOP ($p = 0.15$), CDR ($p = 0.23$) and VA ($p = 0.22$) between the right and left eyes.

A one-way ANOVA showed that the differences in the average age of presentation for the various types of glaucoma, average IOP and CDR were not statistically significant ($p = 0.9$, $p = 0.2$ and $p = 0.7$, respectively). However, the difference in the average VA at presentation was statistically significant ($p = 0.01$), and the post-hoc analysis using the least significance difference (LSD) test revealed a statistically significant difference between SG and the other types of primary glaucoma: POAG ($p = 0.04$), PACG ($p = 0.03$) and JG ($p = 0.03$). The majority of POAG cases ($n = 182$, 72.4%) were of the high-tension type of glaucoma while 27.6% ($n = 70$) were of the normal tension type. Approximately one-third ($n = 4$, 33.3%) of JG were the normal tension type while the rest ($n = 8$, 66.7%) were of the high-tension type. There was no statistically significant difference between the average age of presentation between males and females ($p = 0.06$), or between their average IOP ($p = 0.55$), CDR ($p = 0.64$) and VA ($p = 0.98$) at presentation (IOP, CDR and VA measured in the right eye only). These associations are shown in Table 4.

A one-way ANOVA revealed no statistically significant difference among the various ethnic groups and their average IOP values ($p = 0.41$) as well as their average ages ($p = 0.07$). However, differences in their average VA readings were statistically significant ($p = 0.04$) as were their average CDR values ($p = 0.02$). The *post-hoc* analysis (LSD) revealed differences in average CDR values between Akan and Mamprusi ($p = 0.00$), Akan and Frafra ($p = 0.00$), Akan and Dagomba ($p = 0.03$), Akan and Ga-Adangbe ($p = 0.00$) and Mamprusi and Gonja ($p = 0.04$). The *post-hoc* analysis (LSD) also showed differences in average VA values between Akan and Gonja ($p = 0.03$), Akan and Mamprusi ($p = 0.00$), Akan and Frafra ($p = 0.01$), Gonja and Frafra ($p = 0.04$), Mamprusi and Frafra ($p = 0.03$), Ewe and Gonja ($p = 0.03$) and Ewe and Frafra ($p = 0.01$). These associations are shown in Table 5.

Table 6 provides the associations between glaucoma and demographic and clinical characteristics.

The main methods of managing glaucoma were administering drugs and trabeculectomy. All of the patients ($n = 311$) were taking or prescribed some glaucoma medication with the first line of treatment being mainly beta-blockers (91.4%), specifically timolol, followed by prostaglandin analogues (5.4%) and carbonic anhydrase inhibitors (3.2%). Only 2.5% ($n = 8$) had undergone a trabeculectomy.

TABLE 1: Distribution of the types of glaucoma for 311 patients, classified also by gender.

Type	Eyes		Patients		Males		Females	
	n	%	*n*	%	*n*	%	*n*	%
POAG	468	84.0	252	81.0	131	82.0	121	80.0
SG	55	9.9	36	11.6	20	13.0	16	10.0
JG	22	3.9	12	3.9	5	3.0	7	5.0
PACG	12	2.2	11	3.5	3	2.0	8	5.0
Total	**557**	**100.0**	**311**	**100.0**	**159**	-	**152**	-

POAG, primary open-angle glaucoma; PACG, primary angle-closure glaucoma; SG, secondary glaucoma; JG, juvenile glaucoma.

TABLE 2: Distribution of glaucoma types and occupation.

Occupation	POAG		PACG		SG		JG	
	n	%	*n*	%	*n*	%	*n*	%
Agriculture	102	40.5	0	0.0	28	77.8	0	0.0
Unemployed	76	30.2	2	18.1	0	0.0	0	0.0
Trading	41	16.3	4	36.4	2	5.5	0	0.0
Artisan	7	2.8	4	36.4	5	13.9	0	0.0
Student	0	0.0	0	0.0	0	0.0	12	100.0
Teaching	9	3.6	0	0.0	1	2.8	0	0.0
Civil servant	8	3.2	1	9.1	0	0.0	0	0.0
Clergy	6	2.4	0	0.0	0	0.0	0	0.0
Mining	3	1.2	0	0.0	0	0.0	0	0.0
Total	**252**	-	**11**	-	**36**	-	**12**	-

POAG, primary open-angle glaucoma; PACG, primary angle-closure glaucoma; SG, secondary glaucoma; JG, juvenile glaucoma.

TABLE 3: Clinical characteristics of the types of glaucoma of the right eye of 311 patients.

Variable	POAG	SG	JG	PACG
Average age (years)	61.7 ± 16.8	61.6 ± 11.9	20.1 ± 13.6	60.6 ± 16.2
Average IOP (mmHg)	27.8 ± 10.5	31.5 ± 12.9	24.8 ± 12.9	29.1 ± 13.3
Average CDR	0.7 ± 0.2	0.8 ± 0.2	0.6 ± 0.2	0.7 ± 0.1
Average VA (logMAR)	0.9 ± 0.7	1.3 ± 0.8	0.5 ± 0.9	0.7 ± 0.4

IOP, intraocular pressure; POAG, primary open-angle glaucoma; PACG, primary angle-closure glaucoma; SG, secondary glaucoma; CDR, cup-to-disc ratio; VA, visual acuity; JG, juvenile glaucoma.

TABLE 4: Clinical characteristics of glaucoma by gender (right eyes only).

Variable	Male	Female	*p*-value
Average age	62 ± 17.7	57.8 ± 18.4	0.06
Average IOP	27.8 ± 11.7	28.6 ± 10.2	0.55
Average CDR	0.7 ± 0.2	0.7 ± 0.2	0.64
Average VA (logMAR)	0.9 ± 0.7	0.9 ± 0.7	0.98

IOP, intraocular pressure; CDR, cup-to-disc ratio; VA, visual acuity.

TABLE 5: Clinical characteristics of glaucoma by ethnicity (right eyes only).

Ethnicity	Average age (years)	Average IOP (mmHg)	Average CDR	Average VA (logMAR)
Akan	57.78 ± 15.82	27.97 ± 11.46	0.62 ± 0.22	0.76 ± 0.74
Ewe	56.42 ± 20.55	26.77 ± 10.91	0.72 ± 0.22	1.01 ± 0.68
Ga	58.09 ± 21.34	26.63 ± 10.14	0.74 ± 0.25	0.88 ± 0.68
Ga-Adangbe	58.87 ± 21.63	30.28 ± 11.37	0.77 ± 0.19	0.94 ± 0.62
Gonja	65.30 ± 14.49	29.80 ± 10.34	0.69 ± 0.28	1.14 ± 0.62
Mamprusi	56.64 ± 20.81	31.36 ± 11.76	0.86 ± 0.25	1.18 ± 0.65
Frafra	67.88 ± 14.04	27.57 ± 10.24	0.81 ± 0.22	1.21 ± 0.60
Dagomba	64.94 ± 18.50	24.86 ± 10.03	0.78 ± 0.21	0.81 ± 0.63

IOP, intraocular pressure; CDR, cup-to-disc ratio; VA, visual acuity.

TABLE 6: List of probability values among different variables.

Variables	*p*-value
Glaucoma and gender	0.35
Glaucoma and occupation	0.21
Average IOP for right and left eyes	0.15
Average CDR for right and left eyes	0.23
Average VA for right and left eyes	0.22
Glaucoma type and average age of presentation	0.90
Glaucoma type and average IOP	0.2
Glaucoma type and average CDR	0.7
Glaucoma type and average VA	0.01
Average age of presentation and gender	0.06
Average IOP and gender	0.55
Average CDR and gender	0.64
Average VA and gender	0.98
Average IOP and ethnicity	0.41
Average age of presentation and ethnicity	0.07
Average VA and ethnicity	0.04
Average CDR and ethnicity	0.02

IOP, intraocular pressure; CDR, cup-to-disc ratio; VA, visual acuity.

Discussion

Glaucoma is a serious condition that poses significant public health and economic challenges, particularly in resource-limited countries.[9] The key to effectively managing glaucoma is early detection and the prompt initiation of treatment. However, the level of awareness of glaucoma within the African population is low, with many patients not being aware that they have the condition probably because of the asymptomatic nature of the disease at the early stages. Studies aimed at investigating the epidemiologic profiles of glaucoma can therefore help to raise the levels of awareness and inform policy interventions.

Age is a known risk factor for glaucoma.[2] The mean age of presentation for POAG, PACG and SG patients was 60 ± 18.1 years and they usually presented with an advanced form of the disease, which, with the exception of PACG, may be attributed to its asymptomatic nature. Previous studies[6,7,8] reported similar mean ages at presentation in Ghanaian populations, with Al Obeidan et al.[10] and Sharma et al.[11] noting a mean age of > 50 years in Saudi Arabia and North India, respectively. These results suggest that glaucoma is a disease that primarily affects the elderly population, with persons older than 50 years being recommended to undergo regular screenings to reduce the burden of associated blindness, specifically the financial burden upon family, relatives and the government.[11]

In this study, POAG was found to be the most common type, and while the results from this hospital-based study may not be a true representation of the general population, it is consistent with the findings of two population-based studies in Ghana.[4,12] Most studies conducted among African populations have also reported POAG as the most common type of glaucoma.[2,6,7,8,13,14] In the current study, PACG was the least common type, with a prevalence of 3.6%. This can be compared to the findings of Ntim-Amponsah et al.[12] and Herndon et al.[15] who, although they reported slightly higher rates (5.7% and 6.6%, respectively), had similar results regarding PACG. Al Obeidan et al.[10] found PACG to be the most common type of glaucoma among Saudis, as was also the case in studies conducted in Asian countries, which attributed this finding to the anatomical predisposition of Asian eyes.[3,16]

The main occupation in all the districts of the Ashanti Region of Ghana is agriculture (animal husbandry and forestry),[17] which is the case for most of the subjects in this study (41.8%). While most of the cases of SG (61.1%) were as a result of trauma during agricultural work, there was no statistically significant difference between the type of glaucoma and occupation (p = 0.21). This is similar to the findings of Ntim-Amponsah et al.[12] in a Ghanaian population.

Globally, the association between gender and an increased risk of glaucoma remains disputed; this study found no statistically significant difference between gender and any specific type of glaucoma, while other studies had contrary findings. Vajaranant et al.[18] reported that women were more prone to PACG but did not find any gender difference for POAG. Similarly, Ntim-Amponsah et al.[12] did not find any gender difference for POAG. Rotchford and Johnson[19] reported that Zulu men in South Africa were more likely to develop glaucoma than women while Rudnicka et al.[20] also reported the same gender bias to POAG from a meta-analysis involving 1355 cases. The present study found no statistically significant differences between gender and the clinical indices (IOP, VA and CDR) analysed. The results of this study therefore suggest that male and female glaucoma patients may present with similar clinical indices and therefore have comparable severity and disease progression.

Intraocular pressure remains the only modifiable risk factor for glaucoma and is associated with the progression of the disease.[21] A fluctuating IOP over a 24 hour period or across visits may put an individual at a higher risk of glaucoma.[21] The average IOP in this study was 28.2 mmHg. Leske et al.[22] reported a slightly lower average IOP (27 mmHg). This difference may be because of high recordings from the SG cases (average IOP = 31.5 ± 12.9 mmHg) and also because most POAG cases (72.4%) were of the high-tension type (average IOP = 27.8 ± 10.5 mmHg).

Although the average IOP for POAG and PACG were 27.8 mmHg and 29.1 mmHg, respectively, this difference was not statistically significant (p = 0.2), with Al Obeidan et al.[10] reporting similar findings (27 mmHg for POAG and 29 mmHg for PACG). Slightly more than one-quarter (27.6%) of POAG cases in this study were of the normal tension type, which Ntim-Amponsah et al.[12] reported 21%. The Gambia Study reported 50% of POAG cases as being of the normal tension type while the Rotterdam Eye Study reported 38.9%. The majority of POAG cases were found to be associated with a high IOP, which is consistent with the results reported by Ntim-Amponsah et al.[12] However, McMonnies[23] stated that there is no definite evidence to support the different aetiologies

for normal and high-tension glaucoma, and that IOP remains the only major modifiable risk factor for glaucoma.

There are approximately 100 ethnic groups in Ghana,[24] of which the current study recorded data pertaining to eight groups. The Akan tribe was the most predominant (32.7%), which may be because of the health facility where the study was conducted which was situated in an Akan community (the Ashanti Region). While there were no statistically significant differences among the various ethnic groups with respect to age and IOP, there was a difference in their CDR. *Post-hoc* analysis revealed differences between ethnic groups in the southern (Akan and Ga-Adangbe) and northern parts of Ghana (Gonja, Mamprusi and Frafra). Based on this, we suggest that the northern ethnic groups have a more severe form of the disease than their southern counterparts. This suggestion is supported by the fact that a statistically significant difference was found between the southern and northern ethnic groups in terms of VA, as significant neuroretinal tissue loss is reflected in loss of vision.[25] To the authors' best knowledge, no study has been conducted on the clinical indices of glaucoma patients from different Ghanaian ethnic groups.

The only effective treatment for glaucoma is to lower IOP with medication, laser or traditional surgery or a combination of these methods. However, because of the chronicity, the cost of medication, the low level of awareness and education, and the low-income population, adherence to treatment has been one of the main challenges experienced by people with glaucoma in developing countries such as Ghana. The first line of treatment of glaucoma reported in this study was beta-blockers (specifically timolol). This is similar to that found in a study by Ocansey et al.[26] involving three referral centres in Ghana. Lafuma and Berdeaux[27] reported that prostaglandin analogues (specifically latanoprost) are a more effective first line of treatment in controlling IOP than beta-blockers. However, only 5.4% of the 311 patients used prostaglandin analogues. Both classes of glaucoma drugs are included in the list of essential medicines in Ghana and are therefore covered by the National Health Insurance Scheme, with patients who are not registered on this insurance scheme having to purchase them. As timolol is less expensive than latanoprost in Ghana, patients who are not registered on the National Health Insurance Scheme and who cannot afford latanoprost may be put on it as a first line of treatment, which may account for its high use.

Conclusion

The majority of glaucoma patients in Agogo consult the eye care facility later in the progression of the disease, with POAG being most commonly encountered in this facility. While there was no gender predominance regarding the occurrence of the different types of glaucoma, the CDR and VA showed an ethnic predilection. These results provide important epidemiologic reference for medical treatment and future prevention of this disease in a resource-constrained country with many ethnic groups for which provision is necessary.

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Competing interests

The authors have declared that no competing interest exists.

Authors' contributions

D.N.A. and K.P.M. were involved in conceptualising, designing and preparing the draft manuscript. D.N.A. collected the data. D.N.A. and K.P.M. made equal contributions in writing this article.

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Disclaimer

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