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Profile of Primary Open Angle Glaucoma Patients Attending a Tertiary Health Institution in Niger Delta, Nigeria – A case study of 1000 patients

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Abstract
Background: *Glaucoma is a leading cause of irreversible blindness worldwide and primary open-angle glaucoma (POAG) is the most prevalent clinical type of glaucoma in sub-Sahara Africa.The clinical and epidemiological profile of patients with primary open angle glaucoma often correlate with the disease.However, not much information is available on the profile of glaucoma patients and their influence in Niger Delta, Nigeria.****Methodology:****This was a prospective study of 1000 consecutive POAG patients attending the Glaucoma unit of the Ophthalmology department of the University of Port Harcourt Teaching Hospital from 2010 to 2022. The demographic, epidemiological and clinical profile of the study participants were collected through an interviewer-administered semi-structured questionnaire, clinical examinations and records. Data were collated and analyzed using the SPSS-version 25. Statistically significant values were set at p≤0.5,****Results:*** *The modal age group of study participants was 55-64 years, mean age- 60.1 ± 9.5 years and the male to female ratio was 1.8:1.The prevalence of Primary Open Angle Glaucoma was 79.8% of all cases of glaucoma (95% CI; 68.7 – 84.2). Six hundred and twenty-six (n=626; 62.6%) of the subjects had a positive family history of glaucoma in first degree relatives, while 42 % had positive family history among second degree relatives. The presenting acuity of the study population varied widely, over 46% had moderate visual impairment and 3.2 % blind.Using the ISGEO-2002 classification, 615 (65.1%) were in Criteria 1, 353 (35.3%) were in Criteria 2 and 32 (3.2%) were in Criteria 3. The difference in the various categories was not statistically significant (p=0.996).* ***Conclusion:****The profile of glaucoma patients in the Niger-Delta region of Nigeria is similar to those obtainable from other parts of Sub-Saharan Africa.*

Keywords: *Glaucoma, Niger-Delta, Nigeria, Profile*

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I. Introduction

Currently glaucoma is known as the leading cause of irreversible blindness worldwide [1]. Among black African population, the prevalence of primary open angle glaucoma (POAG) is more than in Caucasian counterparts [2,3]. The burden of glaucoma in the world is high and also increasing with the aging population [4]. The Africa region has the highest incidence and prevalence of glaucoma [2] and in Nigeria, glaucoma is responsible for 15-20% of blindness [5]. Also, in Nigeria, Primary open-angle glaucoma (POAG) is the most common type, accounting for over 51% of all glaucoma cases [6]. In the Niger Delta Region POAG is the most prevalent variant of glaucoma; accounting for 20.8% of bilateral blindness [7].

Open-angle glaucoma usually runs a symptomless but progressive course, leading to retinal ganglion cell death and eventual loss of the peripheral vision initially and in the later stage significantly affecting the central vision. It has been postulated that there may be 40-50 percent structural axonal loss before any significant functional change is detected [8]; therefore, there is a need to improve on the methods and techniques for early diagnosis and treatment. Most patients in Africa have poor or inadequate knowledge of glaucoma and therefore present very late for clinical evaluation and treatment. In addition, there is often reluctance in the acceptance of medical or surgical interventions among African populations [9,10]. Therefore, many affected remain undiagnosed, presenting only when the disease is late in the disease process with irreversible loss of vision [11-13].

The clinical and epidemiological profile of POAG could be very useful in early diagnosis and effective treatment of the disease. Presently, there is a dearth of scientifically robust data on the profile and characteristics of POAG subjects in the Niger-Delta region of Nigeria. Hence this study aims to bridge the gap.

II. Materials and Methods

Ethical Statement:

Ethical approval to conduct this study was obtained from the Ethics Committee of University of Port Harcourt. This study adhered to the tenets of the Declaration of Helsinki on study involving human subjects. Study participants' informed consents were obtained. Participation was absolutely voluntary. Participants were free to opt out at any stage of the study without victimization. All information obtained from the participants of this study was treated with utmost confidentiality. No personal identification (names, clinic number) was stored electronically. There was no health risk to the participants of this study.

Study Area:

This study was carried out in the Glaucoma Unit of University of Port Harcourt Teaching Hospital, Port Harcourt, Rivers State, Nigeria. Consenting confirmed cases of glaucoma diagnosed between January 2010 andDecember 2022 were recruited into the study.

Study Design: This was a prospective hospital-based study of 1000 POAG patients.

Eligibility Criteria:

Inclusion Criteria

Patients diagnosed with glaucoma who are indigenes of Rivers State.

Exclusion Criteria

Subjects with history of eye surgery prior to diagnosis of glaucoma, cases of secondary glaucoma, history of ocular trauma, or history of significant use of systemic or ocular glucocorticoids for a period exceeding 6 months (to avoid steroid-responders to increase in intraocular pressure).

Sampling Method:

Consenting consecutive confirmed cases of glaucoma who met the eligibility criteria were recruited into the study. An interviewer-administered semi-structured questionnaire to collectrelevant bio- data, findings from clinical records andbasic ophthalmic examinations were used to obtain data from the respondents.The presenting distant and near visual acuities (VA) were determined using illuminated standard Snellen's and E-tumbling charts at a distance of 6 meters (for distant VA) and at 40 cm for near vision.

Basic ocular examinations (which included evaluation of the eyelids, the globe, cornea, pupil and the lens) were done with the aid of a bright pen touch and slit lamp Topviewoptics'slit lamp-LS-4. Fundoscopy was carried out with +78D lens. Pupillary dilatation was achieved using Mydriacyl 0.5% after refraction and measurement of the intraocular pressure. Intraocular pressure measurement was determined using Perkin's applanation tonometer (MK2-model), after instilling local anaesthetic agent (1% tetracaine) and fluorescein dye into the conjunctival sac. IOPs was measured in both eyes three consecutive times. The measurements were done with the subjects in sitting position. The mean IOP value was adopted. CCT measurements were obtained with ultrasonic pachymetry (Tomey SP-3000, Tomey Ltd, Japan.) under topical anesthesia with tetracaine 1%. Measurements were obtained three times from the center of the cornea and the average reading was adopted. The Shaffer's grading system of the drainage angle was adopted in this study [14]: Grade 4 – The widest angle. The ciliary body can be visualized with ease; it is incapable of closure. Grade 3- An open angle in which at least the scleral spur can be identified; it is incapable of closure.Grade 2-Is a moderately narrow angle in which only the trabeculumcan be identified; angle closure is possible but unlikely.Grade 1- Is a narrow angle in which only Schwalbe's line, and perhaps also the top of the trabeculum can be identified; angle closure is not inevitable but the risk is high.Slit angle- Is one in which there is no obvious iridocorneal contact but no angle structure can be identified; this angle has the greatest danger of imminent closure.Grade 0- is a closed angle due to iridocorneal contact and is recognized by the inability to visualize the apex of the corneal wedge.

Data Analysis

The definitional criteria of the International Society of Geographical and Epidemiologic Ophthalmology (ISGEO-2002) [15] were used in categorizing the subjects: Criterion 1 Diagnosis (Structural and Functional Evidence). Eyes with a VCDR of 0.7 or more and less than 0.9 and/or VCDR asymmetry of 0.2 or more or a neuro-retinal rim width reduced to less than or equal to 0.1 CDR (between 11 and 1 O'clock or 5 and 7 O'clock) that also showed a definite visual field defect consistent with glaucoma. Criterion 2 Diagnosis (Advanced Structural Damage with Unproved Field Loss). If the subject could not satisfactorily complete the visual field test but had eyes with VCDR of 0.9 or more and/or VCDR asymmetry of 0.3 or more. Criterion 3 Diagnosis (Optic Disc Not Seen, Field Test Impossible). If it was not possible to examine the optic disc, and

eyes had visual acuity less than 6/60, presence of relative afferent pupillary defect with IOP of 26 mm Hg or higher, and/or evidence of glaucoma surgery or medical records confirming glaucomatous visual morbidity. A subject was categorized as having open angle glaucoma (OAG) on fulfilling one of the ISGEO criteria and the angles were adjudged open on gonioscopy.

All the data obtained were entered into Microsoft Excel sheet, cleansed and later exported to IBM Statistical Package for Social Sciences (SPSS) version 25 software (SPSS) Inc; Chicago, IL, USA for statistical analysis. Relevant data were presented in tables and charts. Statistical significance was performed using Chi square and statistical significance was set at $p \leq 0.05$.

III. Results

Table 1: Age and Sex Distribution of the study population

The male to female ratio was 1.8:1, with a mean age of 60.1 ± 9.5 years, and an age range of 40 to 92 years. The modal age was 55-64 accounting for 36.2% of the study population.

Age Group (yrs)	Male	(%)	Female	(%)	Total	(%)
< 45	32	(3.2)	20	(2.0)	52	(5.2)
45-54	156	(15.6)	134	(13.4)	290	(29.0)
55-64	214	(21.4)	148	(14.8)	362	(36.2)
65-74	176	(17.6)	44	(4.4)	220	(22.0)
75 -84	53	(5.3)	10	(1.0)	63	(6.3)
85 and above	10	(1.0)	3	(0.3)	13	(1.3)
Total	641	(64.1)	359	(35.9)	1000	(100)

Mean age =60.1±9.5 years M:F = 1.8:1, Age range 41 to 92 years

Table 2: Educational and Occupational Status of the Study Population

Educational Status	Male (n)	(%)	Female (n)	(%)	Total (n)	(%)	Chi-Square Test & p-value
Tertiary	140 (14.0)		98	(9.8)	238	(23.8)	20.915 ; p=0.000
Secondary	282(28.2)		106	(10.6)	388	(38.8)	
Primary	107(10.7)		82	(8.2)	189	(18.9)	
No Formal Educ	112	(11.2)	73 (7.3)		185	(18.5)	
Total	**641 (64.1)**		**359 (35.9)**		**1000**	**(100)**	
Occupation							
Public Servant	192	(19.2)	64	(6.4)	256	(25.6)	
Trading/Business	84	(8.4)	98	(9.8)	182	(18.2)	
Farming	78	(7.8)	26	(2.6)	104	(10.4)	108.632; p=0.000
Fishing	54	(5.4)	25	(2.5)	79	(7.9)	
Artisan	40	(4.0)	17	(1.7)	57	(5.7)	
Retiree	159	(15.9)	72	(7.2)	231	(23.1)	
Full Time Housewife	-		20	(2.0)	20	(2.0)	
Unemployed	34	(3.4)	37	(3.7)	71	(7.1)	
Total	**641 (64.1)**		**359 (35.9)**		**1000**	**(100)**	

Over 23% of study participants had tertiary education, out of these 9.8% (n=98) were females. Among the study participants that had no formal education were 73 (7.3%) females. The difference in the distribution of the study participants according to their educational status was statistically significant (p=0.000) [Table 2].Majority of the study participants (23.1%%) were retired public/civil servants, and most of the retirees were males (n=159; 15.9%). There was a statistically significant difference in the distribution of the participants of this study among the various occupational status (p=0.000) [Table 2].

Table 3: Family History of Glaucoma in the Study Population

Positive Family History of Glaucoma	No of Subjects (n)	(%)
First Degree Relative	626	62.6
Second Degree Relative	420	42.0
Unaware	167	16.7

Six hundred and twenty-six (n=626; 62.6%) of the subjects had a positive family history of glaucoma in first degree relatives, while 42 % had positive family history of glaucoma among second degree relatives; 16.7% were unaware of any family history of glaucoma among first- or second-degree relatives [Table 3].

Table: 4 Presenting Visual Acuity (VA) in the Study subjects

Variable	**Distribution in all Glaucoma cases n=1000 (n) (%)**	**Chi Square**	**p-value**
Best Presenting VA		324.225	0.000
No Visual Impairment	268 (26.8)		
Moderate Visual Impairment	464 (46.4)		
Severe Visual Impairment	225(22.5)		
Blind	43 (4.3)		
Total	**1000(100)**		
Best Corrected VA		76.090	0.000
No Visual Impairment	502(50.2)		
Moderate Visual Impairment	196 (19.6)		
Severe Visual Impairment	267 (26.7)		
Blind	35 (3.5)		
Total	**1000(100)**		

The presenting acuity of the study population varied widely. On presentation, over 26% (n=268) of the study population had no visual impairment, 46.4% (n=464) had moderate visual impairment, 22.5% (n=225) had severe visual impairment while 4.3% (n=43) were blind. The difference in the visual acuity status of the study population on presentation was statistically significant (p=0.000). However, after best correction, the blind participants in this study reduced to 3.5% [Table 4].

Table 5: Ocular Parameters (IOP, Drainage angle,ISGEO categories) of Study subjects

Ocular Parameter	No of Subjects (n)	%	Mean IOP	Chi Square Test/ P-value
Intraocular Pressure (mmHg)				
High (≥22)				
Normal (11-21)	350	35.0		0.035
Total	650	65.0	18.3 ± 6.1 mmHg	
	1000	100		
Drainage Angle				0.949
Open Angle (≥grade II)	1000	100		
ISGEO categorization of the subjects				
Criterion 1	615	61.5		0.996
Criterion 2	353	35.3		
Criterion 3	32	3.2		
Total	1000	100		

The mean intraocular pressure (IOP) of the study population on presentation was 18.3 ± SD 6.1 mmHg. One hundred and forty-three subjects (n=350; 35.0%) had high intraocular pressure (≥22mmHg) while 650 (65.0%) subjects had IOP within the normal range of 11.0 mmHg to 21.0 mmHg. This difference in the IOP of the study participants was statistically different (p=0.035).

All the study population had open drainage angle of between grade II and IV of Shaffer's classification. Concerning the ISGEO-2002 categorization of the subjects, 615 (65.1%) were in Criteria 1, 353 (35.3%) were in Criteria 2 and 32 (3.2%) were in Criteria 3. The difference in the various categories was not statistically significant (p=0.996) [Table 5]

TABLE 6. Prevalence of the Various Forms of Glaucoma

Glaucoma Type	No. of Subjects	Crude Prevalence %	95% Confidence Interval (CI)
POAG	798	79.8	(68.7 -84.2)
PACG	6	0.06	(0.03 – 0.96)
Secondary	196	19.6	17.2 – 21.8)
Total	1000	100	

IV. Discussion

This work sets out to explore the epidemiological, sociodemographic and clinical characteristic portraits exhibited by glaucoma patients attending the Glaucoma clinic of the University of Port Harcourt Teaching Hospital; thereby correlating their usefulness in the diagnosis of glaucoma in our environment.

Age and Gender Characteristics of the study population

Advancing age (over 40 years) is a risk factor for glaucoma [16-19].In this study, increase in age was associated with higher prevalence of glaucoma. The mean age of the glaucoma subjects was 60.1 ± 9.5 years with an age range of 40 to 92 years. The modal age was 55-64 accounting for 36.2% of the study population. This finding is in tandem with the observations of other researches [20-23] and lends support to the association of increasing age with glaucoma.Working independently and in different periods of time, Murdoch et al., in a study among 1563 people of Hausa/Fulani ethnic extraction of Nigeria; reported that POAG was more prevalent in individuals aged 45 years and older [24] while Adeoye in South Western region of Nigeria observed that POAG was more prevalent in individuals aged 50 years and older [25].

Our study was hospital-based while the studies of Kyari et al.,Awoyesuku et al., Murdoch et al. and Adeoye were population-based studies with larger sample sizes, in similar socio-cultural backgrounds, yet with similar results, thus lending credence to the assertion of this study on the correlation of increasing age with the prevalence of Glaucoma [22-25]. Also, corroborating with the findings of this work are the works of Leske et al., in the Barbados Eye Study which observed that adult-onset POAG was predominately in populations 45 years and older and that POAG significantly increases with age in all populations [26].

There are varyingfindings on gender-basis of the utilization of glaucoma services.Our present study found that 64.1% of our study participants were males and 35.9% were females. This difference was statistically significant (p= 0.000). Our finding was similar to previous studies inNigeria [22,27,28], Ghana [29] and South Korea [30] which also reported a higher prevalence of glaucoma in men than women. However, the studies of Ezinne et al, in Zamfara State, Nigeria and Ntim-Amponsah in Ghana found no significant difference in glaucoma prevalence between male and females [31,32].Moreover, gender predilection of glaucoma has not been established suggesting the need for more studies to determine the association of glaucoma with gender.

Educational and Occupational Characteristics of the study population

In this present study, it was demonstrated that the subjects had different educational backgrounds. Over 23% of the study participants in the POAG group had tertiary education, among which the female folk has over 9%. The finding was in agreement with the studies of Awoyesuku et al., Olawoye et al. and Kyari et al. [23,27,33]. Majority of the study participants (23%) were retired civil servants with different levels of educational status. There was a statistically significant difference in the distribution of the participants in this study among the various occupational status (p=0.000). The modal class of the study participants in our study was 60-69 years; most of them- retirees (15.1%). The distribution of the proportion of retired civil servants in the study population is in tandem that the retirement age from civil service in Nigeria is from 65 years [34].

Visual Acuity and visual impairment in the study population

The visual acuity in the study population varied widely. Over 26% of the study population had no visual impairment while 4.3% were blind (VA < 3/60) on presentation. However, after correction, the population with no visual impairment increased to over 50% and the blind decreased to 3.5%. This buttresses the importance of refraction and adequate optical correction among the visually impaired. Our findings are in line with previous reports from other parts of Nigeria [22,27,33,35] and Saudi Arabia [36]. In North-eastern Nigeria, a study found that about 76% were already blind on presentation in an eye clinic.The difference in the visual acuity status among the participants pre- and post-correction was statistically significant (p=0.000).

Family history of Glaucoma in the study population

Many studies have identified a positive family history of primary open angle glaucoma in black populations, as strongly correlated with risk of developing glaucoma reflecting heritability and/or shared environmental factors [37,38]. This study showed that, six hundred and twenty-six (n=626;62.6%) of the subjects had positive family history of glaucoma among first degree relatives while 42% (n=420) had positive family history of glaucoma among second degree relatives. These findings corroborate with other studies among black populations [26, 38]. In the Baltimore Eye Survey, it was demonstrated that, the odds of POAG were 18-fold higher with a positive family history and that siblings of an affected patient were at the highest risk

of developing POAG compared to parents or children [37]. However, some researchers have noted that family histories of patients may be incomplete, fraught with bias or lack of familiarity with glaucoma as a diagnosis and this could make this variable difficult to measure reliably [23,39]. This difficulty in eliciting family medical history was also encountered in our current study as 16.7% study participants were unaware of any incident of glaucoma in their first- or second-degree relatives. Recalling and eliciting family medical history (history of glaucoma in one's family) could also be a function of his/her educational background.

Intraocular Pressure (IOP), Drainage angle and vertical Cup to Disc Ratio

Many important risk factors and ocular features associated with primary open angle glaucoma (POAG) such as the intraocular pressure (IOP), trabecular meshwork architecture (TM) and the drainage angle; the vertical cup-disc-ratio of the optic disc head are well documented.

In this study, the mean intraocular pressure (IOP) of the study population was 18.3 ± SD 6.1 mmHg. One hundred and forty-three subjects (n=350; 35%) had high intraocular pressures (≥22mmHg). The role of raised intraocular pressure in the pathogenesis of POAG cannot be overemphasized as it is currently theestablished only modifiable risk factor of POAG. Many epidemiological, clinical, histopathological, and experimental studies support the role of IOP in glaucoma pathogenesis [3].

Eyes with raised IOP are at an increased risk of POAG. The risk of developing POAG is up to six times higher in those with ocular hypertension than in those without any risk factors for glaucoma [40]. In a randomized clinical trial with a total of 1636 participants, Kass et al., observed that the risk of developing POAG in ocular hypertension in the Ocular Hypertension Treatment Study was 9.5% over 5 years. The Barbados Eye Study showed POAG risk increased 12% for each 1 mmHg increase in IOP [41].

In this current work, the study population had open drainage angles of between grade II and IV on Shaffer's classification. This finding agrees with the results of the works of [22,23,42]. Tham et al., in a systematic review and meta-analysis reported that 140,496 (84%) cases of POAG had open drainage angles. They searched PubMed, Medline, and Web of Science for population-based studies of POAG of populations aged 40 to 80 years. Hierarchical Bayesian approach was used to estimate the pooled glaucoma prevalence along with 95% credible intervals (CrIs) [42]. Among African studies, the work of Kyari et al., suggests that POAG subjects have open angle chambers.

One of the distinctive features of glaucoma is the characteristic pattern of damage to the optic nerve head; recognized at the superior and inferior quadrants of the optic disc. The vertical cup: disc ratio is pathognomonic in glaucomatous loss of the neuro-retinal rim. The cut off point for normal VCDR is for the time being, arbitrary and partially flawed by the fact that there is overlap between the range of VCDRs in eyes with and without glaucomatous visual loss, hence the adoption ≤ 0.7 [44].The respondents in this current work, had vertical cup to disc ratio of ≥ 0.7 and above.

Using the ISGEO criteria for glaucoma diagnosis, it wasobserved in this study that 61.5% of the study population were classified int category 1, 35.3% into category 2 and 3.2 % into category 3. The observed prevalence of POAG was 79.8% (68.7 – 84.2 95% CI). The result of this study substantiated the evidence 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 [3,37, 43, 44]. The results obtained in this study is closer to reported values by Ashaye et al in South-Western Nigeria with a prevalence of 84.7% of all the diagnosed glaucoma[45].

An advantage of the ISGEO criteria [15] is that it takes into consideration eyes in which visual field testing or disc evaluation is impossible, which was not captured in most surveys on glaucoma prevalence before the adoption of the ISGEO classification.

V. Conclusion:

The profile of glaucoma patients in the Niger-Delta region of Nigeria is similar to those obtainable from other parts of Sub-Saharan Africa.The prevalence of glaucoma was higher than previously reported in other parts of Nigeria and remains a public health problem in Nigeria.Majority of glaucoma patients present late in Niger-Delta regionand this calls for urgent public health measures for glaucoma control in this region.

Conflict of Interest: Nil

Sponsorship: Nil

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