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**Advanced glaucoma at presentation is associated with poor follow up amongst glaucoma patients attending a tertiary eye facility in Southern Nigeria.**

**Running head: Advanced glaucoma is associated with poor follow-up**

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## ABSTRACT

**Purpose:** Globally, particularly in Africa, poor compliance with medication is a major problem in glaucoma management but little is known about follow-up rates among African glaucoma patients. The aim of this study was to determine rates of follow-up among glaucoma patients attending a tertiary hospital in southern Nigeria and investigate predictors of poor follow-up.

**Methods:** Data were extracted from medical records of new glaucoma patients who attended the hospital between June 2011 and May 2013. Socio-demographic and clinical parameters (visual acuity; stage of glaucoma) recorded at diagnosis were extracted using a pre-tested form. Follow-up was defined as good if they had attended within 9 months of the study date, inadequate when the last follow-up was more than 9 months and failed if they did not attend any follow-up or the most recent visit was more than 14 months from the study date. Univariate and multivariable analyses were undertaken to explore predictors of poor follow-up (inadequate plus failed).

**Results:** 348 patients were recruited, 54% were male and the mean age was 52.7 (range 16-88) years. Follow-up was as follows: good 28.4%, inadequate 46.6%, failed 25%. Overall 71.6% had poor follow-up. Independent predictors of poor follow-up were poorer visual acuity (OR 3.85, 95% confidence interval (CI) 1.25-11.80 for visual impairment; OR 4.11, 95% CI 1.32-12.81 for blind) and end-stage glaucoma (OR 3.55 (1.31-9.62),  $p=0.01$ ).

**Conclusion:** Enhanced counselling of patients with moderate to advanced glaucoma and visual impairment is required to improve follow-up and hence glaucoma management.

**Key words:** Advanced glaucoma, follow-up, rates, predictors, Africa.

## INTRODUCTION

At the first African Glaucoma Summit in Accra, Ghana in 2010, the World Glaucoma Association stated that blindness from glaucoma is an important cause of blindness globally, and in Sub-Saharan Africa it poses a very difficult and complex public health problem.<sup>1</sup> By 2013 glaucoma was estimated to affect 64.3 million people aged 40-60 years worldwide, and this is expected to increase to 76.0 million people by 2020.<sup>2</sup> It has also been estimated that 8.4 million would be blind from glaucoma by 2010 and this is expected to increase to 11.1 million by 2020.<sup>3</sup> In a recent review of the epidemiology of glaucoma in Sub-Saharan Africa, glaucoma had an estimated prevalence of approximately 4% in adults aged 40 years and above where it was responsible for up to 15% of blindness.<sup>4</sup> In Nigeria, glaucoma is a disease of great public health importance. Recent estimates from the National Blindness Survey showed the prevalence of glaucoma was 5.02% in adults over 40 years.<sup>5,6</sup> An estimated 1.2 million Nigerians are affected with about 1 in 5 persons (20%) already blind from the disease. The majority (86%) had primary open angle glaucoma.<sup>7</sup> Independent risk factors for open angle glaucoma among Nigerians include increasing age, higher intraocular pressure and the Igbo ethnic group.<sup>8</sup>

In countries with efficient health systems and relatively well educated patients, topical medication is usually the first line treatment for glaucoma. However, in Africa, surgery such as trabeculectomy is advocated as first line treatment, as patients often present late with advanced disease, and the more effective topical medications are either not available or are too expensive.<sup>9,10,11,12</sup> However, acceptance of surgery can be very low, as reflected by very low output of glaucoma surgery.<sup>13,14</sup> Laser treatment is not widely available in most African countries so medical treatment is the norm.<sup>15,16,17</sup>

A number of studies report on non-adherence to glaucoma treatment, but few have addressed rates of follow up amongst glaucoma patients or factors associated with follow-up, particularly in Africa.<sup>18,19,20</sup> Identifying factors associated with poor follow-up can help to guide the interventions required to improve follow-up and hence reduce the incidence of glaucoma blindness. A study of patients attending a glaucoma clinic in Baltimore, USA, showed that those with inconsistent follow-up were more likely to have mild disease, less likely to have been prescribed glaucoma medication and expressed more displeasure with long waiting times in the clinic.<sup>21</sup> In another study from the United States patients on glaucoma medication and those with more advanced disease were less likely to adhere to follow up, whereas in Tamil Nadu, India, inconsistent follow-up was associated with little or no formal education, not using glaucoma medication and the perception that follow-up is less important when patients are compliant with medication.<sup>22,23</sup> In a study from Ibadan, Nigeria

the following patients were more likely to have dropped out of follow up at one year: younger patients, males, patients who travelled long distances to the clinic, those with mild to moderate glaucoma, no family history of blinding eye diseases, and those taking two or more topical medications<sup>24</sup>.

The purpose of this study was to determine rates of follow up among glaucoma patients attending a tertiary referral eye department in southern Nigeria, West Africa, and to investigate predictors of follow-up documented at time of diagnosis. Findings of interviews with a selected sample of non-attenders will be reported separately.

~~The hospital has a catchment population of over four million most of whom (83%) are below 40 years of age. Nigeria is ranked third on the world poverty index with about 61% living below the poverty level of living on less than 1 USD per day.<sup>25</sup> Adult literacy in English is about 62% in the state, slightly above the national average (56.9%).<sup>26</sup>~~ **The hospital has a catchment population of over four million, most of whom (83%) are below 40 years of age.** The eye department has facilities for glaucoma diagnosis and management, with ten consultant ophthalmologists and trainee positions for fifteen ophthalmic residents. The eye department also runs a glaucoma screening service as part of a comprehensive medical assessment offered at the Centre for Disease Control at the hospital.

**Nigeria is ranked third on the world poverty index with about 61% living below the poverty level of living on less than 1 USD per day.<sup>25</sup> Adult literacy in English is about 62% in the state, slightly above the national average (56.9%).<sup>26</sup>**

## **METHODS**

This was a descriptive retrospective review of case records of adult glaucoma patients.

Medical records of new glaucoma patients attending the hospital between June 2011 and May 2013 were compiled from the departmental log book in July 2014. The following patients were eligible: aged 16 years and above with a diagnosis of glaucoma confirmed by a consultant ophthalmologist or senior ophthalmic resident. Patients with incomplete records, cataract surgery or other surgery which might influence routine glaucoma care and frequency of follow up were excluded as were glaucoma suspects.

Data were extracted from medical records by ophthalmology residents trained in the study protocol using a structured questionnaire. Socio-demographic data included age, sex, distance from patient's residential address to the facility and occupation. Distance was estimated by calculating the average distance by road from the patient's town/village of residence to the facility. Clinical information at diagnosis was extracted, and included best corrected visual acuity (BCVA), presenting intraocular

pressure (IOP), findings from gonioscopy and visual field analysis, vertical cup:disc ratio (VCDR) assessed by direct funduscopy and slit lamp biomicroscopy with a +78/90D lens. Data on other ocular and systemic co-morbidities were also extracted. The number of visits until diagnosis, the total number of subsequent visits, and the interval between the most recent visit and the study date were determined.

### Categories used in the analysis

Occupations were grouped into four categories to reflect economic status, and indirectly, education: 1. high/middle income (i.e., professionals, businessmen and civil servants), 2. low income (i.e., semi-skilled occupations; artisans, craftsmen, hairdressers, carpenters and unskilled occupations: petty traders, farm workers and security guards); 3 very low income (i.e., retired or pensioner groups) who often receive some low unspecified income and 4. unemployed/no income (i.e., students, housewives, unemployed adults and dependants). Distance to the eye facility was categorised into three groups: within 50 kilometres (km) of the facility, 50-100km and greater than 100km. Visual acuity was classified using the World Health Organization (WHO) categories of visual loss as not impaired i.e., VA in the better eye of 6/18 or better; impaired VA less than 6/18 to 3/60, and blind, VA less than 3/60.

Stage of glaucoma at presentation was graded by eye and then at the person level using the grade in the worst affected eye using the following definitions: 1) end stage: VA of hand movements or worse with a VCDR of 1.0; 2) advanced: VA 3/60 or worse with VCDR of greater than 0.8 and central visual field defects of less than 10° of fixation; 3) moderate: any level of VA, VCDR >0.7 (a VCDR cut-off of 0.7 was used as this was the 97.5<sup>th</sup> percentile in the Nigeria national survey) with defects within 10-20° of central fixation, and 4) mild: any other glaucomatous visual field loss and VCDR of 0.7 or less.<sup>27,28</sup> 7 (a VCDR of >0.7 was used as this was the 95<sup>th</sup> percentile in the Nigeria national survey with defects within 10-20° of central fixation, and 4) mild: any other glaucomatous visual field loss and VCDR of 0.7 or less.<sup>27,28</sup>

The following categories were used to define compliance with follow up using the study date of July 2014 as the point of reference, based on the fact that glaucoma patients are usually given follow up appointments of 6 months or less. Good follow up was defined as attended more than one follow up appointment and the last follow up attendance was within 9 months of the study date; inadequate follow up: attended more than one follow up appointment with the most recent being 9 -14 months from the study date; failed follow up – did not attend a follow up appointment or the most recent attendance was more than 14 months from the study date. For univariate and multivariable analysis, follow up was categorised as good or poor (inadequate plus failed).

**Commented [C1]:** Ref to add [Kyari E](#), [Abduil MM](#), [Sallo FB](#), [Spry PG](#), [Wormald R](#), [Peto T](#), [Faal HB](#), [Gilbert CE](#); [Nigeria National Blindness and Visual Impairment Study Group](#). Nigeria normative data for defining glaucoma in prevalence surveys. [Ophthalmic Epidemiol.](#) 2015 Apr;22(2):98-108.

Data were entered into an Excel spreadsheet and transferred into IBM SPSS version 22 (Chicago Inc.) for analysis. Chi-square (p-values), odds ratio (OR) and 95% confidence intervals were calculated to assess associations between follow up and explanatory variables. Multivariable logistic regression was used to assess independent predictors of follow-up using a significance level of 0.2 for variables used in univariate logistic regression.

Ethical approval was obtained from the ethics committees of the University of Benin Teaching Hospital and the London School of Hygiene & Tropical Medicine and the study was in accordance with the provisions of the Helsinki treaty.

## **RESULTS**

572 records of glaucoma/glaucoma suspects were reviewed, 348 of whom were eligible for inclusion. 54% were male and their mean (SD) age was 52.7 years (SD 18.1; range 16-88 years). 19.1% of participants were blind and 50.8% had advanced /end stage glaucoma (Table 1).

Overall 99 (28.4%) participants had good follow-up, 160 (41.6%) had inadequate follow-up and 89 (25%) failed follow-up. 249/348 (71.6%) had poor follow-up (i.e., inadequate plus failed). The median number (interquartile range (IQR)) of visits were as follows: good follow-up: median 6 (IQR 4-10) visits; inadequate follow-up median 2 (IQR 1-5) visits and failed follow up 1 (IQR 0-2) visits. Overall, 261 (75%) patients had two or more follow up visits while 208 (59%) had 3 or more follow up visits.

### **Predictors of follow-up**

In univariate analysis, increasing severity of glaucoma was associated with poor follow up. Those with moderate, advanced and end-stage glaucoma were 1.2, 2.2 and 5.5 times more likely to have poor follow up as those with mild disease (Table 2). Age, sex, occupation, distance to facility, ocular and systemic co-morbidity were not significantly associated with follow up. Multivariable logistic regression analysis showed that being visually impaired (adjusted odds ratio (OR) 3.85: 95% confidence interval (CI) 1.25-11.80; p=0.02); being blind (OR 4.11, 95% CI 1.32-12.81; p=0.02) and having end-stage glaucoma at presentation OR 3.55 (95% CI 1.31-9.62; p=0.01) were independently associated with poor follow up (Table 2).

**Table 1: Table I: Socio-demographic and clinical characteristics of study participants, by level of follow up**

Variables	Sample overall		Follow-up (%)				p-value
	(N=348)		Good (N = 99)		Poor (N = 249)		
	n	% of N	N	% of N	N	%	
<b>Age group</b>							
16-39 years	88	25.3	23	23.2	65	26.1	0.92
40-59 years	104	29.9	32	32.3	72	28.9	
60 years and above	151	43.4	43	43.4	108	43.4	
Missing	5	1.4	1	1.0	4	1.6	
<b>Sex</b>							
Male	188	54.0	50	50.5	138	55.4	0.46
Female	160	46.0	49	49.5	111	44.6	
<b>Approximate distance to hospital</b>							
1-50 km	299	85.9	90	90.9	209	83.9	0.24
51-100 km	37	10.6	7	7.1	30	12.0	
>100 km	12	3.4	2	2.0	10	4.0	
<b>Employment/occupation</b>							
High/middle income	95	27.3	27	27.3	68	27.3	0.48
Low income	105	30.2	33	33.3	72	28.9	
Very low income	88	25.3	26	26.3	62	24.9	
No income/unemployed	51	14.7	10	10.1	41	16.5	
<b>Best corrected visual acuity in better eye</b>							
>6/18 (not impaired)	258	74.1	90	90.9	168	67.5	<0.001
6/18 – 3/60 (impaired)	36	10.3	4	4.0	32	12.9	
<3/60 (blind)	53	15.2	5	5.1	48	19.3	
Missing	1	0.3	0	0	1	0.4	
<b>Stage of glaucoma at presentation (worse eye)</b>							
Mild	129	37.1	49	49.5	80	32.1	<0.001
Moderate	65	18.7	22	22.2	43	17.3	
Advanced	95	27.3	21	21.2	74	29.7	
End-stage	58	16.7	6	6.1	52	20.9	



**Table 2: Factors associated with poor / failed follow up: univariate and multivariable analysis**

Parameter	Univariate analysis		Multivariable analysis*	
	Unadjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
<b>Sex</b>				
Male	1		1	
Female	0.82 (0.52-1.32)	0.41	1.05 (0.62 -1.78)	0.85
<b>Age group</b>				
16-39 years	1		1	
40-59 years	0.80 (0.42-1.50)	0.48	0.59 (0.29 - 17)	0.13
60 years and above	0.89 (0.49-1,61)	0.70	0.40 (0.18 -0.85)	0.18
<b>Best corrected visual acuity in better eye</b>				
≥6/18	1		1	
<6/18-3/60	4.29 (1.47-12.50)	0.01	3.85 (1.25-11.80)	0.02
<3/60	5.13 (1.98-13.38)	<0.01	4.11 (1.32-12.81)	0.02
<b>Stage of glaucoma at presentation (worse eye)</b>				
Mild	1		1	
Moderate	1.20 (0.64-2.37)	0.57	1.11 (0.57-2.14)	0.77
Advanced	2.16 (1.18-3.94)	0.01	1.84 (0.94 -3.62)	0.08
End-stage	5.31 (2.12-13.28)	<0.001	3.55 (1.31-9.62)	0.01
<b>Ocular co-morbidity</b>				
None	1		1	
Co-morbidity	1.46 (0.91-2.33)	0.12	1.39 (0.74 -2.61)	0.30
<b>Employment/occupation</b>				
High/middle income	1		-	-
Low income	0.87 (0.47-1.59)	0.64		
Very low income	0.95 (0.50-1.79)	0.87		
No income/unemployed	1.63 (0.72-3.71)	0.25		
<b>Approximate distance to hospital</b>				
0-50 km	1		-	-
51-100 km	1.85 (0.78-4.36)	0.16		
>100 km	2.15 (0.46-10.03)	0.33		

## DISCUSSION

Regular follow-up is critical in glaucoma care to monitor the disease and adjust treatment when necessary. Almost three quarters of the glaucoma patients in our study either failed follow-up or had poor follow-up according to our definition, which can be regarded as conservative. A more stringent criterion of 4-6 months between visits, which reflects usual practice in our hospital, would likely show even lower rates. The rate of poor follow-up (71.6%) is similar to that reported from Ibadan, Nigeria where the drop-out rate was 60.5% in the first year and similar to the 75% failure of follow up in the first year of care reported from India.<sup>24,23</sup> In the United States, non-compliance with follow up was lower (40%), but many were glaucoma suspects who were dissatisfied with waiting times.<sup>22</sup> These studies show that poor follow-up is a common and serious problem in glaucoma care worldwide. The reasons are likely to be multi-factorial and vary from setting to setting. In this study a sample of glaucoma patients who failed follow up were invited to attend focus group discussions in which their reasons for non-attendance were explored. The findings will be reported in another paper.

In this study greater disease severity and visual loss from glaucoma were independently associated with poor follow up. This is similar to that reported from the USA in which greater disease severity and being on IOP lowering medication were independent risk factors.<sup>21</sup> However, the study in India had different findings where poor education, non-adherence to medication and the belief that follow up is not needed if the vision was stable were significant predictors.<sup>23</sup> The differences may reflect differences in the setting (high income versus low income) or in the methods used. The USA study and this study were both reviews of medical records while that from India was a case control study in which a range of subjective parameters were also investigated.

Poor follow up amongst those with severe disease may reflect lack of independent mobility and the need for an escort, which would increase costs. Patients with more severe disease may also be discouraged by the irreversible nature of the disease and be reluctant to attend follow-up. Another explanation is that patients may have attended follow up at another service provider, such as the private eye hospital in the city, but this is unlikely as only a quarter were categorized as being high/middle income. It is also likely that poor follow up may have led to more severe disease. As this study had a cross sectional design, temporality and causality cannot be inferred, and longitudinal studies would be required to determine the true sequence of events. Poor follow up may reflect lack of understanding of glaucoma i.e., that visual loss cannot be reversed, or lack of acceptance or fatalistic views.<sup>28</sup> Many studies have confirmed the low level of awareness and understanding about glaucoma among the general population, hospital workers as well as glaucoma patients.<sup>29,30,31,32.</sup>

In our study the findings at diagnosis were used in the analysis, and data on adherence to topical medication or whether glaucoma was subsequently controlled over time were not extracted, which might have influenced the findings. For example, someone who became blind soon after diagnosis might be less likely to attend for follow up. Collecting data on disease progressions was not possible for several reasons: the limited number of follow up visits (only 59% attended 3 or more follow up visits) and signs of progression, such as change in visual fields or VCDRs, were not recorded in a consistent manner and were recorded by multiple observers.

#### *Other findings*

Those living more than 50 kilometres from the facility were almost twice as likely to have poor follow-up than those living nearer, but the difference was not statistically significant. Distance is likely to be associated with greater costs as well as logistical challenges as public transport is limited in many parts of Nigeria. There may also be opportunity costs for patients and those who accompany them. Some elderly patients may have used the address of relatives they stayed with for the clinic appointment rather than their own address, which would under-estimate the role of distance.

In this study a quarter of participants were less than 40 years of age (mean 52.7 years) which is similar to other studies in Nigeria and Africa<sup>16,24,33</sup> which supports the earlier age of onset and the aggressive course of glaucoma in Africans.<sup>34,35</sup> Poor follow up was also high in the younger group despite many living within 50km of the facility.

Almost 20% of the glaucoma patients in this study were blind at presentation using a visual acuity (VA) criterion, and half presented with advanced/end stage glaucoma. These findings are consistent with an earlier report from his centre where 25% of new patients were blind using VA criterion and 55% by visual field criterion.<sup>36</sup> Higher rates have been reported in other parts of Nigeria, 31% of glaucoma patients were reported blind by VA criterion in the East while in a tertiary unit in Bauchi, North east Nigeria, 35% of glaucoma patients were blind and 76% had advanced glaucoma at presentation.<sup>37,13</sup> High rates of blindness (34%) and advanced glaucoma (70.2%) have also been reported amongst glaucoma patients in Ghana, West Africa.<sup>33,38</sup> Higher literacy and possibly better awareness among the population in the region where our study was undertaken may influence health seeking behaviour and hence earlier presentation. This hospital also runs a glaucoma screening service which may have led to some cases being identified at an earlier stage of disease.

### **Limitations and strength of study**

The educational status of patients can influence their health seeking behaviour but this could not be analysed due to incomplete data. However, occupation, which was used as a proxy for education and economic status, did not predict follow up. Information on family history, which may also influence adherence to follow up, was also not collected in a consistent manner. Study participants were examined by different ophthalmologists which may lead to variation in the diagnosis and documentation of glaucoma as this was not standardised. We attempted to adjust for this by only including patients diagnosed by senior ophthalmologists. A strength of this study is that it was not subject to recall bias and the sample size was large enough to demonstrate statistically significant differences. **A limitation of the study was that it was a retrospective review of medical records, and data were not always recorded in a standard manner and some data were missing. A prospective study is warranted.**

### **Implications for service delivery and recommendations**

This study shows that poor follow up is significantly associated with greater disease severity and poorer visual acuity, and the implications for service delivery are that health education and counselling are required for all glaucoma patients, but particularly those with moderate or advanced disease and who live far away. This may need to be repeated at each visit, and should include other members of the family. Reminding patients about follow up by print or electronic media or using mobile text messages or a call-in system to re-schedule appointments has the potential to improve follow up in both high and low income countries.<sup>39</sup> Most adult Nigerians irrespective of socio-economic status or location own and use a cell phone, and in this study over 80% of patients had a contact telephone number. Coverage of text message reminders has the potential to be high but its effectiveness needs to be investigated in this setting.

The high rate of poor follow-up highlights the need for an acceptable and effective once-off intervention which would require less frequent follow up.<sup>40</sup> Providers must make determined efforts to offer enhanced counselling to glaucoma patients, particularly those with advanced disease, to address management options, goals, treatment compliance as well as patients' expectations and challenges. These efforts have the potential to improve follow-up and ultimately reduce the incidence of glaucoma blindness.

For stable patients it is important to develop the capacity of secondary level hospitals so that patients can be followed up nearer home. It may be expedient to offer distant glaucoma patients who are stable, less frequent follow-up appointments and prescriptions for drugs to last them for

the intervals between follow-up visits. Laser treatment should be developed as less frequent follow up may be required.

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## REFERENCES

1. World Glaucoma Association African Glaucoma Summit Aug 2010 Accra. Glaucoma challenges [Internet]. Available from: <http://www.worldglaucoma.org/AfricaSummit/pages/africa.php>.
2. Tham YC, Li X, Wong TY, Quigley HA, Aung T, Cheng CY. Global prevalence of glaucoma and projections of glaucoma burden through 2040: a systematic review and meta-analysis. *Ophthalmol*. 2014; 121 (11): 2081-2090.
3. Quigley HA, Broman AT. The number of people with glaucoma worldwide in 2010 and 2020. *Br J Ophthalmol*. 2006; 90(3):262-267.
4. Kyari F, Abdull MM, Bastawrous A, Gilbert CE, Faal H. Epidemiology of glaucoma in sub-saharan Africa: prevalence, incidence and risk factors. *Middle East Afr J Ophthalmol*. 2013 ;20(2):111–125.
5. Abdull MM, Sivasubramaniam S, Murthy GVS, Gilbert C, Abubakar T, Ezelum C, et al. Causes of blindness and visual impairment in Nigeria: the Nigeria national blindness and visual impairment survey. *Invest Ophthalmol Vis Sci*. 2009 ;50(9):4114–4120.
6. Rabiou MM, Kyari F, Ezelum C, Elhassan E, Sanda S, Murthy GVS, et al. Review of the publications of the Nigeria national blindness survey: methodology, prevalence, causes of blindness and visual impairment and outcome of cataract surgery. *Ann Afr Med*. 2012;11(3):125–130.
7. Kyari F, Entekume G, Rabiou M, Spry P, Wormald R, Nolan W, et al. A population-based survey of the prevalence and types of glaucoma in Nigeria. *BMC Ophthalmol*. 2015;15:176.
8. Kyari F, A Abdull, Wormald R, Evans J, Nolan W, Murthy GV, Gilbert CE. Risk factors for open-angle glaucoma in Nigeria: results from the Nigeria National Blindness and Visual Impairment Survey *BMC Ophthalmol*. 2016;16:78.
9. Bowman RJ, Kirupananthan S. How to manage a patient with glaucoma in Africa. *Comm Eye Health*. 2006;19(59):38–39.
10. Rotchford A. What is practical in glaucoma management? *Eye*. 2005;19(10):1125–1132.
11. Wormald R. What's new in glaucoma treatment? *Comm Eye Health*. 2006;19(59):33–35.
12. Omoti AE. A review of the choice of therapy in primary open angle glaucoma. *Niger J Clinical Pract*. 2005; 8 (1): 29-34.
13. Abdull MM, Gilbert CE, Evans J. Primary open angle glaucoma in northern Nigeria: stage at presentation and acceptance of treatment. *BMC Ophthalmol*. 2015;15(1):111.
14. Adekoya BJ, Akinsola FB, Balogun BG, Balogun MM, Ibadapo OO. Patient refusal of glaucoma surgery and associated factors in Lagos, Nigeria. *Middle East Afr J Ophthalmol*. 2013; 20(2):168–173.
15. Abdull M. Patients and glaucoma: what are the challenges? *Community Eye Health*. 2012;25(79-80): 44–45.

16. Megbelayin E, Nkanga D, Asana U, Duke R, Etim B, Ibanga A. Challenges in the management of glaucoma in university of Calabar teaching hospital, Calabar, Nigeria: A 10 year review. *Arch Int Surg*. 2013;3(1):23.
17. Kyari F, Nolan W, Gilbert C. Ophthalmologists' practice patterns and challenges in achieving optimal management for glaucoma in Nigeria: results from a nationwide survey. *BMJ Open*. 2016;6(10):e012230.
18. Tsai JC. A comprehensive perspective on patient adherence to topical glaucoma therapy. *Ophthalmology*. 2009 ;116(11 Suppl):S30–36.
19. Kowal M, Choragiewicz T, Mietlicka K, Wyszyńska A, Zarnowski T. Obstacles to medication compliance for patients with glaucoma. *KlinOczna* 2008.;110(10-12):347–351.
20. Omoti AE, Ukponmwan CU. Compliance with new drugs in glaucoma therapy in Benin City, Nigeria *Pharmacy Pract*. 2005; 3: 135-143
21. Ung C, Murakami Y, Zhang E, Alfaro T, Zhang M, Seider MI, et al. The association between compliance with recommended follow-up and glaucomatous disease severity in a county hospital population. *Am J Ophthalmol* ; 2013];156(2):362–369.
22. Kosoko O, Quigley HA, Vitale S, Enger C, Kerrigan L, Tielsch JM. Risk factors for noncompliance with glaucoma follow-up visits in a residents' eye clinic. *Ophthalmology* . 1998;105(11):2105–2111.
23. Lee BW, Sathyan P, John RK, Singh K, Robin AL. Predictors of and barriers associated with poor follow-up in patients with glaucoma in South India. *Arch Ophthalmol*. 2008;126(10):1448–1454.
24. Ashaye AO, Adeoye AO. Characteristics of patients who dropout from a glaucoma clinic. *J Glaucoma* .2008;17(3):227–232.
25. NBS (2010a). 'Nigeria Poverty Report 2010'. Available at: <http://www.nigerianstat.gov.ng/pdfuploads/Nigeria%20Poverty%20Profile%202010.pdf> (accessed on 20 October 2015).
- ~~26. National Literacy Survey. resourcedat.com/wp-content/uploads/2012/04/National-Literacy-Survey-2010.pdf.~~
- ~~Foster PJ. The definition and classification of glaucoma in prevalence surveys. *Br J Ophthalmol*. 2002;86(2):238–242.~~
27. Kyari F, Abdull MM, Sallo FB, Spry PG, Wormald R, Peto T, Faal HB, Gilbert CE; Nigeria National Blindness and Visual Impairment Study Group. Nigeria normative data for defining glaucoma in prevalence surveys. *Ophthalmic Epidemiol*. 2015 Apr;22(2):98-108.
- ~~Dineen B, Gilbert CE, Rabiu M, Kyari F, Mahdi AM, Abubakar T, et al. The Nigerian national blindness and visual impairment survey: Rationale, objectives and detailed methodology. *BMC Ophthalmol*. 2008; 8:17.~~
28. Abdull MM, Chandler C, Gilbert C. Glaucoma, “the silent thief of sight”: patients' perspectives and health seeking behaviour in Bauchi, northern Nigeria. *BMC Ophthalmology*. 2016;16(1):1-9.

29. Chen X, Chen Y, Sun X. Notable role of glaucoma club on patients' knowledge of glaucoma. *Clin Experiment Ophthalmol*. 2009;37(6):590–594.
30. Komolafe OO, Omolase CO, Bekibele CO, Ogunleye OA, Komolafe OA, Omotayo FO. Awareness and knowledge of glaucoma among workers in a Nigerian tertiary health care institution. *Middle East Afr J Ophthalmol* 2012;20(2):163–167.
31. Tenkir A, Solomon B, Deribew A. Glaucoma awareness among people attending ophthalmic outreach services in Southwestern Ethiopia. *BMC Ophthalmol* 2010;10:17.
32. Sandhya R., Abhilasha S, Niharika S. A Study of Awareness of Glaucoma among Ophthalmology out patients in a 2-Tier City, Tumkur in India. *J Clinical and Experimental Ophthalmol* 2015;1(3):156-158.
33. Ntim-Amponsah CT, Amoaku WM, Ofosu-Amaah S, Ewusi RK, Idirisuriya-Khair R, Nyatepe-Coo E, *et al*. Prevalence of glaucoma in an African population. *Eye (Lond)* 2004;18:491-497.
34. Buhrmann RR, Quigley HA, Barron Y, West SK, Oliva MS, Mmbaga BB. Prevalence of glaucoma in a rural East African population. *Invest Ophthalmol Vis Sci* 2000;41:40-48.
35. Rotchford AP, Johnson GJ. Glaucoma in Zulus: A population-based cross-sectional survey in a rural district in South Africa. *Arch Ophthalmol* 2002;120: 471-478.
36. Omoti AE, Osahon AI, Waziri-Erameh MJ. Pattern of presentation of primary open-angle glaucoma in Benin City, Nigeria. *Trop Doct*. 2006 Apr;36(2):97-100.
37. Awoyesuku EA, Ejimadu CS. Visual disability in newly diagnosed primary open angle glaucoma (POAG) patients in a tertiary hospital in Nigeria. *Niger J Med*. 2012;21(1):78–80.
38. Gyasi M, Amoako W, Adjuk M. Presentation patterns of primary open angle glaucomas in north eastern Ghana. *Ghana Med J*. 2010;44(1):25–30.
39. Gurol-Urganci CJ., De Jongh T, Vodopivec-Jamsek V, Atun R, Car J. Mobile phone messaging reminders for attendance at healthcare appointments. *Cochrane Database Syst Rev* 2013;12:CD007458.
40. Cook C. Glaucoma in Africa: size of the problem and possible solutions. *J Glaucoma*. 2009 Feb;18(2):124-128.

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