THE PATTERN OF GLAUCOMA IN PATIENTS ATTENDING THE EYE CLINIC AT JUBA TEACHING HOSPITAL, SOUTH SUDAN

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A DISSERTATION PRESENTED IN PARTIAL FULFILLMENT OF THE REQUIRMENT FOR DEGREE OF MASTER OF MEDICINE (OPHTHALMOLOGY) AT THE UNIVERSITY OF NAIROBI,

DECLARATION

I declare that this dissertation is my original work and has never been published or presented for a degree in any other University.

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DEDICATION

This work is dedicated to my beloved wifeand twins, parents and my sister for the support and understanding during the entire period of this study.

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LIST OF ABBREVIATIONS AND ACRONYMS

ACG	Angle Closure Glaucoma
VA	Visual Acuity
IOP	Intraocular Pressure
ISGEO	International Society of Geographical & Epidemiological Ophthalmology
MMC	Mitomycin-C
NTG	Normal Tension Glaucoma
OAG	Open Angle Glaucoma
PACG	Primary Angle Closure Glaucoma
PBS	Population-Based Surveys
POAG	Primary Open Angle Glaucoma
SSA	Sub-Saharan Africa
5FU	5-Fluorouracil
CCT	Central corneal thickness
HVF	Humphrey visual field
RNFL	Retinal nerve fiber layer
vCDR	Vertical cup disc ratio
CI	Confidence interval

OCT	Ocular coherence topography

ABSTRACT

Background: Glaucoma is an irreversibly blinding eye disease which damages the optic nerve head fibres. The disease may be asymptomatic in certain clinical types, until advanced stage, so much emphasis is to be given for early diagnosis.

Objective: The objectives of the study were to (i) assess the patterns of glaucoma in patients attending the eye clinic; (ii) establish the causes of secondary glaucoma in these patients; and document the treatment modality employed

Study Design: This study was a cross-sectional hospital based study conducted in the eye clinic at Juba Teaching Hospital, Juba South Sudan.

Study Population: Study population comprised of all glaucoma patients aged 40 years and above attending the eye clinic at Juba Teaching Hospital during the study period.

Data Management and Analysis: All data was stored in password protected files kept under lock and key by the principal investigator to avoid elicit data access Descriptive analysis was done to determine means, frequencies and proportions of the various variables and findings presented by means of graphs, tables and charts where appropriate. Proportionate test was used to compare proportions of the categorical and continuous variables describing demographics and pattern of glaucoma.

Results: Almost all patients attending the eye clinic (99.2%) had open angle glaucoma and only 0.8% had angle closure glaucoma. Most patients were in the age group 50 to 59 (35.3%).Males patients were significantly more than the females M: F Ratio (1.5:1) (p=0.043). Majority of the patients (72%) did not have family history of glaucoma or other risk factors. Hypertension, diabetes mellitus, trauma, glaucoma, and myopia are conditions that would increase susceptibility to glaucoma. Patients presented to hospital because of symptoms of reduced vision, with many already blind in at least one eye (46.2%). Further, majority of patients on medical treatment were using beta-blocker (81.5%) with a few patients using prostaglandins

(1.7%) medication. Moreover, considerable number of patients were not on medication (16.8%).

Recommendations: Our study recommends improving awareness and increasing knowledge about glaucoma especially among persons affected by the condition, as well as training glaucoma specialists. Also, policy makers come should come up with strategies which promote earlier detection and promote greater acceptance and adherence to glaucoma treatment. Finally, it was recommended that cost of glaucoma medication be subsidized

1.0 INTRODUCTION

Data from Resnikoff *et al*indicate that glaucoma is the second leading cause of blindness, accounting for 8% of blindness among the 39 million people who are blind world-wide.[1] In Africa, glaucoma accounts for 15% of blindness, making it the region with the highest prevalence of blindness relative to other regions in the world.[2]

1.1 Classification of Glaucoma

1.1.1 Primary Open-Angle Glaucoma

According to the American Academy of Ophthalmologyprimary Open-Angle Glaucoma is a chronic slowly progressive optic neuropathy with characteristics patterns of optic nerve damage and visual field loss.[3] POAG lacks the identifiable contributing factors of the secondary open-angle glaucoma, such as pigment dispersion in pigmentry glaucoma or the exfoliative material seen in exfoliation syndrome. Elevated intraocular pressure is the principal risk factor for POAG; although other factors such as lower ocular perfusion pressure, race, low central corneal thickness (CCT), advanced age, and positive family history also contribute to the risk of developing this disease. POAG is a multifactorial disease process with numerous contributing susceptibility factors that may include abnormalities of axonal or ganglion cell metabolism and disorders of the extracellular matrix of the lamina cribrosa. Unfortunately, we do not fully understand the interplay of the multiple factors involved in the development of POAG.

1.1.2 Primary Angle-Closure Glaucoma

In primary angle-closure glaucoma, elevated IOP results from closure of the anterior chamber angle rather than any other factors. In primary angle-closure glaucoma, relative pupillary block and plateau iris are the main angle-closure mechanisms. As the primary mechanism of angle-closure is relative pupillary block in the majority of cases, primary angle-closure glaucoma can ordinarily be defined as identical relative pupillary block.[4]

1.1.3 Normal-Tension Glaucoma, Normal-Pressure Glaucoma

Leskeexplain that in this subtype of primary open-angle glaucoma (broad definition), IOP constantly remains within the statistically determined normal range during the development and progression of glaucomatous optic neuropathy.[5] However, this does not necessarily mean that normal IOP does not play a role in the development of optic neuropathy in normal-tension glaucoma.

1.1.4 Secondary Glaucoma

Secondary glaucoma is glaucoma in which elevated IOP is caused by other ocular, or systemic diseases, as well as drug use. The approach that was used to define secondary glaucoma only in cases in which glaucomatous optic neuropathy is present, is an interpretation that is consistent with the definition of glaucoma.[4]

1.1.5 Ocular Hypertension

Ocular hypertension is not the same as glaucoma, which is a disease of the eye in which glaucomatous optic neuropathy is associated with high intraocular pressure. In people with ocular hypertension, the optic nerve appears normal and no signs of glaucomatous field loss are found on visual field testing despite the presence of high intraocular pressure. However, people with ocular hypertension are considered “glaucoma suspects,” and should be monitored closely by an ophthalmologist to detect any signs of progression to open angle glaucoma.[6]

1.2 LITERATURE REVIEW

1.2.1 Diagnosis for Glaucoma

According to Abduthere are minimal difficulties in evaluating glaucoma patients in tertiary institution as most of the basic facilities for glaucoma detection are available.[7] Optic nerve damage causes apparent papillary defect which can be detected by swinging light test.

1.2.2 History Taking

Japan Glaucoma Societypromulgated that a detailed interview is indispensable in order to exclude the possibility of secondary glaucoma.[4] In addition, history of ocular trauma, inflammation, surgery, and infection be obtained. It is important to determine the patient's history of systemic diseases e.g. Asthma, Diabetes, hypertension and medications.

1.2.3 Slit-Lamp Microscopy

Japan Glaucoma Society point out that in this examination, the conjunctivae, anterior chamber, iris, lens, etc., are observed, but an auxiliary lens (goinolens, +78D and +90D and 3 mirrow lens) may also be used in combination in order to observe the anterior chamber angle and ocular fundus.[4]

1.2.4 Tonometry

***Intraocular Pressur*e:** Results of study by Fingeretconducted in large numbers of subjects have shown that the distribution of IOP is skewed towards higher values (21 mmHg) and does not show a fully normal distribution.[8] Africans have higher IOP due to their thin cornea.[9]

According to American Academy of Ophthalmologythe Ocular Hypertension Treatment Study (OHTS) found that low corneal thickness was a strong predictive factor for the development of glaucoma in subjects with ocular hypertension.[3]Subjects with a corneal thickness of 555 µm or less had a threefold greater risk of developing POAG compared with participants who had a corneal thickness of more than 588 µm. whether this increased risk of glaucoma is due to underestimating actual IOP in patients with low corneal thickness or whether low corneal is a risk factor independent of IOP measurement has not been completely determined; but OHTS found CCT to be a risk factor for progression independent of IOP level.

Tonometers: As the Goldmann applanation tonometer is the most clinically accurate device, this tonometer is used on a standard basis in the diagnosis and treatment of glaucoma.[4]

1.2.5 Gonioscopy

Anterior Chamber Angle: Gonioscopy is indispensable in the treatment and diagnosis of glaucoma.[10]

Trabecular Meshwork*:* Kingmanadds that in diseases such as exfoliative glaucoma, pigmentry glaucoma, and pigment dispersion syndrome, a pronounced pigmentation is frequently observed on the trabecular meshwork.[10]

Compression Gonioscopy*:* Compression gonioscopy are useful for distinguishing between a simple narrow anterior chamber angle or functional closure and organic closure due to peripheral anterior synechiae.

1.2.6 Ophthalmoscopy

Optic Disc and Retinal Nerve Fiber Layer: Observation of optic nerve head by ophthalmoscopy can be conducted by 1) Direct ophthalmoscopy, 2) slit-lamp bio microscopy using an auxiliary lens+78Dor +90D, 3) funduscopic photography, and 4)red free Fundoscopy.[4]

1.2.7 Perimetry

Visual Field*:* Lawannotes that the normal visual field has an elongated elliptical shape, it measures 60 degrees superiorly and medially, 70-75 degrees inferiorly, and 100-110 degrees temporally.[11]

Static Visual Field*:* Static visual field measurement is more sensitive in detecting visual field anomalies in the early stages of glaucoma because it measures the Magnocellular pathway compared to dynamic visual field measurement.[4]

1.3 Treatment of Glaucoma

Abdustipulates that glaucoma treatment can broadly be divided into two, namely, medical and surgical including Laser.[7]Ideally one should use the lowest dose of a particular drug that will

produce the greatest therapeutic response with the least number of side effects. However, there is a general consensus to start glaucoma medical therapy with one topical intraocular pressure (IOP) lowering medication.

1.4 Pattern of Presentation of Glaucoma

Ashaye*et al*stipulated that visual field-testing using manual perimeters in previous years indicates classical changes such as peripheral depression, nasal step, temporal wedge, and massive peripheral visual constriction has largely been replaced by automated perimeters that show mean and pattern standard deviation and other reliability parameters.[2]The tests recorded are reproducible and amenable to comparison with further test made at a later date.

Lawanpointed out that the introduction of Stratus OCT machine in some tertiary centers has given additional capacity to diagnose, assess, and follow up patients with glaucoma.[12]Retinal nerve fiber layer (RNFL) measurement is available, which greatly aid in objectively assessing the disease at presentation and monitoring stabilization or progression over time. RNFL measurements using OCT is important in making diagnosis of glaucoma and determines extent of ganglion cell loss at presentation in addition to monitoring progression of the disease.

Studiesreveal that the advantages of RNFL measurements using OCT include the fact that it is a noncontact noninvasive procedure that produce in vivo retinal image and do not require pupillary dilation.[8, 13]Data obtained is stored in the system and can be retrieved and compared with that obtained at a later date. However, the machine is expensive for the health budget of most developing countries.

Dueker *et al* explained that stratus OCT has lower acquisition speed, less depth resolution and has no 3-dimentional imaging technology like the latest Fourier Domain OCT.[14] Studies to determine reference values have been conducted and about to be published. Some tertiary centers have equipment to do parchymetry and can more objectively determine the patient's intraocular pressure after accounting for corneal thickness. Africans are known to have thinner

cornea of about 534 μm, and studies have suggested this as an independent risk factor for raised IOP leading to glaucoma.

Tchabi*et al* found out that among the various parameters for screening glaucoma, IOP appears to be the easier option.[15] However, there are people with high pressures who have normal optic discs and visual fields (Ocular hypertension), and others with abnormal discs and visual fields with IOP within "normal values" (Normotensive glaucoma). This test requires skill and equipment. If age is considered it may be ideal to test from as young as twenty years as a report from Benin showed high IOP levels in younger adults Reference. Mahmoud *et al*added that index cases can be used to identify and screen first degree relatives.[16] Cup to disc ratios can be assessed although some studies have shown high ratios with normal IOP. Employee screening can be employed to detect cases early.

Wilson and Jungnerexplained that the difficulty is that none of the test can easily be applied on a large scale or at community level.[17]Considering the principles of early disease detection criteria by Wilson and Jungner glaucoma is of public health significance, there are facilities for diagnosis and treatment, and there are various treatment modalities for those recognized to have the disease. However, the latent stage may not easily be recognized. In addition, there is no single screening test that can be identified as suitable to the population. In most case one can identify cases to treat, though sometimes this is not so. The natural history of glaucoma cannot be said to be largely understood.[18]

1.5 Global Overview of Glaucoma

It was estimated that 60.5 million people world-wide had glaucoma in 2010, and this is projected to increase to 20 million by 2020.[19]

Rijalconducted a study to determine the prevalence and pattern of glaucoma among patients who presented to Nepal Eye Hospital.[20] This was a retrospective hospital based analysis of medical records of patients attending Nepal Eye Hospital Glaucoma clinic over a period of 2 years (Jan 2003 - Jan 2005). The study established that glaucoma patients comprised 0.74%

(827) of total outpatient's population of (110794). Male to female ratio was 49.6%:50.4%. Primary Open Angle Glaucoma (POAG) found to be more common (57.3%).

Kim *et al*conducted a study to investigate the prevalence and characteristics of glaucoma in a population of the rural Korean town of Sangju.[21] Residents of Sangju aged greater than 50 years old were included in this study. The prevalence of glaucoma was determined to be 3.4% (95% confidence interval [CI], 2.1-4.8). (Normal tension glaucoma) was determined to be the most common with a prevalence as high as 2.5% (95% CI, 1.8-3.7). Additionally, primary angle closure glaucoma was determined to have a prevalence of 0.3% (95% CI, 0.1-0.9). Open-angle glaucoma with low IOP accounted for 94.4% of the open-angle glaucoma cases.

The Africa region also has the highest incidence and prevalence of glaucoma. Most studiesestablished that black populations of the Caribbean, Africa and USA have the highest prevalence of open-angle glaucoma (OAG).[5, 22]

1.6 Epidemiology of Glaucoma in Africa

Studies have shown that the epidemiology of glaucoma in Africa is not as clear.[23,24,25] There have been many anecdotal reports of high rates of open angle glaucoma (OAG) in Africans, and this seems to begin at a younger age than among white people. Efforts to understand more about the magnitude and distribution of glaucoma in Africa have usually been limited by reliance on clinic based studies and varying definitions of glaucoma.

Other studies by Akogun and Ezepueindicated that OAG is an important cause of blindness in Africa.[23,24] Reports indicate that most people with glaucoma are not aware of having it and at least half of eyes are already blind at presentation. Yet few population based studies of glaucoma with strict definitions have been completed in Africa. The first, in the Western Cape of South Africareported a prevalence of OAG of 1.5% while the prevalence of primary angle closure glaucoma was 2.3%.[25] The population in this study included a distinctive ethnic mix of mainly South East Asian ancestry mixed with East African and European and it is not representative of the bulk of sub-Saharan Africa. A study in Tanzania by Buhrmannfound a

prevalence of open angle glaucoma of 3.1% (95% CI = 2.5±3.8) in people over the age of 40.[26] In the Tanzanian population OAG accounted for 5% of all blindness while the prevalence of angle closure glaucoma in Tanzania was only 0.6%.

Kyari *et al*carried out a study to review the epidemiology of different types of glaucoma prevalent in Sub-Saharan Africa (SSA) and to discuss the evidence regarding the risk factors for onset and progression of glaucoma, including risk factors for glaucoma blindness.[27] They highlighted that glaucoma in SSA is a public health problem and predominantly an open-angle type. It is the second-leading cause of blindness, has a high prevalence, an early onset and progresses more rapidly than in Caucasians. These factors are further compounded by poor awareness and low knowledge about glaucoma even by persons affected by the condition.

Ashaye *et al* carried out a study to determine the prevalence and identify the types of glaucoma in the Akinyele district of Oyo State in Southwestern Nigeria.[2] Residents of Akinyele district of Oyo State in Southwestern Nigeria aged 40 years and older were randomly selected in a stratified manner. A sample of 811 subjects (90% response rate) was examined. The crude prevalence of all forms of glaucoma was 7.3% (95%CI] 5.5%–9.1%) with an age and sex standardized rate of 6.9% (95% CI 6.88%–6.92%). Primary open angle glaucoma was found in 6.2% (95% CI 4.5%–7.8%) and primary angle closure glaucoma in 0.2% (95% CI 0.0%–0.6%). Secondary glaucoma accounted for 0.9% of the cases, with couching and neovascular process being the main causes (0.2% each). Prevalence of glaucoma increased significantly with increasing age (P for trend < 0.05).

Francis *et al*conducted a study to compare the clinical features of glaucoma patients who present at a rural hospital in North Eastern Ghana and an urban hospital in the capital city of Accra.[28] It was a multi-center retrospective case series involving analysis of records of newly diagnosed glaucoma patients with emphasis on primary open angle glaucoma (POAG). A total of 949 patients (1868 eyes) (437 rural; 512 urban) were included. Rural vs. urban comparisons, respectively: mean age, 53.2 ± 16.3 vs. 54.5 ± 16.4 years; male: female ratio, 3:2 vs. 1:1; POAG, 78.1% vs. 50.6%; POAG suspect, 10.3%vs. 41.9%; IOP, 39.2 ± 7.1 vs. 31.8 ± 7.3 mmHg; bilateral

blindness, 34.1% vs. 17.5%; uniocular blindness, 52.2% vs. 32.9%.Females at the rural hospital were twice as likely to present blind in at least one eye (OR 2.04, CI 1.36 - 3.07, p<0.001). Francis *et al* concluded that patients with POAG at the rural hospital present with more advanced disease characteristics**.**[28]

Study by Olawoye & Tarellasreported the types and severity of glaucoma at presentation in patients attending the glaucoma clinic of the University College Hospital, Ibadan, Nigeria.[29] The information was intended to help in designing an awareness and management strategy that would help in reducing glaucoma blindness. New glaucoma patients of all age groups who presented to the glaucoma clinic of the University College Hospital, Ibadan, over a 1-year period between January and December 2009 were consecutively recruited and evaluated. They established that a total of 336 patients (669 eyes) presented with glaucoma (mean age was 56.5 ± 16.5, males comprised 56.3%). The mean presenting IOP was 23 ± 11.6 mmHg and 48.5% of the 669 eyes evaluated had severe glaucoma (MD > -12dB, cup to disc ratio of =0.9). Primary open angle glaucoma (POAG) was the most common form (51.2%), there were 55 (16.4%) glaucoma suspects, 66 (19.6%) patients had normal tension glaucoma (NTG), 28 (8.3%) patients had primary angle closure glaucoma (PACG), and 15 (4.5%) patients had secondary glaucoma.

Gyasi*et al.* study addressed the prevalence and clinical presentation of patients with POAG in the greater Accra metropolitan area.[30]It was a retrospective case series of 455 patients (813 eyes) at the Emmanuel Eye Clinic. At presentation nearly 24% were blind in at least one eye. The average age was 56.7 ±16.7 years and the average IOP was 33.9 mmHg ± 12.7 mmHg for right eyes and 33.5 mmHg ±12.0 mmHg for left eyes. The mean vertical cup to disc ratio (vCDR) was 0.83 for right eyes versus 0.82 for left eyes. A total of 32 patients (53 eyes) were diagnosed with NTG p<0.01).

Mondaycarried out a study to determine the pattern of ocular findings among patients aged 40 years and above attending to eye clinic at Juba Teaching Hospital in South Sudan. He established that Glaucoma was the 4th commonest disease condition seen with an estimated

prevalence of 13.5% preceded by Ocular disease 36.9%, cataract 21.5% and refractive errors 20%.[31]

Light for the Worldaments that while the burden of glaucoma conditions in South Sudan is significantly high; eye care services to respond to these conditions are insufficient.[32] consequently, there is a need for research on glaucoma in South Sudan in all aspect.

These studies indicate that glaucoma in Africa tends to be of open angle type, begins at an earlier age, follows an aggressive cause that end in blindness. Lack of awareness especially among rural populations' means that most patients present late in the disease process when vision has been irreversibly lost in one or both eyes.

2.0 JUSTIFICATION

Most cases of glaucoma are asymptomatic and hence difficult to detect in the early stages. The condition of glaucoma where the intraocular pressure is higher than what the ocular tissues can tolerate is irreversible. However, interventions are available to halt or retard the natural progress of the disease to blindness. With early intervention having greater benefits than late

intervention, this study will be of great importance from the public health perspective. South Sudan is a newly independent country in Africa with poorly developed health infrastructure. More than 80% of the population are uneducated and live in rural area where health care facilities are inadequate. The exact magnitude of glaucoma in South Sudan is not known. Studies on the prevalence and pattern of glaucoma in the country have not yet been done. Thus, this study to determine the pattern of glaucoma in patients attending eye clinic at Juba Hospital Eye Department, would provide baseline information that could inform planning and provision of glaucoma services in the country

2.1 OBJECTIVES

2.1.1 Broad Objective

To determine the prevalence and pattern of glaucoma among patients attending the eye clinic at Juba Teaching Hospital, South Sudan.

2.1.2 Specific Objectives

1. To assess the pattern of glaucoma among patients attending the eye clinic.
2. To identify the causes of secondary glaucoma in this Population.
3. To document the currently available treatment of glaucoma patients.

3.0 MATERIAL AND METHODS

3.1 Study Design

This study was a hospital based, cross-sectional study conducted in the eye clinic at Juba Teaching Hospital, South Sudan.

3.2 Study Area

Figure 1: Map of South Sudan showing Juba County

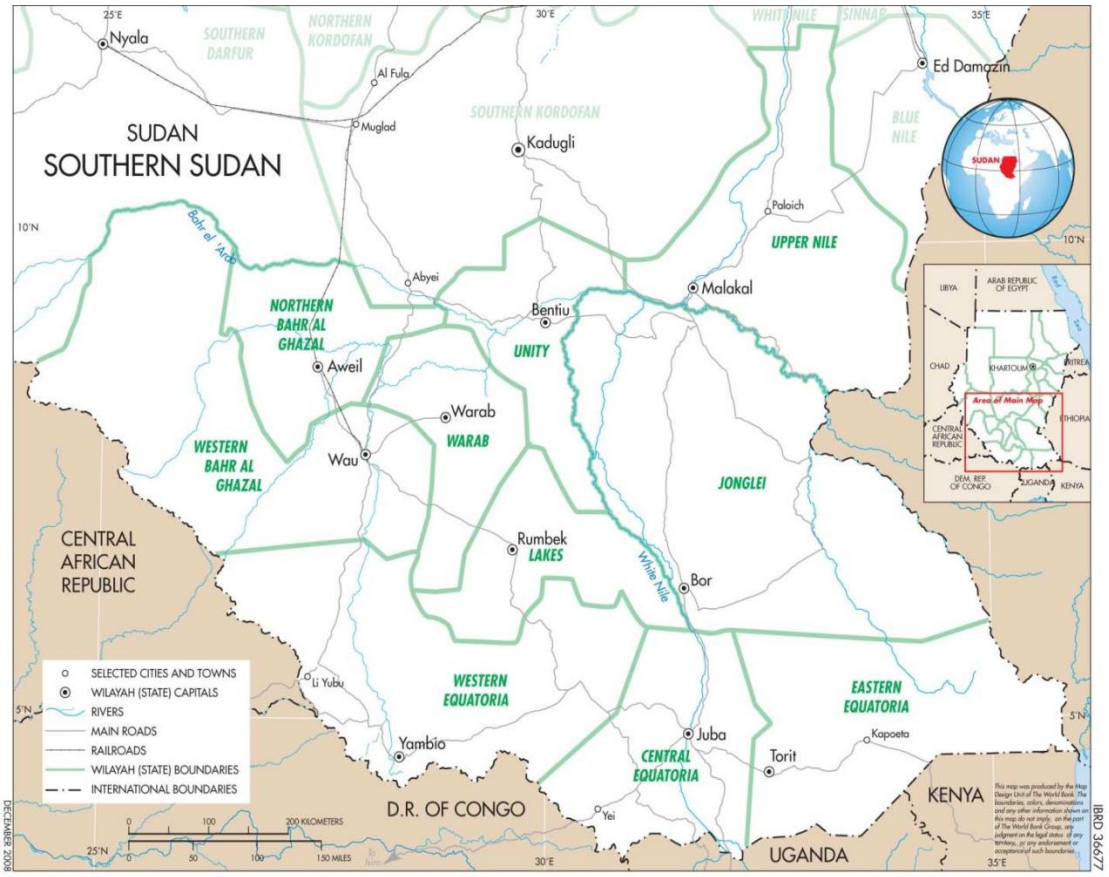


Figure 2: Location of Juba Teaching Hospital in Juba

The study was carried out at the eye clinic in Juba Teaching Hospital, South Sudan which serves as the teaching and referral center for eye disease. Juba Teaching Hospital is located in Juba the capital of South Sudan and State capital of Jubak State. It has a catchment area of about 150 km/s and population of 350,000.[33]The eye unit operates from Monday to Friday with the number of patient seen per day ranging from 30 to 40. Out of this 5 to 10 are glaucoma patients.

3.3 Study Population

Study population was composed of glaucoma patients 40 years and above attending the eye clinic in Juba Teaching Hospital during the period from 19th September to 19th October 2016.

3.4 Sample Size

The following sample size determination formula for finite population correctionwas used to estimate the size of the study sample.[34]

$$n^1 = \frac{NZ^2\mathrm{P}(1-P)}{d^2(N-1)+Z^2\mathrm{P}(1-P)}$$

Where

N' = sample size with finite population correction,

N = size of the target population = 110 (5 x 22 days) (estimated minimal number of glaucoma patients seen in the eye unit, Juba Teaching Hospital is approximately 5 patients per day according to the registry book in one month)

Z = statistic for 95% level of confidence

P = estimated proportion of patients with glaucoma – 7.3% [2]

d = margin of error = 2.1%

$$n^1 = \frac{110x1.96^2\mathrm{x}0.073\mathrm{x}0.927}{(0.021^2x110)+(1.96^2\mathrm{x}0.073\mathrm{x}0.927)}$$

n^1 = 92.7

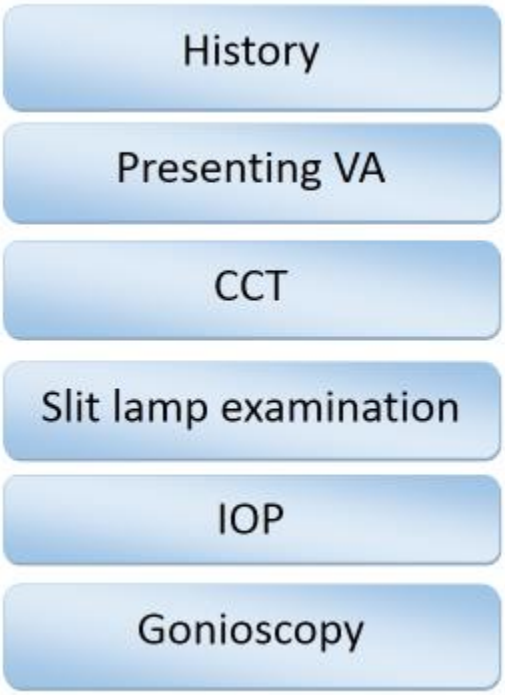
93 Patients (minimal sample size)

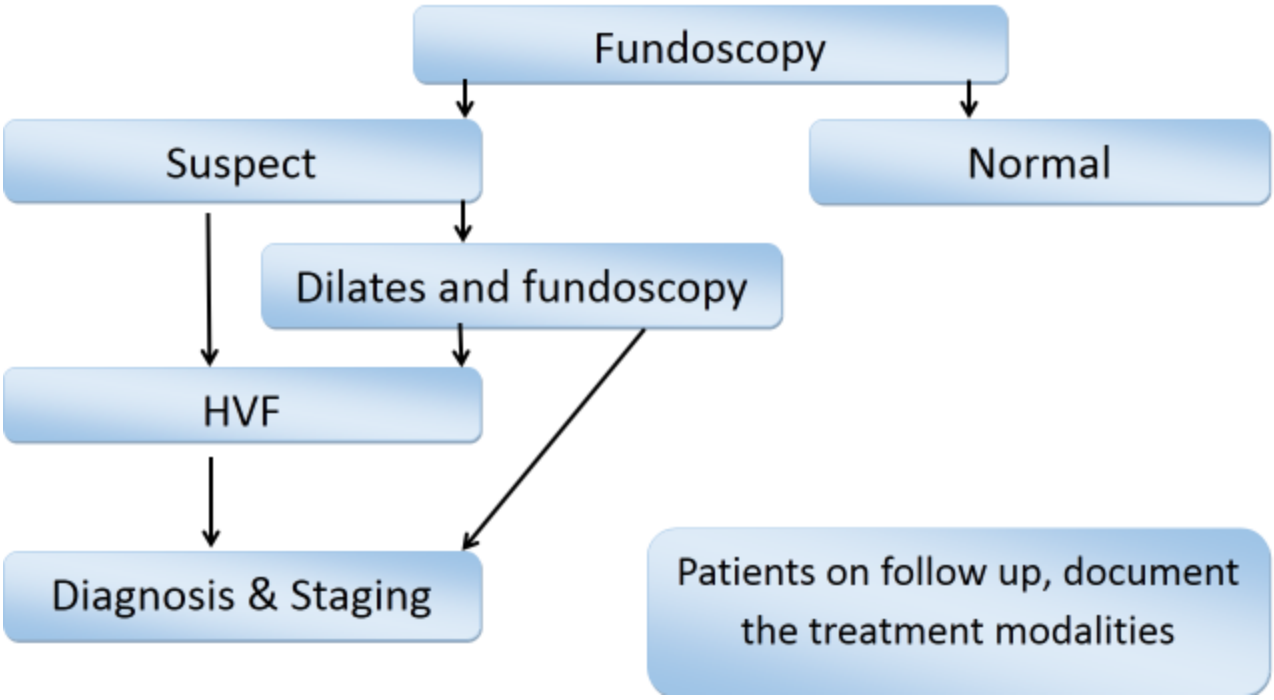
3.5 Inclusion and Exclusion Criteria

Inclusion criteria was all eyes of all glaucoma patients aged 40 years and above attending the eye clinic during the study period.Patients were considered to have glaucoma if the IOP measured with applanation tonometer was greater than 21mmHg and or there was evidence of glaucomatous optic neuropathy. The exclusion criteria include patients who were unable to give information e.g. cognitive impairment and subject who refuse to give consent as well as those with media opacities precluding examination of the fundus.

3.6 Data Collection Procedure

Figure 2: Examinations for Glaucoma Diagnosis





Personal information such as age sex ,area of residence, history of diabetes, hypertension, medical treatment of glaucoma, surgery for glaucoma in the past, family history of glaucoma (a family member taking treatment or diagnosed as suffering from glaucoma), ocular trauma, and use of steroid medication was collected through interview using closed questions. History of systemic disease e.g. Asthma, was self-reported, however, for those referred for detailed examination in hospital; histories was verified from the case records

Vision for each eye was tested with: Snellen's illiterate 'E' chart held at 6 m distance.

Central corneal thickness (CCT) was measured for all patients using parchymeter (Reichert iPac).

The anterior segment was examined with the slit lamp.

The eye was anesthetized using 0.5% tetracaine eye drops. Ocular pressure of each eye was measured using Goldman applanation tonometer mounted on the slit lamp.

Slit lamp bio-microscopy was used for Fundoscopy with a 78D or 90D Lens before dilatation , a depiction of the optic disc and surrounding area was drawn especially to study the cup: disc (C:

D ratio) in the vertical directions, arrangement of blood vessels, haemorrhage on and around the disc and any other abnormal signs were noted for each eye separately.

Patients were referred for Humphrey's visual field (HVF) test after the disc could be clearly seen, diagnosed and staged accordingly. Patients whose optic disc was not clearly seen were dilated using 1.0% tropicamide, 1 drop in each eye, and repeated after 20 minutes. Fundus was seen and patients were sent the next day for HVF. Patients that were done HVF test had the pattern of visual field loss diagnosed and staged while those who were not done were diagnosed and staged directly according to Foster *et al*., 2002.

Anyone using anti-glaucoma treatment or who was operated before due to glaucoma or had laser done before was recorded. Ifocular pressure was > 21 mmHg and/or the disc changes was suggestive of glaucoma, we considered the person having risk factors of glaucoma and labeled him/her as ocular hypertension.

Gonioscopy was performed using a Goldman three mirror contact lens: the angle of the anterior chamber was graded by the Shaffer system (see Appendix 7.2). The Shaffer system is the most popular grading system. It uses both angle width and angle structures to classify angle grade: this is confusing because sometimes width and structures may place an angle into different categories. In this grading system angles between 35 and 45 degrees are classified as grade 4, those between 20 and 35 as grade 3, those between 10 and 20 as grade 2 and those ≤10 as grade 1, with a closed angle classified as grade 0. Angle width is often preferred to angle depth in the description of Anterior Chamber Angle, because the latter may differ in different locations. Taking into consideration the angle structures, Shaffer classification's grade 4 comprises all structures, grade 3 the structures up to the sclera spur, grade 2 up to the trabecular meshwork, in grade 1 only the Schwab's line is visible and in grade 0 none of the angle structures are visible.

In a person with glaucoma and having angle grade 0, 1 or 2 in at least 2 quadrants, the eye was labeled as having angle closure glaucoma; if the eye had angle grade 3 or 4 in 2 quadrants it

was labeled as having open angle glaucoma. Pseudoexfoliative flakes on the lens or iris or in the angle of the anterior chamber were noted.

Based on the history, clinical examination and special investigations, the researcher concluded the glaucoma status of each eye. Each participant was classified as: ocular hypertension, glaucoma suspect and glaucoma, then the glaucoma patients was staged further

A senior ophthalmologist reviewed all available information on the participants and determined the glaucoma status of each person. Considering the fundus, intraocular pressure and visual field changes as recorded.

3.7 Diagnostic Classification

An angle was classified as occludable when at least 3 quadrants were graded Shaffer grade 1 or narrower. Primary angle closure glaucoma (PACG) was diagnosed if the eye has occludable angles, a cup-disc ratio of 0.65 or greater and a glaucomatous visual field (see Appendix 7.3 – 7.5).Primary open angle glaucoma (POAG) was diagnosed if the cup-to-disc ratio is 0.65 or greater with a glaucomatous visual field, non-occludable angles and an intraocular pressure greater than 21 mmHg. Normal tension glaucoma (NTG) was diagnosed if the criteria for POAG were fulfilled and the intraocular pressure is 21 mmHg or less. Ocular hypertension was diagnosed when the intraocular pressure (IOP) is greaterthan21 mmHg in the absence of disc and field criteria for glaucoma. Only Goldmann applanation tonometry readings was used for diagnostic classification.

3.8 Data Management and Analysis

The collected data was entered into the computer, cleaned, validated and coded using SPSS version 20. It was checked for any wrong entry and double entry and corrected. Back up was created in an external hard disk in case of damage and/or loss of original data and it was password protected. All data was stored under lock and key and with password protected files under the custody of the principal investigator to prevent any illicit access to the data. Use of coded data was done to ensure maximum confidentiality. At the end of the study, the raw data

was destroyed and deleted from any existing hard copies by paper shredding and formatting and deleting from any soft copy storage devices including computers, flash discs and hard disks.

The data was analyzed using *SPSS*, version 20, and parametric univariate analysis was carried out. Frequencies, rates with 95% confidence interval (CI), estimated numbers in population and adjusted prevalence was calculated. The association of risk factors with glaucoma was estimated by calculating relative risk with 95%CI and chi-squared values. We also conducted binary logistic regression analysis to identify the predictors of glaucoma. Presence of glaucoma was the dependent variable. Age, sex, regional group, history of diabetes, history of hypertension, family history of glaucoma as independent variables was inserted using the step-in method.

3.9 Ethical Considerations

3.9.1 Confidentiality

The identity of the patients was kept anonymous during data collection. No record of the identity of the patient or file number was made. No photocopies of medical records was made. The information of the patient was only available to the statistician and investigator for analysis only.

3.9.2 Approval by Ethics Committees

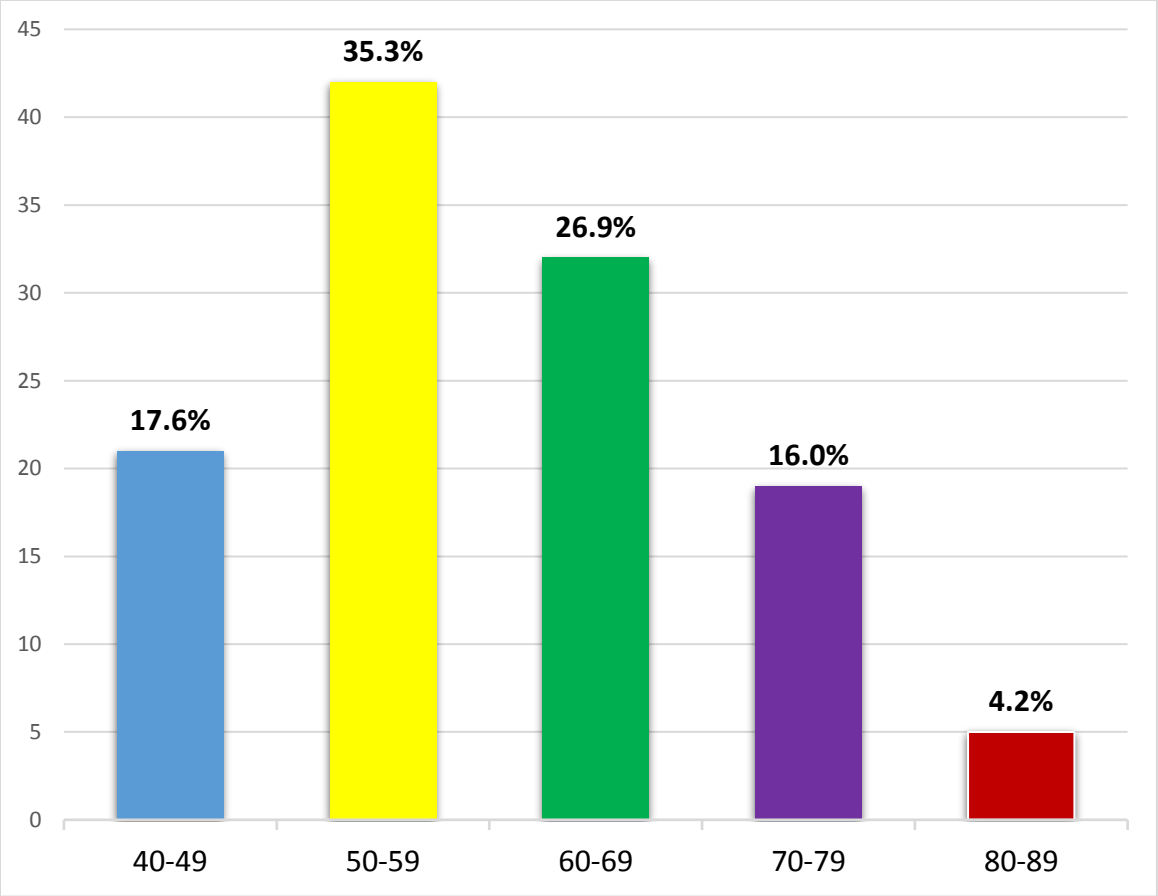
Written ethical approval to conduct the study was sought from the Ethics and Research Committee of University of Nairobi and Kenyatta National Hospital. Approval was also sought from Juba Teaching Hospital and Ministry of Health in South Sudan.

The consent information was translated into Arabic.

4.0 RESULTS

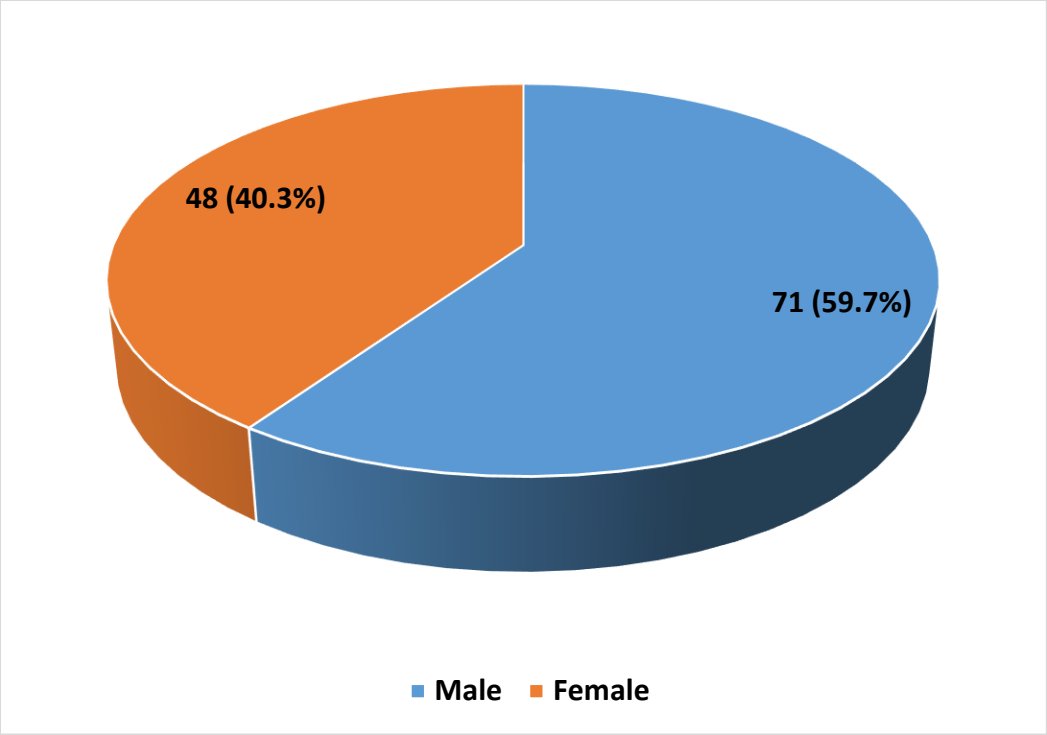
A total of 238 eyes of 119 patient fulfilled the inclusion criteria. Inclusion criteria was all glaucoma patients aged 40 years and above attending the eye clinic at Juba Teaching Hospital Both eyes underwent examination to establish if the patient has glaucoma, determine the type of glaucoma, identify the causes of secondary glaucoma, and document the current treatment of glaucoma patients in the study population.

Figure 3: Distribution by age of patients in the study population (n=119 patients)



The patient's age ranged from 40 years to 85 years with mean age 58.97 (median = 58.00) SD 10.785 years.

Figure 4: Distribution by Sex of patients in the study population (n=119 patients)



Males comprised of 59.7% and females 40.3% [Ratio = 1.48:1 (M: F), p=0.043] of the total study group

Figure 5: Risk factors associated with glaucoma (n=37 patients)

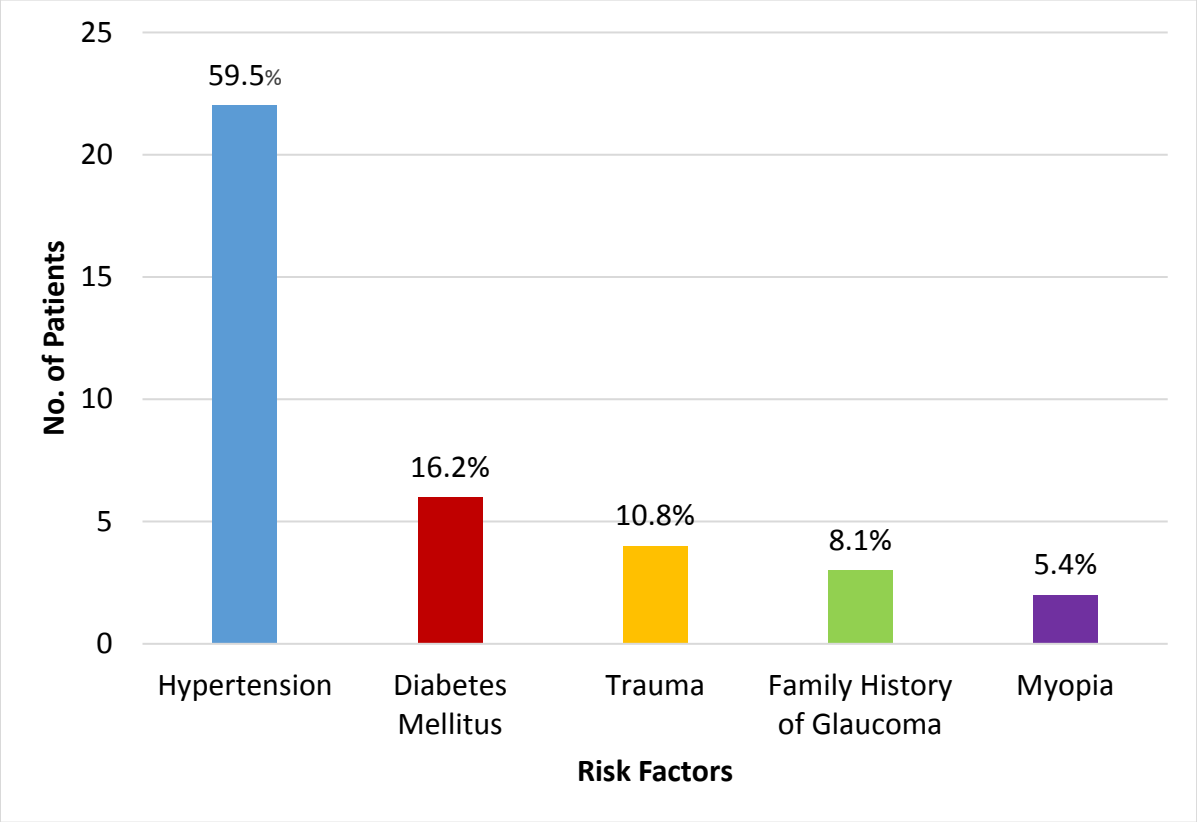
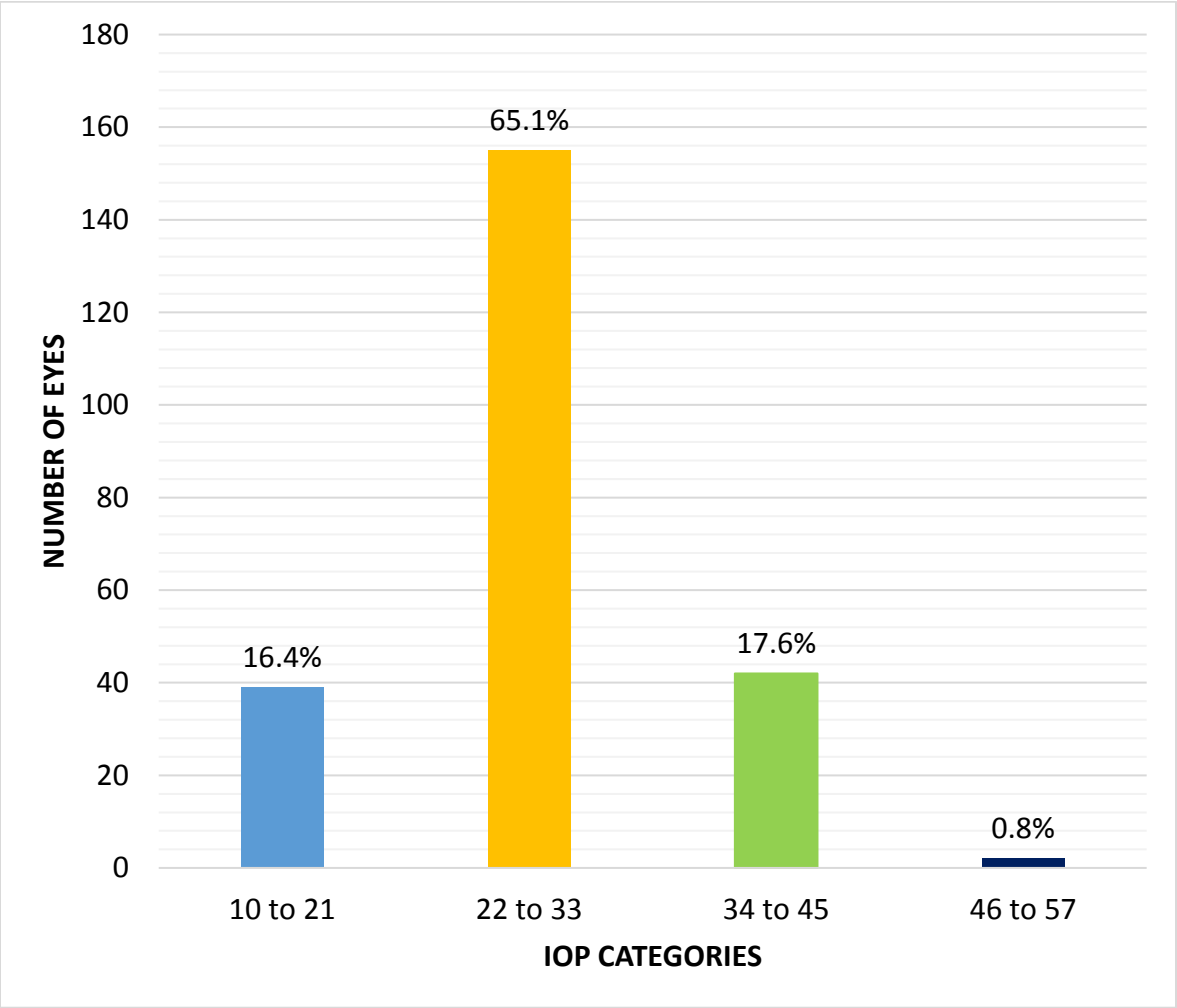


Table 1: Presenting VA of the better eye and the overall number of eyes in the study population

	Presenting VA of the better eye (n=119 patients)		**Overall number of eyes (n=238)**	
	Frequency no.	**Percentage %**	**Frequency no.**	**Percentage %**
Normal (6/6-6/18)	35	29.4	70	29.4
Visual Impairment (<6/18-6/60)	31	26.1	60	25.2
Severe Visual Impairment (<6/60-3/60)	21	17.6	21	8.8
Blind (<3/60)	32	26.9	87	36.6
Total	**119**	**100**	**238**	**100**

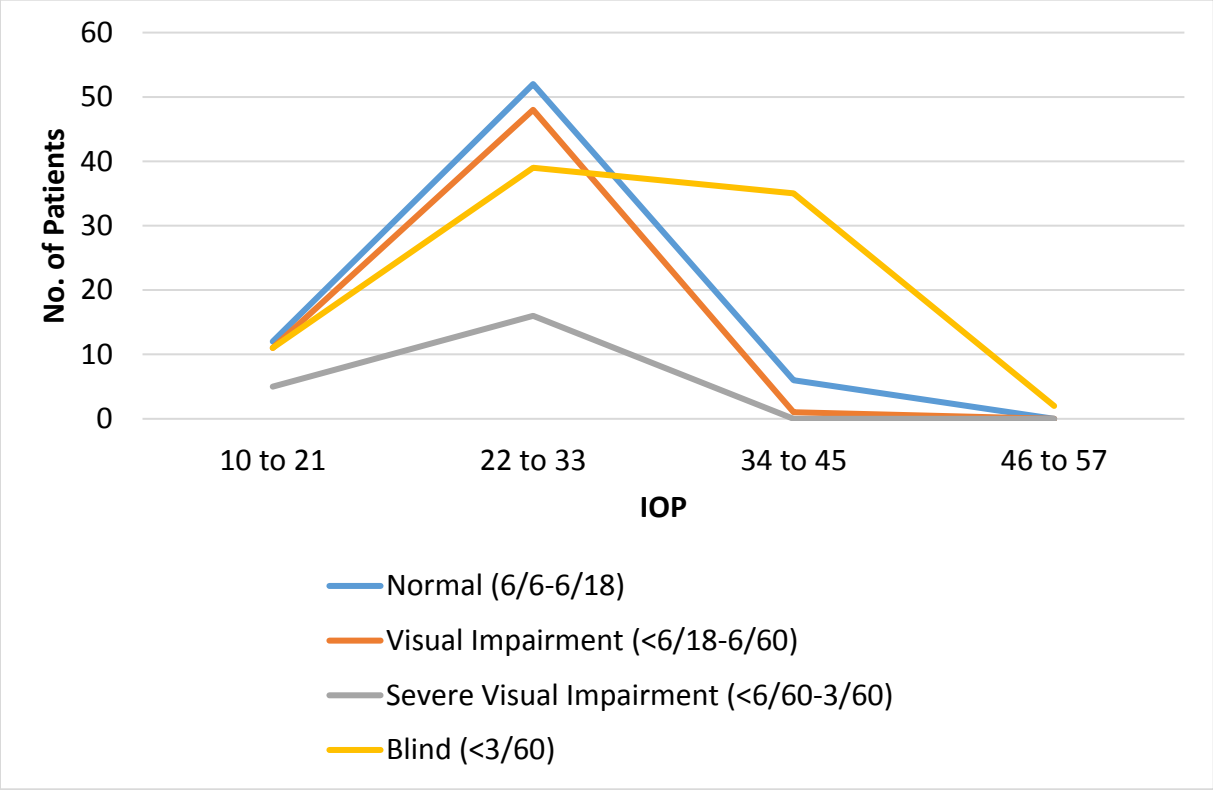
Figure 3: Presenting IOP for each eye in the study population (n=238 eyes)



The IOP's for eyes ranged from 12 mmHg to 52 mmHg with mean IOP 26.997 (median = 26.00)

SD 6.83 mmHg.

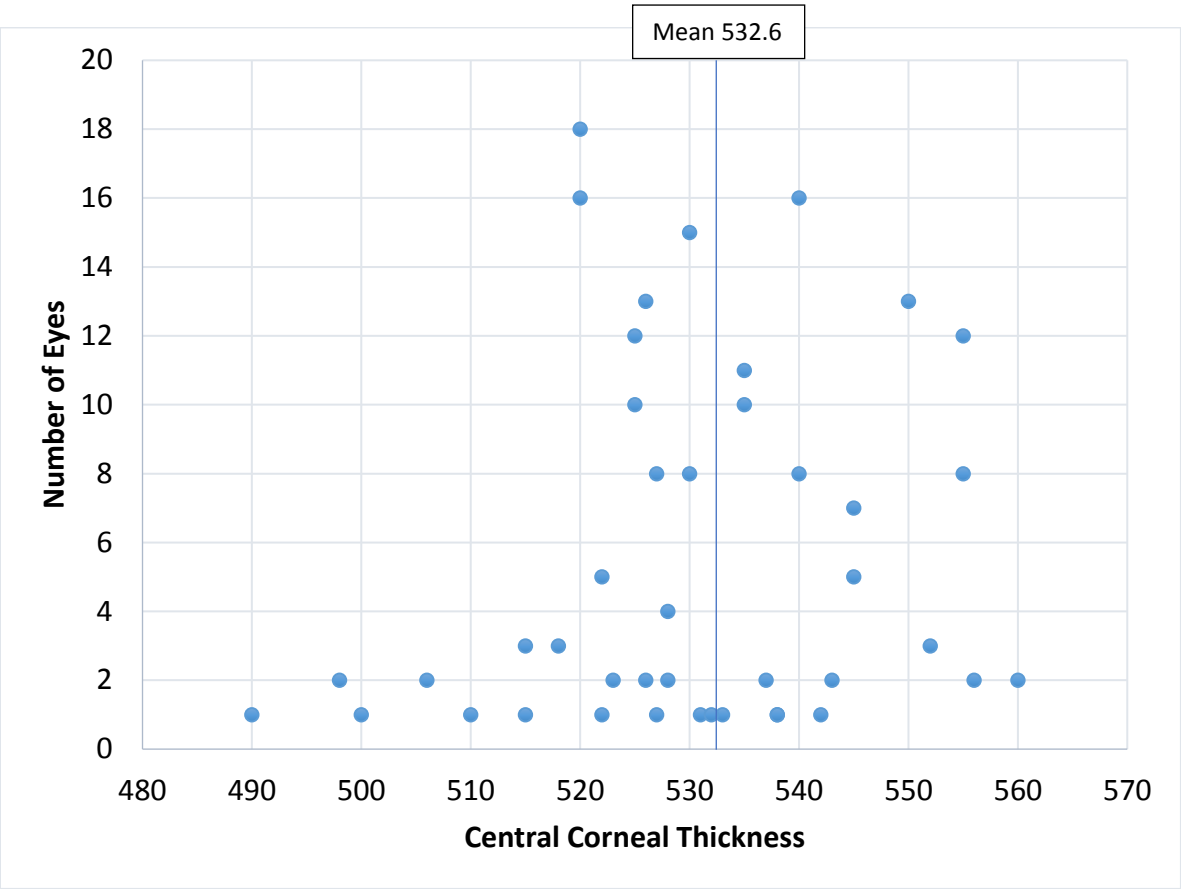
Figure 4: Visual Acuity vs. Intra Ocular Pressure (n=238)



P Value = 0.000

Figure 7 shows that most of the blind eyes had very high IOPs.

Figure 5: Central Corneal Thickness for Both Eyes (n = 238 eyes)



The CCT's ranged from 490 micro meters to 560 micro meters with mean CCT 532.64 (median = 530.00) SD 12.861 micro meters.

Table 2: Anterior segment examination findings of glaucoma patients (n=238 eyes)

Examination	Number of Eyes
Normal	87
Bleb	17
KPs	6
Microcystic Edema	3
Shallow anterior chamber	16
Peripheral Iridectomy	17
Rubiosis	3
Cortical + PSC	26
Cortical Cataract	39
Pseudophakic	29
Pseudoexpholiation	5

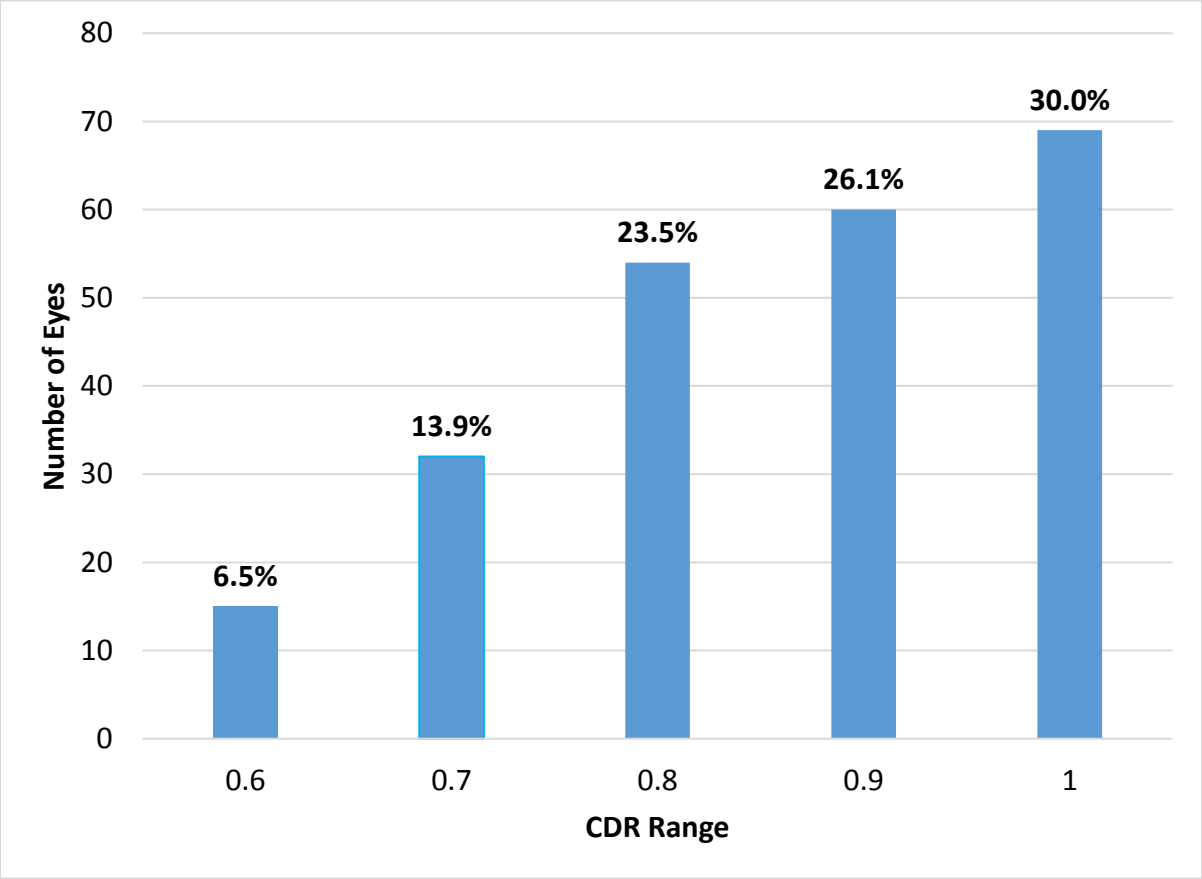
N is >238 because one eye can have more than one finding

Table 3: Gonioscopy of glaucoma patients (n=119 patients)

	Number of Patients	**Percent**
Open angle	112	96.6
Closed angle	7	3.4
Total	119	100

The majority of patients have open angle glaucoma.

Figure 6: Cup Disk Ratio range and distribution for glaucoma patients (n = 230 eyes)



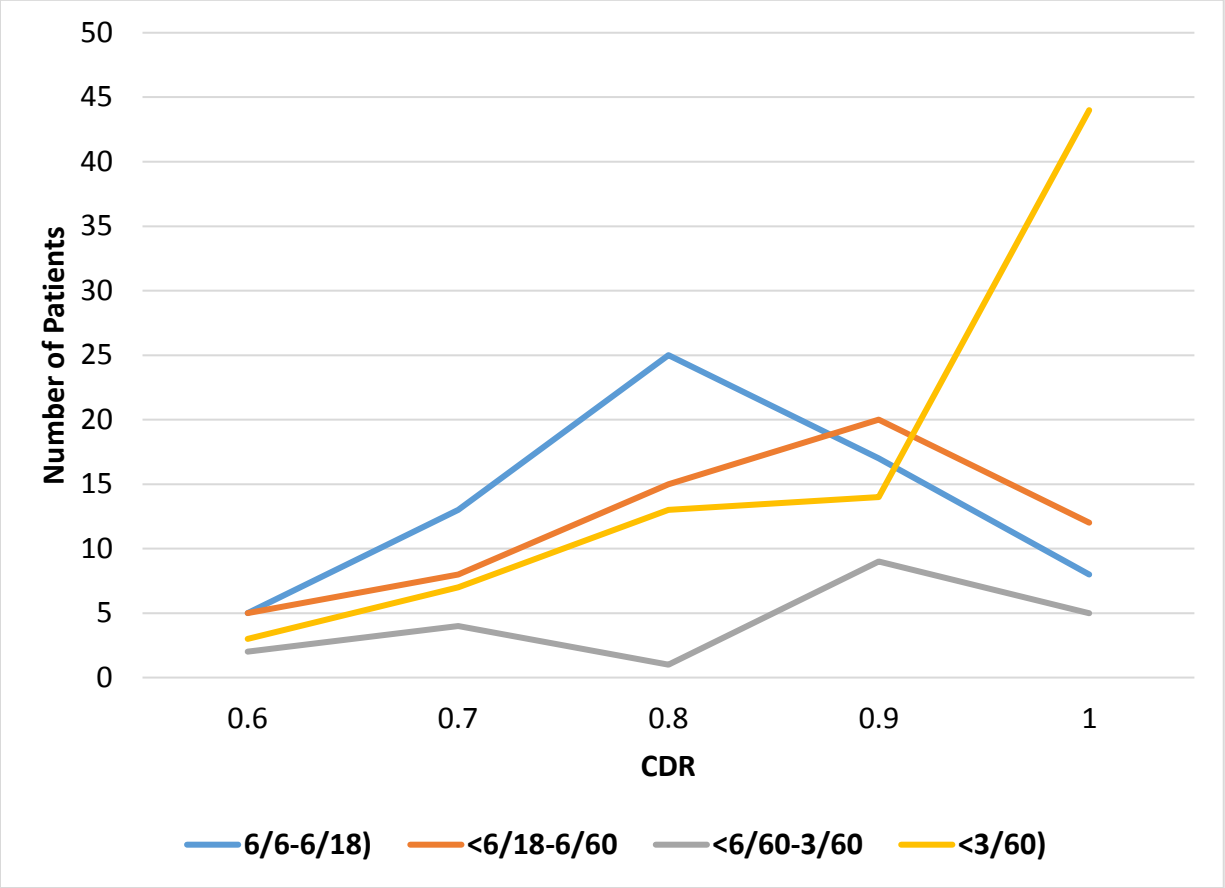
CDR = Cup Disc Ratio

The CDR on both eyes ranged from 0.6 to 1.

More than 50% of the eyes had advanced glaucomatous damage of a CDR >0.9.

Eight (8) eyes fundus could not be seen and this was due to media opacity.

Figure 7: **Cup Disk Ratio vs. Visual Acuity (n=230)**



Most of the blind eyes had advanced glaucomatous damage

Table 4: Humphrey Visual Field of glaucoma patients

Category	**Number of Eyes**	**Percentage %**	**Number of Patients**	**Percentage %**
Normal HVF	14	5.9	7	5.0
Abnormal HVF	48	18.8	30	26.1
Not Done	176	75.3	82	68.9
Total	**238**	**100**	**119**	**100**

The low number of eyes on HVF test indicates that majority of the eyes were not tested, this was due to the high cost for conducting the test and poor vision.

Table 5: Surgical Treatment of the eyes in the study population

Type of surgery	**Number of Eyes**	**Percentage %**	**Number of Patients**	**Percentage %**
Trabeculectomy	17	7.2	12	10.1
No Previous Glaucoma Surgery	221	92.8	107	89.9
Total	**238**	**100**	**119**	**100**

Only 12 patients (17 eyes) underwent trabeculectomy with remaining patients on medical treatment.

Table 6: Medical Treatment of glaucoma patients (n=119 patients)

Medications	**Number of Patients**	**Percentage %**
Beta-Blocker	94	81.5
Prostaglandin Analogue	2	1.7
No Medication	23	16.8
Total	119	100

Table 6 shows that majority of the patients were on Beta-Blocker (Timolol) this was due to availability and cost of the drug. No patients were on more than one medication.

Some patients were using oral CAI at some point and others were using PGA.

Those who were not on medication were using anti glaucoma before but had run out of medicines.

Table 7: Stage of glaucoma by using the cup disc ratio of each eye of the study population

	Number of Eyes n=238	**Percentage %**	**Number of Patients n=119**	**Percentage %**
Early (CDR <0.65)	11	4.6	1	.8
Moderate (CDR 0.7-0.85)	64	26.9	26	21.8
Advanced (CDR >0.9)	163	68.5	92	77.3

Table 7 shows that majority of the patients had advanced glaucoma, this was due to late presentation and lack of awareness about the disease.

Staging was done according to Allingham and Damji (2011).[52]

Table 8: The prevalence of different types of glaucoma in the study population

Diagnosis	Eye No. (%) N=238	Patient No. (%) N=119	Unilateral N=17	Bilateral N=102
Primary open angle glaucoma (POAG)	183 (82.8))	96 (80.7)	9 (9.4)	87 (90.6)
Primary angle closure glaucoma (PACG)	14 (6.3))	7 (5.9)	0 (0.0)	7 (100.0)
Normotensive glaucoma	10 (4.5)	6 (5.0)	2 (33.3)	4 (66.7)
Uveitic Glaucoma	6 (2.7)	4 (3.4)	2 (50.0)	2 (50.0)
Neovascular Glaucoma	3 (1.4)	3 (2.5)	3 (100.0)	0 (0.0)
Pseudoexpholiative Glaucoma	5 (2.3)	3 (2.5)	1 (33.3)	2 (66.7)
No Glaucoma	17	-	-	-

POAG most prevalent with the majority of patients being bilateral

5.0 DISCUSSION, CONCLUSION, RECOMMENDATIONS AND LIMITATION

5.1 Discussion

Our study determined the pattern of glaucoma in patients attending the eye clinic at Juba Teaching Hospital, South Sudan. Study population was composed of all glaucoma patients 40 years and above attending the eye clinic between 19th September and 19th October 2016. A minimum of 93 patients were targeted, and we managed to get a total of 119 patients. This study was important as it provides initial information on the pattern of glaucoma in South Sudan, a newly independent country in which information on this blinding disease is lacking.

To assess the pattern of glaucoma among patients attending the eye clinic.

This study has confirmed that a high proportion of patients attending the eye clinic at Juba Teaching hospital have glaucoma. Majority of the patients (83.0%) had open angle glaucoma and only 8.0% had angle closure glaucoma. This finding is in tandem with previous studies. A hospital-based survey of glaucoma patients in Ghana reported that the most common form of glaucoma was primary open-angle glaucoma seen in 44.2%.[28]

Our study established that most of the patients were between the ages of 50 to 59 (35.3%), while the least represented age category was the age group 80-85 (5 Patients) with only (4.2%). This finding suggests that glaucoma in South Sudan has an early onset. Previous studies in Africa share similar results.[2, 27]The age factor is further compounded by poor awareness and low knowledge about glaucoma even by persons affected by the condition. Thus, later presentation to the health care system is the most likely explanation for this variance.

Previous studies conducted in Tanzania and South Africa in populations aged 40 years and older found prevalence ranging from 4.2 - 5.3%.

On sex distribution, this study found out that males patients were significantly more than the females [M: F Ratio = 1.48:1 There is no clear evidence of gender predilection in glaucoma.[35]Vajaranant*et al*. explained that even though some studies report a higher incidence

of occludable chamber angles in women,several recent studies found no sex difference in theoccurrence of angle closure glaucoma.[35] However, our findings promulgates that men are more likely to seek care for any condition including glaucoma than women. Lack of access to health care could influence this discrepancy. Women in South Sudan have less access to health care, and less likely to be diagnosed and seek treatment for glaucoma. This observation is consistent with previous studiesshowing lower treatment rates in ocular diseases for women.[36,37]

In this study only 28% of patients reported to have a family history associated with glaucoma or its risk factors. Previous studiesreveal that the contribution of genetics in glaucomariskpredictionhasusuallybeenlimited to knowledge of family history.[38] Patients were likely to be unaware of family members who have been diagnosed with glaucoma or had risk factors. That in our study, 72% of the patients did not have a family historyassociated with glaucoma or its risk factors adds to the unreliability of this variable. Previous studies found that family history carry a tenfold relative risk for being diagnosed with glaucoma.[39, 40] The relative importance of family history may vary according to the closeness of relationship of a patient to an affected family member.

Our findings highlight systemic diseases that have come to define susceptibility to glaucoma in the region: hypertension, diabetes mellitus, trauma, glaucoma, and myopia. Systemic hypertension has been proposed as potential risk factors for glaucoma in clinic-based studies. This possibly is due to the fact that hypertension has a propensity to reduce blood flow to the optic nerve head resulting in ischemia.[41, 42, 43]It appears that diabetes may increase the risk of glaucoma, especially as hyperglycemia results in heightened sensitivity to IOP and risk of neuronal injury. Myopia has been found to be a significant risk factor for glaucoma.[44, 45, 46] However, the association between family history and glaucoma remains controversial.

Our results suggest a predominance of POAG followed by PACG, NTG, uveitic glaucoma, pseudoexpholiative glaucoma, and neovascular glaucoma, respectively. Uveitic glaucoma, pseudoexpholiative glaucoma, and neovascular glaucoma were classified as secondary

glaucoma with the prevalence of 6.4%. Studies conducted in Africa found that exfoliative glaucoma was responsible for 16% of all glaucoma in Tembaand 21.6% of all glaucoma in Hlabisa in South Africa.[18,47]Our results are also similar to many Western based studies that report POAG as far more common than PACG worldwide.[48] However, population based studies from Asia and the Far East, specifically from countries with high population size such as China and India report that closed angle is more prevalent than open angle glaucoma.[46]

In general, primary glaucoma is believed to be a bilateral disease. Although the condition may present unilaterally initially, it is expected that the other eye will eventually be affected as the disease advances. This study demonstrates that majority of glaucoma patients show a greater tendency to bilateral eye involvement. POAG and PACG were shown to be associated with bilateral involvement. Moreover majority of the patients had advanced glaucoma, this was due to late presentation and lack of awareness about the disease.

To identify the causes of secondary glaucoma in this Population

Our study further found that causes of secondary glaucoma include: uveitis (3.6%), neovascularisation (2.7%), and pseudoexfoliation (2.7%). However, different studiescarried out to determine the causes of secondary glaucoma depict different percentages of different causes depending upon the environments in which these studies are carried out and variation with different groups of patients.[51]

To document the current treatment of glaucoma patients

The majority of patients in this study who were on medical treatment were using beta-blocker (81.5%) with only a few patients using prostaglandins (1.7%). Even though the prostaglandin agents are consistently superior to beta-blocker in terms of their pressure lowering ability, majority of the patients in South Sudan are treated with beta-blocker and this is mainly due to availability and cost of the drugs. In addition, our study established that considerable number of patients were not on medication (16.8%). The reason for no medication among patients was

due to the fact that most of the patients could not afford medication and it may also not be available in the market, and as a result they stopped using it at some point. This underpins the argument that socioeconomic status is likely to influence compliance to treatment for glaucoma.

5.2 Conclusion

1. Most of the patients were between the ages of 50 to 59 (35.3%), and males patients were slightly more than the females. Lack of access by women to health care could influence this discrepancy.
2. Primary open angle glaucoma was found to be the most common type of glaucoma with the majority of patients being bilateral.
3. Hypertension, diabetes mellitus, trauma, glaucoma, and myopia were found to be the major risk factors but family history was not.
4. Majority of patients in this study presented to hospital because of symptoms of poor vision, with many already blind in at least one eye (26.9%).
5. Majority of patients on medical treatment were using beta-blocker (81.5%).

5.3 Recommendations

1. To improve awareness and increase knowledge about glaucoma especially among persons affected by the condition. This can be done through the media, organizing workshops and seminars, and improve ways of disseminating information about the disease.
2. Training of eye health workers in glaucoma detection and glaucoma specialists to deliver surgical treatment.
3. Policy makers can come up with strategies which promote earlier detection that may promote greater acceptance and adherence to glaucoma treatment.

5.4 Limitation

- This study was a hospital baseline study, therefore cannot be generalized to the whole population in the country

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7.0 APPENDICES

Appendix I: Staging for Glaucomatous Damage

STAGE	CDR	IOP	HVF
Suspect (One of the following in at least one eye)	• A suspicious disc • CDR asymmetry of > 0.2	An elevated IOP greater than 21 mm Hg.	A visual field abnormality consistent with glaucoma
Early	Early glaucomatous damage (<0.65)		and /or mild VF defect not within 10° of fixation (MD better than –6 dB on HVF 24-2)
Moderate	Vertical CDR 0.7–0.85		and (or) VF defect within 10° of fixation (MD -6 to –12 dB on HVF 24-2)
Advanced	Advanced glaucomatous disc features C/D >0.9		and (or) VF defect within 10° of fixation (e.g. MD worse than –12 dB on HVF 24-2^{S})

Source: Allingham and Damji, 2011.[52]

Appendix II: Shaffer Grading System for Anterior Chamber Angle

Classification	Findings	Angle Width (Deg.)
Grade 4	Ciliary body is visible	35-45
Grade 3	Scleral spur is visible	20-35
Grade 2	Only Trabecular meshwork is visible	20
Grade1	Only Schwalbe's line is visible	<10
Grade 0	Angle is closed	0

Source: Campa et al., 2011.[53]

Appendix III: Classification of Primary Angle Closure

Classification of primary angle closure (PAC)
(1) Primary angle closure suspect An eye in which appositional contact between the peripheral iris and posterior trabecular meshwork is considered possible [a] (see footnote)
(2) Primary angle closure (PAC) An eye with an occludable drainage angle and features indicating that trabecular obstruction by the peripheral iris has occurred, such as peripheral anterior synechiae, elevated intraocular pressure, iris whorling (distortion of the radially oriented iris fibres), "glaucomfleken" lens opacities, or excessive pigment deposition on the trabecular surface. The optic disc does not have glaucomatous damage.
(3) Primary angle closure glaucoma (PACG) PAC together with evidence of glaucoma, as defined above.
[a]In epidemiological research this has most often been defined as an angle in which ≥ 270^0 of the posterior trabecular meshwork (the part which is often pigmented) cannot be seen. This definition is arbitrary and its evaluation in longitudinal study is an important priority. Producing a more evidence based definition of this parameter is a major research priority.

Source: Foster et al., 2002.[48]

Appendix IV: Criteria for Classification as Glaucoma Suspect

Criteria for classification as glaucoma suspect
Disc suspects. Those who met category 1 (but not category 2) disc criteria, but were not proved to have definite field defects. Field suspects. Those with definite field defects, but not meeting category 1 disc criteria. Those with optic disc margin haemorrhages. Those with an IOP ≥ 97.5th percentile. Those with an occludable drainage angle, but normal optic disc, visual field, intraocular pressure, and no peripheral anterior synechiae.

Source: Foster et al., 2002.[48]

Appendix V: Diagnosis of Glaucoma in Cross-Sectional Prevalence Survey

The diagnosis of glaucoma in cross sectional prevalence surveys (The diagnosis is made according to three levels of evidence)
Category 1 diagnosis (structural and functional evidence) Eye with a CDR or CDR asymmetry ≥ 97.5th percentile for the normal population, or a neuro retinal rim width reduced to ≤ 0.1 CDR (between 11 to 1 o'clock or 5 to 7 o'clock) that also showed a definite visual field defect consistent with glaucoma
Category 2 diagnosis (advanced structural damage with unproved field loss) If the subject could not satisfactorily complete visual field testing but had a CDR or CDR asymmetry ≥ 97.5th percentile for the normal population, glaucoma was diagnosed solely on the structural evidence. In diagnosis category 1 and 2 glaucoma, there should be no alternative explanation for CDR findings (dysplastic disc or marked anisometropia) or the visual field defect (retinal vascular disease, macular degeneration, or cerebrovascular diseases).
Category 3 diagnosis (Optic disc not seen**,** Field test impossible) If it is not possible to examine the optic disc, glaucoma is diagnosed if: (A) The visual acuity < 3/60 and the IOP > 99.5th percentile, or (B) The visual acuity < 3/60 and the eye shows evidence glaucoma filtering surgery, or medical records were available confirming glaucomatous visual morbidity.

Source: Foster et al., 2002.[48]

Appendix VI: Diagnosis of Glaucoma in Cross-Sectional Prevalence Survey

Introduction

My name is Dr.Patrick Mayan Paul. I am a post graduate student in the department of ophthalmology at the University of Nairobi.

I am conducting a study on: Prevalence and partten of glaucoma in patients attending the eye clinic in Juba Teaching Hospital South Sudan .

Purpose of the study

To assess the patterns of glaucoma among patients attending the eye clinic, to establish the risk factors associated with glaucoma in these population; and to document the treatment modality of glaucoma in these population.

Basis of participation

Your participation will be purely voluntary.You are free to withdraw at any time during the course of the study period.Your refusal to participate or withdrawal at any time during the study period will not in any way affect the quality of your treatment.

Confidentiality

All information obtained in the study will be treated with utmost confidentiality.

I shall NOT use your name in any of my reports.

Benefits

The results of this study may be published in a medical book or journal or for teaching purposes and will be given to the community for better understanding of this topic. You will be given a copy of your visual field result for your medical records.

Risks and discomfort

The examination process and central corneal thickness (CCT), Humphrey's visual field (HVF) are none invasive, and no pain will be experienced. Some of the questions asked may be personal but privacy and confidentiality will be assured at all time.

Request for information

You may ask more questions about the study at any time or at this moment.You will be informed of any significant findings discovered during or after the study.

Request for information

You may ask more questions about the study at any time or at this moment.You will be informed of any significant findings discovered during or after the study.

You may contact Dr. Patrick Mayan Paul on 0704349445 or Dr. Sheila Marco (UON department of ophthalmology) or Prof Dunera Ilako (UON department of Ophthalmology) or KNH/UoN Ethical Review Committee Secretariat P.O Box 20723-00202 Nairobi, telephone number. +2542726300 Ext 44102 and email address uonknh_erc@uonbi.ac.ke.

Consent

Having read this consent form, all my questions have been answered, my signature below indicates my willingness to participate in this study and my authorization to use and share with others.

I……..the(Patient/Guardian)

of……after reading and having the study purpose explained to me by

Dr.Patrick Mayan ,do hereby give informed consent to participate in the study: **Prevalence and pattern of glaucoma in patients attending eye clinic in Juba teaching hospital .South Sudan** .

Signed……. Date…….

Thumb Print……. Date……..

I confirm that I have explained to the patient the above statement.

Signature of questionnaire Investigator (Dr.Patrick Mayan Paul)…….

Dr. Patrick Mayan Paul

Phone No. +254 704 349 445 / +211 955 996 633

Appendix VII: Assent Form

Introduction

My name isDr.Patrick Mayan Paul. I am a post graduate student in the department of ophthalmology at the University of Nairobi.

I am conducting a study on: **Prevalence and pattern of glaucoma in patients attending eye clinic in Juba teaching hospital .South Sudan** . .

Purpose of the study

To assess the patterns of glaucoma among patients attending the eye clinic, toestablish the risk factors associated with glaucoma in these population; and to document the treatment modality of glaucoma in these population.

Basis of participation

Your participation will be purely voluntary.You are free to withdraw at any time during the course of the study period.Your refusal to participate or withdrawal at any time during the study period will not in any way affect the quality of your treatment.

Confidentiality

All information obtained in the study will be treated with utmost confidentiality.

I shall NOT use your name in any of my reports.

Benefits

The results of this study may be published in a medical book or journal or for teaching purposes and will be given to the community for better understanding of this topic. You will be given a copy of your visual field result for your medical records.

Risks and discomfort

The examination process and central corneal thickness (CCT), Humphrey's visual field (HVF) are none invasive, and no pain will be experienced. Some of the questions asked may be personal but privacy and confidentiality will be assured at all time.

Request for information

You may ask more questions about the study at any time or at this moment.You will be informed of any significant findings discovered during or after the study.

Voluntary Participation

You do not have to be in the study if you do not want to be in it. After we begin the study and you do not want to take part in it any further it is fine. We have informed you or your parents/guardian about the study.

If you agree to take part in the study, please sign your name.

Name of the Participant_____ Date_____

Sign your name _____

Thumb Print……. Date……..

I confirm that I have explained the details of the research to the participant.

Researcher's Name _____ Date_____

Signature of Researcher_____

Principal Investigator

Dr. Patrick Mayan Paul

Phone No. +254 704 349 445 / +211 955 996 633

Appendix VIII: Assent Form in Arabic

الاقرار:

المقدمة:
باتريك ميان بول طالب دراسات عليا كليه الطب والعلوم الصحيه جامعه نيروبي قسم العيون أقوم بعمل دراسة /انا دكتور
بعنوان مدي انتشار ونوع ارتفاع ضغط العين بين المرضى الذين يحضرون لعيادة العيون بمستشفى جوبا التعليمي

الهدف من الدراسة:
معرفة نوع ارتفاع ضغط العين ، معرفةالاسس والعوامل المشتركة بين مرضى ارتفاع ضغط العين ، وتدوين الطرق المتبعة
لعلاج ارتفاع ضغط العين بين هؤلاء المرضى

أسس المشاركة :
مشاركتك في الدراسة تكون طوعاً ولَك الحق في الانسحاب في اي لحظة، رفضك او انسحابك عن الدراسة في اي وقت لا يؤثر
باي شكل
من الأشكال في علاجك

السرية:
كل المعلومات الماخوذه للدراسة ستؤخذ وتحفظ في سريه تامة ولا نستخدم الأسماء في اي من النتائج

الفوائد:
نتائج هذه الدراسة قد تنشر في الكتب او المجلات الطبيه او لأغراض
التدريس وستعطى للمجتمع من اجل فهم افضل لارتفاع ضغط العين

المخاطر:
الكشف السريري ،قياس سمك القرنيه وقياس مجال البصر غير مؤلمة
بعض الأسئلة قد تكون خاصة لكن الخصوصية والسرية ستكون محفوظة دائما

طلب المعلومات:
يمكن ان تسئل عدة مرات خلال مراحل الدراسة وسنعطيك كل النتائج خلال وبعد الدراسة

المشاركة الطوعية:
ليس الزاماً عليك ان تكون في الدراسة اذا لم تريد ولَك الحق ان تنسحب في اي مرحلة من مراحل الدراسة

اذا أردت المشاركة في الدراسة عليك كتابة اسمك والتوقيع

اسم المشترك.....
التاريخ.....
البصمة /التوقيع .....

اؤكد انني قد شرحت كل تفاصيل الدراسة للمشترك

اسم الباحث.....
التاريخ.....
التوق.....

Appendix IX: Questionnaire

1. Demographics:

Patient Code No: ☐

Home state:…….

Age:…….

Sex:

Male: ☐ Female: ☐

Occupation: _____

Residence: _____

2. HISTORY:

A) Family history B) DM ☐

C) Myopia ☐ D) Hypertension ☐

E) Trauma ☐ F) Others……..

3. Examination:

Presented V/A

RE:……. LE: ……

4. Current ophthalmic status:

1. Central Corneal Thickness (CCT)

RE:…… LE: …….

2. IOP

RE:…… LE: ……..

3. Anterior segment examination

RE:

A) Conjunctiva B) Cornea

C) A/C D) Iris

E) Lens

LE:

A) Conjunctiva B) Cornea

C) A/C D) Iris

E) Lens

4. Gonioscopy

RE:

A) Open Angle: ☐ B) Close angle: ……..

LE:

A) Open Angle: ☐ B) Close angle: ……..

5. Fundoscopy

RE:

A) Normal ☐ B) CDR……

C) Can't be seen ☐

LE:

A) Normal ☐ B) CDR……

C) Can't be seen ☐

6. HVF

RE:

A) Normal VF: ☐ B) Abnormal VF……

LE: A) Normal VF: ☐ B) Abnormal VF……

7. Medical treatment:

RE:A) Beta-Blocker ☐ B) PGA ☐

C) Alph-2 Agonist ☐ D) CAI (Topical) ☐

E) CAI (Oral) ☐ F) other (specify) ……

G) Total number of medications……..

LE: A) Beta-Blocker ☐ B) PGA ☐

C) Alph-2 Agonist ☐ D) CAI (Topical) ☐

E) CAI (Oral) ☐ F) other (specify) ……

G) Total number of medications……..

8. Surgical Treatment:

RE: A) Laser therapy …… B) Trabeculectomy ☐

C) CPC ☐ D) Others……..

LE: A) Laser therapy …… B) Trabeculectomy ☐

C) CPC ☐ D) Others…….

9. Status of the eye:

RE: A) Normal ☐ B) Ocular hypertension ☐

C) Glaucoma suspect ☐ D) Glaucoma ☐

LE:A) Normal ☐ B) Ocular hypertension ☐

C) Glaucoma suspect ☐ D) Glaucoma ☐

10. Stage of the eye:

RE: A) Early ☐ B) Moderate ☐ C) Advanced ☐

LE:A) Early ☐ B) Moderate ☐ C) Advanced ☐

Appendix X: Budget

Appendix X: Budget Dr.Patrick Mayan Paul

Prevalence and pattern of glaucoma in patients attending eye clinic in juba teaching hospital

Minimal sample size is 93 patients

Item	Quantity	Unit cost (Kshs)	Total kshs
Proposal			
Printing and Packing	35 pages	10	350
Photocopy of Proposal	70 pages	3	210
Binding Proposal	3 copies	120	360
Proposal Printing 2nd draft	30 pages	10	300
Photocopy of proposal 2nd draft	90 pages	3	270
Binding of proposal 2nd draft	4 copies	120	480
Ethics			2,000
Sub-total			**3,970**
Contracted services			
Statistician Research assistants	1 2	50,000 7,500	50,000 15,000
Sub-totals			**65,000**
Data Retrieval			
JTH (Eye clinic Records & Registry)	All Glaucoma Files		5,000
Sub-total			**5,000**
Data Collection			
Printing of questionnaire	4pages	10	40
Photocopy of questionnaire	4 * 150	3	1,800

Subtotal			**1,840**
Transport / Communications and HVF			
Tickets (Nairobi – Juba - Nairobi)			60,000
Telephones calls			5,000
Transport to the hospital +Lunch			30,000
HVF	40	2,500	100,000
Subtotal			**195,000**
Results			
Printing of results (black & white)	3*70 pages	10	2,100
Printing of results (color)	3*20 pages	20	1,200
Black and white	70*8 copies	3	1,680
Color copies	20*8 copies	20	3,200
Binding of final paper	8 copies	200	1,600
Subtotal			**12,220**
Grand total			**282,990**

Approved by: DR NJUGUNA MW

Signed: .....

Date: 01/08/2016

Appendix XI: KNH-UON ERC Approval Letter

UNIVERSITY OF NAIROBI
COLLEGE OF HEALTH SCIENCES
P O BOX 19676 Code 00202
Telegrams: varsity
Tel:(254-020) 2726300 Ext 44355

KENYATTA NATIONAL HOSPITAL APPROVED 29 JUN 2016 KNH/UoN-ERC P.O. Box 20723-00202 NBI

KNH-UON ERC
Email: uonknh_erc@uonbi.ac.ke
Website: http://www.erc.uonbi.ac.ke
Facebook: https://www.facebook.com/uonknh.erc
Twitter: @UONKNH_ERC https://twitter.com/UONKNH_ERC

KENYATTA NATIONAL HOSPITAL
P O BOX 20723 Code 00202
Tel: 726300-9
Fax: 725272
Telegrams: MEDSUP, Nairobi

Ref: KNH-ERC/A/236

29th June, 2016

Dr. Patrick Mayan Paul
Reg. No.H58/69057/13
Dept. of Ophthalmology
School of Medicine
College of Health Sciences
University of Nairobi

Dear Dr. Mayan

REVISED RESEARCH PROPOSAL: "PREVALENCE AND PATTERN OF GLAUCOMA IN PATIENTS ATTENDING EYE CLINIC IN JUBA TEACHING HOSPITAL, SOUTH SUDAN" (P400/05/2016)

This is to inform you that the KNH- UoN Ethics & Research Committee (KNH-UoN ERC) has reviewed and **approved** your above proposal. The approval period is from 29th June 2016 – 28th June 2017.

This approval is subject to compliance with the following requirements:

a) Only approved documents (informed consents, study instruments, advertising materials etc) will be used.
b) All changes (amendments, deviations, violations etc) are submitted for review and approval by KNH-UoN ERC before implementation.
c) Death and life threatening problems and serious adverse events (SAEs) or unexpected adverse events whether related or unrelated to the study must be reported to the KNH-UoN ERC within 72 hours of notification.
d) Any changes, anticipated or otherwise that may increase the risks or affect safety or welfare of study participants and others or affect the integrity of the research must be reported to KNH- UoN ERC within 72 hours.
e) Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. (*Attach a comprehensive progress report to support the renewal*).
f) Clearance for export of biological specimens must be obtained from KNH- UoN ERC for each batch of shipment.
g) Submission of an *executive summary* report within 90 days upon completion of the study. This information will form part of the data base that will be consulted in future when processing related research studies so as to minimize chances of study duplication and/ or plagiarism.

For more details consult the KNH- UoN ERC website **http://www.erc.uonbi.ac.ke**

Protect to Discover

Yours sincerely,

PROF M.L. CHINDIA
SECRETARY, KNH-UoN ERC

c.c. The Principal, College of Health Sciences, UoN
The Deputy Director, CS, KNH
The Assistant Director, Health Information, KNH
The Chair, KNH- UoN ERC
The Dean, School of Medicine,UoN
The Chair, Dept. of Ophthalmology, UoN
Supervisors: Dr. Sheila Marco, Prof. Dunera Ilako, Dr. Wani Mena

Appendix XII: Permission Letter from JTH

GOSS

MINISTRY OF HEALTH

Head of Department of Ophthalmology **20th October, 2016**
University of Nairobi
Faculty of medicine
Dear Prof.Karimurio

REF.DR.PATRICK MAYEN PAUL (MMED STUDENT)

The above named is an MMED (Ophth) student at your department who came to Juba Teaching Hospital where by we gave him go ahead to collect data for his dissertation by the title **(PREVALENCE AND PATTERN OF GLAUCOMA IN PATIENTS ATTENDING EYE CLINIC IN JUBA TEACHING HOPSITAL)** From 19/9/2016 to 20th /10/2017

The Juba Teaching Hospital Eye Unit Department and the Juba Teaching Hospital administration were very grateful for such study to be conducted in our setup, the outcome of such study will help us in planning and mobilizing fund to develop our centre into centre of excellence. We will be happy to have more students from your respected institution to come and conduct more studies in our Country

Yours sincerely

Dr.Wani Mena
Ophthalmologist and Head of Eye Unit
Juba Teaching Hospital

MINISTRY OF HEALTH (RSS)
JTH
JUBA TEACHING HOSPITAL