EPIDEMIOLOGY OF GLAUCOMA:

A POPULATION STUDY IN THE AKWAPIM SOUTH DISTRICT OF GHANA

BY

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DECLARATION

I declare that the work in this thesis, with the exception of the identified references, are the product of my own research undertaken under supervision and written by me. None of the materials contained herein has been presented either in whole or in part for an award of a degree at any other University than the University of Ghana.

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TABLE OF CONTENTS

TABLE OF FIGURES

ABSTRACT

Modern Eye care in Ghana is making progress in prevention of blindness from cataract, onchocerciasis and trachoma, but stuck with glaucoma that remains the leading cause of permanent blindness in Ghana. This project addresses issues on the epidemiology of glaucoma by determining the magnitude of the burden of Primary Open Angle Glaucoma by a prevalence study in the Akwapim South district of Ghana.

It looks at the factors related to advanced damaging effect on vision.

socio-cultural and alternate eye care factors that influence eye care.

A total of 1.843 people aged 30 years and above were screened in a cross-sectional population survey. A prevalence of 6.6% with a 95% confidence interval of 5.46 to 7.76 and an exponential trend line for prevalence/age relationship was found in the 30-64year age group.

A case- control study recruiting 123 patients with early features of glaucoma (control) and 93 patients with advanced glaucoma (cases) was also carried out for risk-factor analysis. Highest level of intra ocular pressure before treatment was the single most important factor associated with advanced visual loss and this was overwhelmingly significant. Adjusted Odd's ratio of glaucoma by multiple logistic regression model showed that intraocular pressure> 31mmHg in

a patient was nearly 3 times more likely to present with advanced glaucoma (OR 2.66, 95% confidence interval 1.45, 4.91, p value 0.0017). Other factors which were tested but showed weak associations that did not reach significant level were age, sex, family history of glaucoma, occupation, and ethnicity.

Data was collected in the population by questionnaire on demographic data and awareness, knowledge and health seeking behaviour related to eye care. The details of the questionnaire included age, gender, and occupation, the respondent's definition/understanding of blindness, causes of blindness known, or cause of action taken in face of an eye disease, past history of eye disease and the individual's knowledge and attitudes to glaucoma Cataract ranked as the most common cause of blindness respondents were aware of (77.2% of respondents) followed closely by eye injuries (71.9%). More than half the respondents were also aware of "kooko" (55.7%) and old age related (54.7%). Only 3.6% were aware that glaucoma causes blindness and 1% (23/1785) of the population knew it may be hereditary. About 3.6% (64/1785) were aware of glaucoma as an eye disease but only 0.8% (15/1785) knew that the disease glaucoma is related to optic nerve damage and, or intraocular pressure. A person in the higher occupational levels was 9 times more likely to understand glaucoma than the lower levels (OR 0.11, 95% CI 0.04-0.3, Pvalue 0.0001). "Kooko" is the indigenous name for piles however it turned out to be an ubiquitous disease that can affect any part of the body including the eye. Nearly half (47%) of respondents used hospital/clinic services while the other half (49%) used

chemical stores[1], herbalists, or self prescribed medication from the last 2 service providers. This data confirms the view that significant eye care services are also provided by chemical sellers and herbalists. It also indicates that the people patronised the services of these alternate service providers as much as they patronised the hospitals and clinics using chi square test (P value 0.78).

Information was collected independently by questionnaire and interviews from 21 chemical sellers and 60 herbalists identified by informants. The chemists sold only antibiotic eye drops that were used as first line treatment for all cases they saw. The herbalists claimed they treat cataract 82%, eye injuries 82%, kooko 75%, and Apollo 28%[2] of respondents. None of them were aware of or treated glaucoma. The routes of administration of the herbal medicine for eye disease were instillation into the eye and nose 50%, instillation into the eye 25%, oral and eye 10%, oral and nasal, and ocular 10% and only oral only 5% of respondents.

Although glaucoma prevalence is high in the Akwapim South district the level of awareness is low in the population, chemical sellers, and herbalists who provide about half of eye care services in the district. The level of the initial intra ocular pressure is the most important factor in determining extent of visual damage.

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[1] chemical stores: shops registered to sell only class C drugs (i.e drugs not requiring prescription)
[2] Apollo: acute haemorrhagic conjunctivitis usually caused by picorna virus.

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DEDICATION

Dedicated to two great men in my life:

my late father ***Jonathan Korboe Opai-Tetteh*** and

my husband ***James Ntim Amponsah***,

the strong pillars of support in my achievements.

ABBREVIATIONS

APOAG	Adult Onset Primary Open Angle Glaucoma
C/d ratio	Cup/Disc Ratio
HTG	High Tension Glaucoma
IOP	Intra Ocular Pressure
JPOAG	Juvenile Onset Primary Open Angle Glaucoma
KBTH	Korle-Bu Teaching Hospital
NTG	Normal Tension Glaucoma
NPL	No Perception Of Light
OD	Right Eye
OR	Odd's Ratio
OS	Left Eye
POAG	Primary Open Angle Glaucoma
TBA	Traditional Birth Attendant

GLOSSARY

Apollo: Acute haemorrhagic conjunctivitis

Adult Onset Primary Open Angle Glaucoma: Glaucoma diagnosed at age 35 years and above.

Chemical stores: shops registered to sell only class C drugs (i.e drugs not requiring prescription)

Cup/disc ratio: the ratio of the vertical optic disc cup diameter to the vertical diameter of the optic disc.

Juvenile Onset Primary Open Angle Glaucoma: Glaucoma diagnosed before the age of 35 years.

Kooko: Name for haemorrhoids in the Ghanaian local languages

Normal tension Glaucoma: glaucoma in the presence of apparently statistically normal intra ocular pressure (i.e IOP< 22mm Hg)

Proband First person in the family recruited for gene analysis for a disease

Standard Occupation Classification Categories

I-professional occupations

II-managerial and technical occupations

III N- skilled non-manual occupations

III M- skilled manual occupations

IV-partly skilled occupations

V-unskilled occupations

INTRODUCTION

Definition of glaucoma

Glaucoma is a group of diseases characterised by chronic progressive optic nerve damage. More often the intraocular pressure (IOP) is above the level compatible with continued health and function of the eye of that individual. Loss of retinal nerve fibres give rise to corresponding visual field changes characteristic of glaucoma. Uncontrolled glaucoma results in blindness.

Classification

There are several classifications of glaucoma. Traditionally they are classified according to:

1. Angle between the iris and cornea in the anterior chamber of the eye into **open-angle** and **angle-closure**
2. Presence of a recognized ocular or systemic cause called **secondary glaucoma** or is idiopathic, **primary glaucoma**.
3. Age at diagnosis: **congenital** in children before the age of 3 years, **juvenile onset** from 3 to 34years and **adult onset** from the age of 35years.

Recent advances in molecular biology are beginning to point to a classification based on whether or not it is inherited. Hereditary types can further be classified by the mode of inheritance, whether autosomal dominant, autosomal recessive

or X-linked As our understanding of the various etiologies that lead to glaucoma increases, all the glaucomas should be "secondary" to a known etiology in the future.

The commonest type of glaucoma (>90%) seen in clinical practice in Ghana is Primary Open Angle Glaucoma (POAG).

Natural history of POAG

When identified at an early stage in its course, treatment usually prevents severe visual loss. Once diagnosed the chronic nature of this disease requires lifelong follow-up. Poor control results in blindness.

Rationale and aims

The National Eye Care Report from the Ministry of Health of Ghana for the year 2000 indicated that POAG is the leading cause of irreversible blindness in Ghana. No population based prevalence survey on POAG has been conducted in Ghana and there is little information on the real magnitude of the burden of disease in our population. We are making progress in prevention of blindness from cataract, onchocerciasis, trachoma, and vitamin A deficiency but are stuck with glaucoma. Glaucoma remains the leading cause of permanent blindness in Ghana. Ageing is an important risk factor for glaucoma and therefore as we aim

towards better health care, and life expectancy continues to increase, we shall have a proportionally more aged population and more problem with glaucoma (Weale, 1999; Stein & Kalache, 1999). In an editorial of the Ghana Medical Journal in 1991, Quarcoopome drew attention to the situation that prevalence studies are expensive and difficult to conduct in our part of the world. That edition contained several articles in ophthalmology, including glaucoma, which were all hospital based. Most of the literature available in Ghana and the West African sub-region is limited to hospital-based studies. Studies from Ghana (Akafo & Hagan, 1990; Wormald & Foster,1990; Verrey et all, 1990), from Nigeria (Olurin,1973), the Gambia (Faal et all 1989), and Sierra-Leone (Stilma, 1983) indicate that glaucoma is common in West Africa where it competes with cataract as the major causes of blindness. A hospital- based study showed in that POAG was responsible for about one third of blindness in Southern Ghana (Adu-Darko, 1991). Estimates from one study on intraocular pressures in the Accra population gives the prevalence of POAG in Ghanaians of about 5% (Ntim-Amponsah, 1996). Glaucoma remains the leading cause of permanent blindness in Ghana. It is therefore important to carry out a scientific population based study to determine the burden of this disease in our communities as prevalence of POAG varies in the different populations studied.

The following Research Questions were investigated.

1. What is the magnitude of POAG in a Ghanaian community?

2. Who are affected?
3. Are certain ethnic groups, more associated with POAG?
4. What are the factors that increase the risk of visual loss from glaucoma?
5. What do people know about eye diseases including glaucoma?
6. What is the health seeking behaviour of the people with eye diseases?
7. Who share the burden of eye health care services?

Magnitude of the problem or world prevalence rates

The prevalence of glaucoma varies in the different populations studied to date. The largest study (4,709 people) conducted in a predominantly black population, the Barbados Eye study found the prevalence for the different racial groups to be Blacks 7.0% , mixed 3.3% and whites 0.8% (Leske et al, 1994)

In another study in the West Indies a prevalence of 8.8% at ages 30 years and over among 1679 black residents have been reported with less comprehensive diagnostic criteria (Mason et al 1989).

The Baltimore Eye Survey found 4.7% prevalence among 2,395 urban black residents and 1% among 2913 whites (Tielsch et al 1991). Diagnostic criteria were less comprehensive than the Barbados study.

Sound epidemiological data on glaucoma is lacking in Africa (Murdock, 1996; Quarcoopome, 1991). Personal Communication with Faal & Chuka-Okosa revealed that In a recent survey on blindness in the Gambia, year 2000, prevalence of glaucomas was found to be 1.2% including 1.0% of the POAG type. Normal tension glaucoma formed fifty percent (50%) of all the types of glaucoma combined.

A review of 15 population-based glaucoma prevalence surveys in Western Europe, the US, the West Indies and Japan showed that the proportion of patients with the condition who had previously gone undetected was at least 50% (Tuck & Crick 1997). The population survey data suggested that under-detection is most pronounced in patients with glaucoma of the normal pressure type.

There appears to be very different clinic based clinical impressions about prevalence of glaucoma in Africa. Ophthalmologists in Southern Coastal area of West Africa report severe POAG and or chronic PACG while those in the Northern savannah find POAG relatively less of a problem (Murdock,1996). It is speculated that Genetic origin of the Barbadians and African-Americans may have been from the Southern coast of West Africa in particular.

Who get it?

The major factors associated with POAG are ageing, family history of glaucoma, and African in origin. It is more likely to occur after the age of 40 in Caucasians, earlier in Africans A family history of POAG is generally considered to be a significantly prognostic indicator. The risk is approximately 10% in siblings and 4% in offspring (Kanski 1994). As there are different modes of inheritance these figures may vary between different populations. Since a gene mutation on chromosome 1, the trabecular meshwork inducible glucorticoid response protein (TIGR/MYOC) was identified different glaucoma genes have been mapped (Safarazi et al, 1998; Alward et al, 1998; Richards et al, 1994). Two of these genes cause congenital glaucoma. Three of these genes are responsible for "POAG; one is a juvenile form and the other two are adult-onset forms of glaucoma. Most studies report on North American Caucasian families of European descent. It is likely that separate genes cause glaucoma in families from different races and ethnic backgrounds. A gene mutation associated with glaucoma, Glu352Lys mutation has recently been found in a Ghanaian individual with ocular hypertension as well as a new mutation in a Columbian with Juvenile open angle glaucoma (Ayala-Lugo et al 2001)

Glaucoma Risk-Factor Analysis (table A)

This analysis was created as part of Glaucoma 2001, a public service project of the American Academy of Ophthalmology designed to significantly reduce the

prevalence of Glaucoma by the year 2001(Pendleton, 1999). Strong historical variables are weighted and summed up to determine one's level of risk of developing glaucoma. A score of 2 is considered low, 3 as moderate, and 4 or greater is high. It is recommended that anyone with moderate to high glaucoma risk should be examined by an Ophthalmologist. This table is only a guide and therefore one can score zero even when glaucoma is present or be younger than 50 years and still have glaucoma.

TABLE A:GLAUCOMA RISK-FACTOR ANALYSIS

Variable	Category	Weight
Age	Less than 50 years	0
	50-64 years	1
	65-74 years	2
	Greater than 75 years	3
Race	Caucasian / other	0
	African American	2
Family History of Glaucoma	Negative	0
	Positive in non-first degree relatives	0
	Positive for Parents	1
	Positive for Siblings	2
Last Complete Eye Examination	Within past 2 years	0
	2-5 years ago	1
	Greater than 5 years ago	2

Source: www.pendletoneye.com/fromligh.htm

Are certain ethnic groups more associated with POAG?

Studies worldwide reviewed by Quigley (1996) point to racial variation and conclude that glaucoma is commoner in ethnic groups within the black population. POAG is known to have a familial, genetically determined aspect, probably polygenic. It would therefore not be surprising to find differences in glaucoma prevalence between different ethnic groups

What are the factors that increase the risk of visual loss from glaucoma?

Ocular hypertension: It is believed that elevated IOP is the most important single prognostic risk factor. The degree of risk for developing glaucomatous damage is related to the level of IOP. IOP less than 16mmHg has 0.8% risk, 16-19mmHg 1.7%, 20-23mmHg 3.1%, and over 23mmHg 10.5 % risk (Thygeson, 1999).

Frazer et al attempted to identify some basic characteristics of people who present with advanced disease from a retrospective case-controlled study. Data obtained suggested that certain subgroups of patients with glaucoma were likely to be at greater risk of presenting with advanced stage of the disease. An African Caribbean patient was estimated to be four and a half times more likely to attend with advanced field loss than a white patient of similar age, sex, IOP, and referral source. A female patient was estimated to be one third as likely to attend late as a male patient of the similar age, IOP, ethnic origin, and referral source. A patient referred via any source other than an optometrist with the correct diagnosis was estimated to be greater than four times more likely to be a late

attender than a patient of the same sex, ethnicity, and similar age but referred with a diagnosis of glaucoma. There was a trend of increasing odds of late presentation with increasing age. A patient with of IOP is 21-25 mm Hg was estimated to be a quarter as likely to attend with advanced field loss than a patient of the same ethnic origin, sex, age, referral source, but with presenting IOP of greater than 31 mm Hg.

The same authors tried to identify the risk factors for having advanced glaucomatous visual field loss on the first hospital visit in 3 hospitals in United Kingdom in a case-controlled study. The data again suggested that certain subgroups of people with glaucoma were at greater risk of having advanced and irreversible field loss on first visiting the eye services investigated. Occupational group, initial intraocular pressure (IOP), family history of glaucoma, method of referral to hospital, and the number of years since the last visit to an optometrist were found to be independently associated with late presentation. A linear trend of increasing odds of late attendance was associated with increasing Standard Occupational Classification. Those in managerial (category II) and skilled (category III) groups were estimated to be, respectively 0.2 (0.00, 0.16 at 95% CI) and 0.27 (0.1, 0.8 at 95% CI) as likely to attend with advanced glaucomatous field loss as unskilled (category V) people with similar initial IOP, family history, referral route, and time since last optometrist visit. The data strongly suggested an association between IOP and advanced field loss at initial hospital examination. There was a 1.2 (1.12, 1.28) increase in the Odds Ratio (OR), an

estimate of the relative risk of late presentation per unit increase in millimeters of mercury after adjustment for the other mentioned factors. People with a family history of glaucoma were estimated to be almost one third (adjusted OR, 0.29 [0.12, 0.74]) as likely to have advanced field loss as those with no family history. People referred by any source other than an optometrist who had made the correct diagnosis of glaucoma were 4.5 times more likely to be late attendants than patients so referred but similar in other mentioned factors. These data also provide strong evidence that the more years since the last visit to an optometrist, the greater the likelihood of having advanced glaucomatous visual field loss on the first visit to the eye service

What do people know about glaucoma?

Peoples' awareness and knowledge of a disease determines their response to a disease.

Population based questionnaire survey in a Metropolitan Melbourne, Australia, population suburbs by Livingstone et al, (1995) indicated that 70% of the 1,711 respondents had heard of glaucoma but only 22% demonstrated reasonable understanding of the disease.

Another population questionnaire based survey on the knowledge of common causes of blindness in an adult Australian population by Attebo et al showed awareness of cataract (98%) and glaucoma (93%) were high in this population, but awareness of AMD was low (20%). Among people who were aware of the

target eye disease, only 29% showed some knowledge of glaucoma, 26% showed some knowledge of Age related Macular Degeneration and 20% showed some knowledge of cataract; Knowledge was related to education level, occupational prestige and knowledge of other eye diseases. After excluding people with a previous diagnosis of eye disease, those people who were aware and had some knowledge of eye disease accessed eye care services more frequently.

Traditional healers and chemical sellers have been a part of the health delivery system in most African cultures. They live and work even in the most rural villages; they are already in place (Courtright & Lewallen, 1997). They are respected by the communities who patronises their services (Bimal,1997; Harjinder, 1997)

The objective of this project was to determine the Epidemiology of Primary Open Angle Glaucoma in the Akwapim South District. This district was selected because the principal investigator had prior clinical impression of high prevalence of POAG from working in the Aburi Eye Clinic. The district also has a mixture of different ethnic groups and is easily accessible.

B ACKGROUND INFORMATION ON DISTRICT

Ghana is a country on the West coast of Africa with a total land area of 238,533 square kilometers. It has a population of about 18.4 million (Ghana Statistical Service, 2000). The basic health unit is the district. There are 10 administrative regions subdivided into a total of 110 districts. About a third is urban population and two thirds rural. Life expectancy at birth for males is 57 and 61 for females Exposure to mass media often used for health program dissemination is variable. Exposure in urban areas are 3-4 times as likely as rural areas. Males and also those with secondary education are more likely to be exposed than female (Ghana Demographic and Health Survey,1998). There are 43 ophthalmologists: 6 have fellowship[3] and the others are at various lower levels. There are also 30 optometrists, and 200 ophthalmic nurses who provide eye-care services in Ghana. About half of the ophthalmologists are in Accra, the capital. Some of the urban hospitals provide eye outreach services for the rural areas.

The Eastern Region covers an area of 19,323 square kilometers and has a population of 2,108,852. There are 15 districts in the Eastern Region. The region has 5 ophthalmologists holding diplomas or similar qualification. There are also 18 ophthalmic nurses, and 1optometrist. Akwapim South District is one of the districts in the Eastern Region of Ghana (figure 0-1:-map of district). It is bounded by Akwapim North district in the North, Ga district in the South and

[3] "fellowship' – the highest level in training of the general ophthalmologist

East, Suhum Kraboa Coaltar and Akim districts in the West. Though this forms about 5% of total surface area of the Eastern Region it is one of those with high population density in the region with a population of about 120,500 (2000 census). About a third of the population are thirty years old and above. The population is scattered with about 55% rural and 45% urban. Nsawam township is the most densely populated followed by Aburi township.

Figure 1-1:Map of the Akwapim South district

Nsawam is the capital of the Akwapim South district and about 35 km from Accra on the Accra Kumasi highway. It is a commercial town close to Accra, (the capital of Ghana) and is rapidly expanding. The population is multi ethnic. The major ethnic groups are the Akwapims, Ewes, Akims, Gas and, Krobos with varying socio-cultural background. The original vegetation was moist semi-deciduous rain forest but most of it is now replaced with farmlands. Important rivers passing through are the Densu, Pakro, Dobro, Mateta,Taban kro. It has a reasonable road net work and the Accra-Kumasi railway line also passes through Nsawam, Pakro, and Bowkrom. Agricultural activities form the major income generating activity. The district produces pineapple for export. Cassava, maize, pineapple and palm-nut are also cultivated.

The health institutions situated in the district are 1 government hospital, 4 private clinics, and 2 optical centres at Nsawam, 1 health centre at Pakro, and 1 mission clinic at Aburi. There is 1 ophthalmologist with a diploma and 1 ophthalmic nurse at Aburi and 1 ophthalmic nurse at Nsawam (Tenkorang, 2000).

CHAPTER ONE:

PREVALENCE OF POAG IN A GHANAIAN POPULATION

Introduction

There are different clinical impressions about the prevalence and severity of glaucoma in West Africa. Clinicians in southern coastal areas report the occurrence of severe POAG and chronic PACG whilst in the savanna POAG is considered less prevalent and therefore less of a problem (Murdock 1996). These impression, however, are based on hospital data. In Ghana, data suggest that glaucoma is the commonest cause of irreversible blindness (Adu-Darko, 1991; Hagan, 2000). However, there is a significant lack of epidemiological data on glaucoma in Ghana in particular, and Africa in general. Specifically there are no population-based studies on epidemiology of glaucoma and its severity in Ghana. As age is an important risk factor for POAG and life expectancy is increasing in Ghana and the rest of Africa it is expected that glaucoma will pose an increasing burden on eye health.

Glaucoma is known to have familial and genetic aspects. It is therefore possible that glaucoma may have different prevalence in the different ethnic groups within a black population. Survey of a multi-ethnic population will provide a general prevalence data, as well as test the hypothesis of tribal differences in glaucoma prevalence in Ghana.

The principal investigator was a visiting ophthalmologist to the Kom eye clinic in Aburi which was the only eye clinic in the district until 1998 and found a high prevalence of glaucoma in hospital attendants (Ntim-Amponsah, 1998). The Akwapim –South district also has a mixture of ethnic groups, accessible towns and villages that are relatively densely populated therefore making it a suitable area for this study on the epidemiology of glaucoma.

The specific objectives were to
Determine prevalence of POAG in the Akwapim South district
Determine differences in prevalence of Glaucoma among different ethnic groups in the study population.

Hypothesis:
The prevalence of POAG in the population is the same as that of Caucasians.

Material And Methods
STUDY DESIGN
The study was a Cross-sectional survey. The study population was all Ghanaians who were 30 years or older living in the Akwapim South district. The project aimed at screening about 5% of the eligible population based on resources available. With the help of the community health nurses of Aburi and a district map towns and villages in the district which had high proportion of ethnic diversity were marked. A day was used by the principal investigator to go round the district and identify the marked places to confirm ethnic diversity from the inhabitants and also assess the density of the population, accessibility by road, and their willingness to participate. Eighteen towns and villages were identified

as eligible. One of the research assistants who did not know the district randomly selected 14 out of the 18.

Opinion leaders (Assemblymen, chiefs) and Churches (catechists, elders) in the locality were briefed on the survey (Appendix 1.1). These leaders announced the arrival of the team to all adults aged thirty years and above in their towns and neighbouring villages about a week before screening helping to get volunteers to participate. The screening was done from August 2000 to March 2001.

Appendix 1-1 RE: FREE- EYE TESTING

Glaucoma is an eye condition that starts very slowly and can be difficult to detect early on as it does not affect vision until more than half of the nerve is damaged. However, left untreated it can lead to blindness.

Many young and old people in Ghana today are blind from glaucoma of which they were not aware.

Who will the eye test help?

ALL PEOPLE WHO ARE 30 YEARS OLD OR MORE

It will help the individual by testing his or her eyes thoroughly using the latest equipment.

It will help the local community because the results will show how much need there is for eye services locally.

It will help the whole country by enabling a better understanding of eye problems

ALL PEOPLE WHO ARE 30 YEARS OLD OR ABOVE NEED THE EYE TEST

We still need to see you even if:

You feel that your eyes are normal.

You have already had your eyes tested.

You are currently receiving treatment at the Eye Hospital.

Thanking you for your usual cooperation.

Dr. C. Ntim-Amponsah (Eye Specialist)

Research assistants measured the visual acuity of all volunteers with a Snellen's chart and clinical examination was done by an ophthalmologist. Three ophthalmologists examined with the principal investigator one at a time. They measured the intraocular pressures in about 12% of the population and performed funduscopy in about 5% of the population. The principal investigator re-examined all suspects and established cases of Glaucoma as well as some normals. Definition of suspects:- IOP> 21mmHg, IOP difference of 4mm Hg or more between the two eyes, and or visual field defect. The diagnosis of glaucoma was based on glaucomatous optic nerve damage including abnormal visual fields and or optic disc cupping. Visual fields were plotted with FDT Visual Field analyser for all participants declared by the principal investigator as suspects of glaucoma on the basis of optic disc c/d ratio >0.5 and I in 20 normals. All volunteers were encouraged to bring other members in their dwelling units to participate in the study.

The indicators of POAG were

a) Optic disc status was assessed by direct ophthalmoscopy during screening. Glaucomatous looking discs were reassessed by biomicroscopy except when cupping was obviously so advanced with cup disc ratio greater than 0.8. Where there was evidence of glaucomatous optic nerve damage it was referred to as glaucomatous. When there was no evidence of glaucoma it was referred to as non glaucomatous. It was referred to as suspicious when cup/ disc

ratio was greater than 0.5, or there was unequal cup/disc ratio difference of more than 0.1 between the 2 eyes.

b) Intraocular pressure: It was intended to use tonopen for screening and Perkin's applanation tonometer for the suspects and glaucoma cases. The tonopen broke down after the first 10% had been screened and so the Perkins was used for the rest of the project. Intraocular pressures were considered normal if it was <22 mmHg. Values > 21 mm Hg or a difference of 4mm Hg or more between the 2 eyes was considered abnormal.

c) Visual fields:

Humphrey's FDT (frequency doubling technology) Visual field analyzer based in a private clinic in Accra was used to plot the fields using full threshold N-30. This is comparable to the traditional Humphrey 24-2 fields. To maximize the turn out the Kom Ambulance transported most of the subjects to Accra on Saturdays for the examination of the fields. Others who preferred otherwise made alternate transport arrangement. People who were found to have glaucoma were given a free bottle of 0.5% timolol eye drops. All those who had their visual field tested were also given a prescription for spectacles when indicated. Subjects with visual field defects suggestive of glaucoma were confirmed as glaucoma if there was either glaucomatous optic disc changes or high intraocular pressure. Those with no visual field defect that could be attributed to glaucoma were labeled as non glaucomatous field changes.

LIMITATIONS

Sampling method

The original design was systematic sampling assuming that statistics on dwelling units can be obtained from the 2000 census and also that we could use identification marks on dwelling units made by the census team. There were no such records available and some of the marks on the houses had been washed off by the rains. The dwelling units were scattered in most areas with no regular pattern of arrangement. Resources available were not sufficient to raise a sample frame of dwelling units in the district. The traditional method of announcements by the chief's gongong beater yielded a low turn out during the stage of pre-testing. A second strategy using churches, assembly men and women worked better. Certain tribes were more concentrated in some villages and suburbs of towns. Cluster sampling using a voluntary sample was found most suitable given available resources. As a volunteer sample it may have the following limitations: 1) a healthy volunteer effect as those with severe visual impairment and invalids would not participate. 2) the unhealthy volunteer effect on the contrary where those with eye problems would turn up for examination as the only ophthalmologist operated in Nsawam and Aburi only. Indeed several people came complaining of itchy eyes. However these eye problems would not affect the prevalence of glaucoma. Steroid containing medications sometimes prescribed for itching were not available for sale in the area and also not likely to predispose them to glaucoma. Unlike the African Caribbean Study in London (Wormald et al, 1994) where it is suggested that it is likely that patients with

known glaucoma would not attend being under the care of eye specialists, the distance to the eye specialist and waiting time to see the few Ophthalmologists among other factors relating to poor eye care access make such free eye examination popular with those already diagnosed. Due to difficulty in explaining glaucoma in the local languages, low levels of literacy, and the general observation that many of the patients in that district are not inquisitive about their diagnosis and the names of medications they are on, it is possible that some of the apparent newly diagnosed cases had had a previous diagnosis made but were not aware of what condition they had. Meetings were held with the opinion leaders to encourage participation and raise level of awareness regarding glaucoma. In the Baltimore study a household was given up as a non-respondent after 10 attempts to reach occupants fail. The resources for this project would not support such a protocol. This project gives important practical experiences of sampling in a typical Ghanaian setting

Sample size: 4.4% instead of 5% of the eligible population anticipated was covered. This limitation was due to limited resources available for the study. The comprehensive examination for glaucoma was time consuming and we could not progress with numbers of recruits as fast as anticipated at the beginning of the study. High increases in fuel prices and transport also contributed.

Age determination in the elderly in this population is more difficult as there were no documents and was limited by their memory. Also the age structure of this population is important as there is tailing off in the older age group despite the fact that some people return to the country side after retirement. These also contributed to a small sample size and the apparently erratic behaviour of the graph in the old people (fig 4). On the other hand it could be a real biphasic behaviour of the graph if the sample sizes were bigger.

Focal group discussions and participant observation was not feasible with the herbalists as intended. This is because it was not possible to overcome the negative barriers that prevented them sharing their knowledge and experience with each other and the principal investigator during the duration of the project.

Although a portable visual field analyzer was available for the project it required a computer to complete the set up in order to plot the pattern deviation required in glaucoma visual field analysis. A lap top computer was not available and therefore candidates for visual fields had 2 options to choose from: Korle-Bu Teaching Hospital and Adenta on the outskirts of Accra close to the district. Only 3 people opted for Korle-Bu. The visual field analyzer in Korle-Bu is a Humphrey C24-2 which is comparable to the Humphrey FDT Visual field analyzer used for the majority. Six glaucoma suspects did not appear for the visual field examination and these incomplete records were rejected. Visual field

testing would have been complete and uniform if resources made it possible to test it on the field at the time of clinical examination.

Results

Twenty-one centres were used (table 1.1).

A total of 1843 people were screened forming 4.4% of the total population of the Akwapim-South district aged 30 years and above. Out of these 1785 were eligible for analysis.

Table 1-1: ELIGIBLE SAMPLE FOR GLAUCOMA PREVALENCE ANALYSIS

EXAMINATION CENTERS	NO. OF SUBJECTS	%
Aburi-3 centres	260	14.57
Adamorobe	24	1.34
Ahodwo	98	5.49
Ahwerease	69	3.87
Amanfro	94	5.27
Berekuso	56	3.14
Dobro	63	3.53
Fotobi	103	5.77
Kitase	136	7.62
Konkonuru	99	5.55
Nsawam-4 centres	515	28.85
Ntoaso	121	6.78
Oboadaka	56	3.14
Obodan	38	2.13
Pokrom	53	2.97
GRAND TOTAL	1785	100.02

The remaining 58 were not eligible for analysis because they had ocular media opacities that made the optic disc inaccessible for assessment. Table 1.1 shows the towns and villages and the number of eligible subjects recruited from each.

The turn out was greater for the older age groups as indicated in table 1.2.

Table 1-2: ESTIMATED SAMPLE PER AGE GROUP FOR GLAUCOMA PREVALENCE DETERMINATION

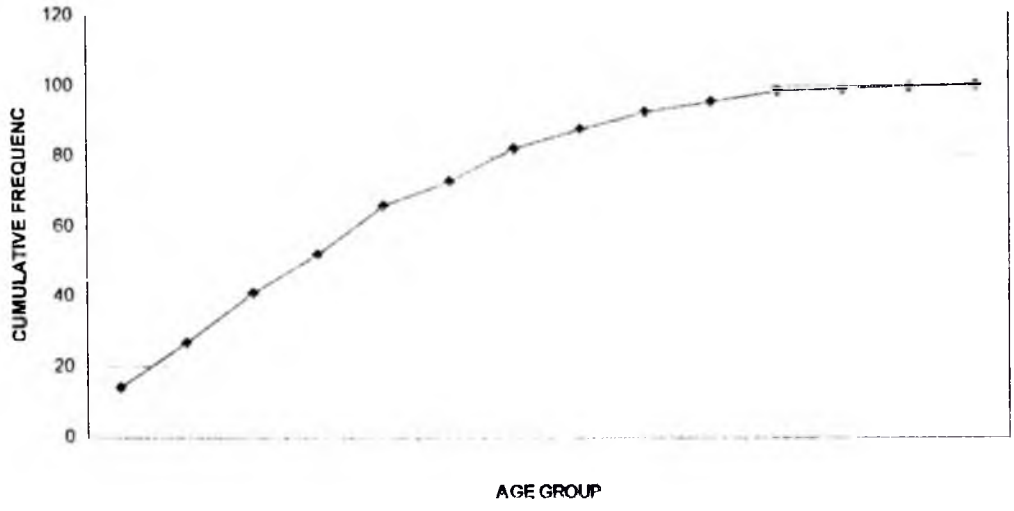
Age	Estimated Population	Subjects Covered	%Covered
30-34	8865.685	252	2.8424
35-39	7348.559	225	3.0618
40-44	6040.794	262	4.3372
45-49	4993.701	202	4.0451
50-54	4117.287	252	6.1205
55-59	3247.671	127	3.9105
60-64	2593.646	168	6.4774
65+	4389.216	355	8.088
total	41596.56	1843	4.4307

There were 893 females and 892 male with mean age 50, median 48 and SD 14.43 The age/sex distribution is summarized in Table 1.3 and the cumulative age frequency in fig 1.1

Table 1-3: AGE/SEX DISTRIBUTION OF SAMPLE EXAMINED FOR GLAUCOMA PREVALENCE DETERMINATION

Age Group	F	M	Total	%	Cumulative
30-34	114	138	252	14.1	14.1
35-39	118	106	224	12.5	26.6
40-44	128	129	257	14.4	41
45-49	107	93	200	11.2	52.2
50-54	111	134	245	14.0	66.2
55-59	53	71	124	6.9	73.1
60-64	92	73	165	9.2	82.3
65-69	41	59	100	5.6	87.9
70-74	54	36	90	5.0	92.9
75-79	31	17	48	2.7	95.6
80-84	32	17	49	2.7	98.3
85-89	6	10	16	0.9	99.2
90-94	2	7	9	0.5	99.7
95-100	4	2	6	0.3	100
Grand Total	893	892	1785	100	

Figure 1.2:CUMULATIVE FREQUENCY OF AGE GROUPS IN POPULATION

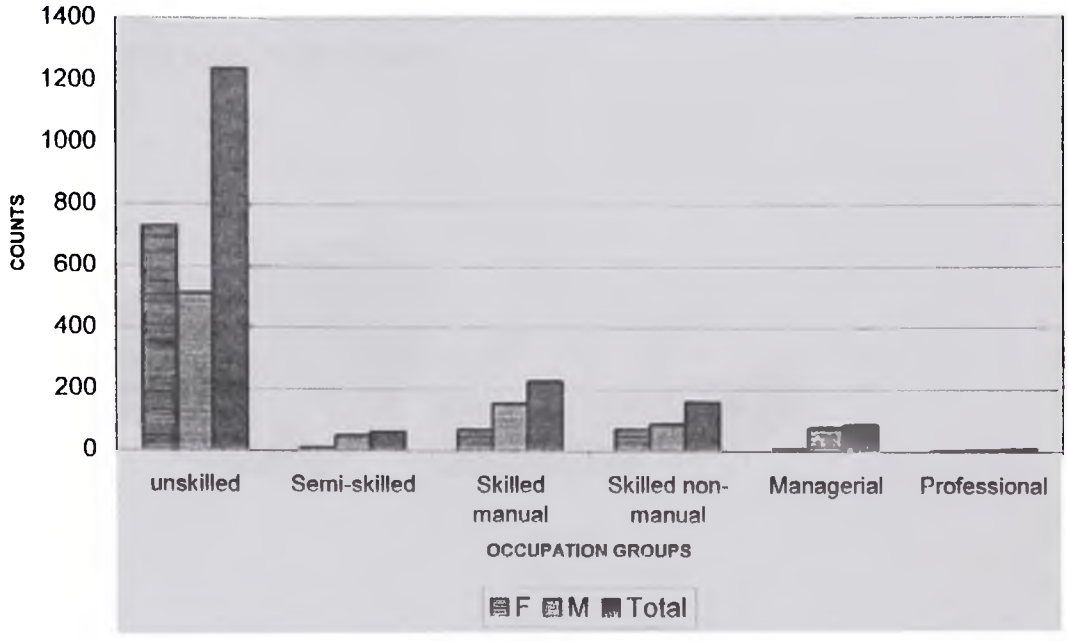


The main occupation was farming and trading for about 70% of the population (table1.4 & figure 1.3).

Table 1-4: OCCUPATION GROUPS IN POPULATION

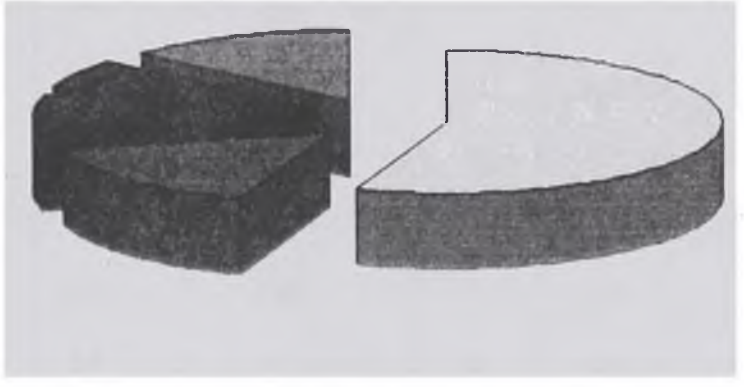
GROUP	F	M	Total	%	cumulative
Unskilled	729	513	1242	69.58	69.58
Semi-Skilled	12	51	63	3.53	73.11
Skilled Manual	70	157	227	12.72	85.83
Skilled Non-Manual	72	89	161	9.02	94.85
Managerial	9	76	85	4.76	99.61
Professional	1	6	7	0.39	100
Grand Total	893	892	1785	100	

Figure 1.3 FREQUENCY DISTRIBUTION OF OCCUPATIONAL GROUPS IN POPULATION GLAUCOMA PREVALENCE



The major self reported tribes were Akwapim 55%, Ewe 15%, Ga and Adangbe 9% (figure 1.4).

Figure 1-4: SELF REPORTED TRIBES



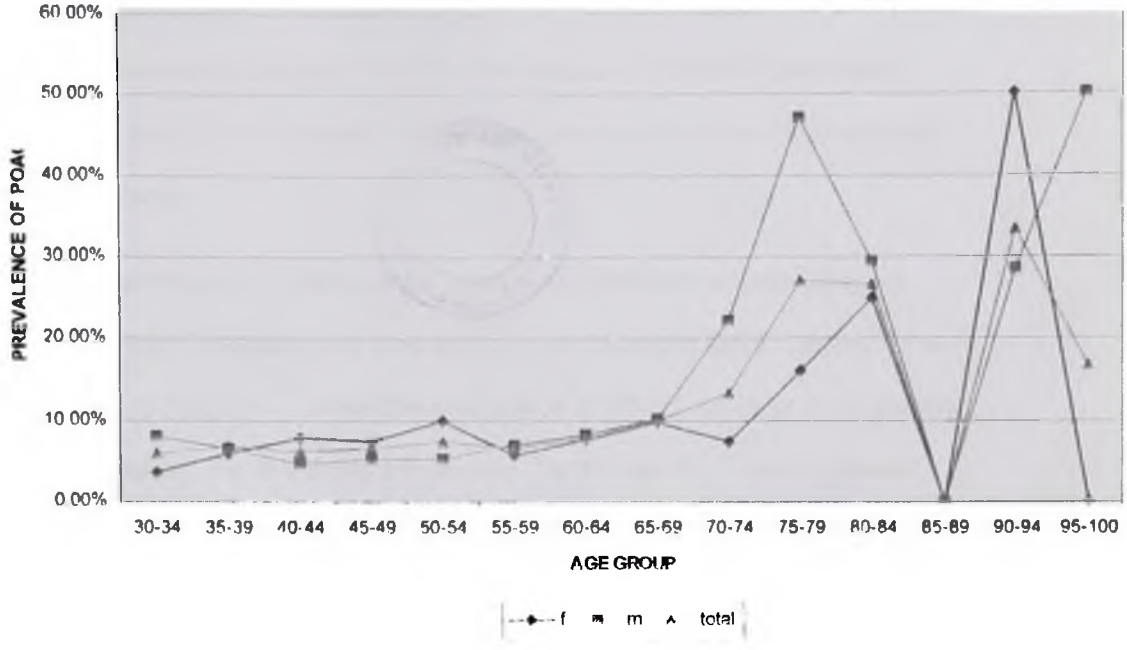
One hundred and fifty-eight (158) cases of the glaucomas were diagnosed. 149 (94%) was of the primary open angle type while 9(6%) were of the chronic angle closure type. 21% of the POAG were of normal tension IOP 21 mmHg or less. Ninety-three percent were newly diagnosed whilst the remainder were known glaucoma patients. Fifteen (10%) were blind of whom 12 were new cases and 11 (7.4%) had positive family history of 1st degree relations. Five of these relations were discovered at the time of the survey.

Age prevalence of glaucoma is summarised in table 1.5 and fig 1. 5 .

Table 1-5: AGE PREVALENCE OF POAG

Age Group	TOTAL F	POAG F	TOTAL M	POAG M	TOTAL POAG	Total F&M	POAG Prevalence
30-34	114	4	138	11	15	252	6.0
35-39	118	7	106	7	13	224	6.7
40-44	128	10	129	6	16	257	6.2
45-49	107	8	93	5	13	200	6.5
50-54	111	11	134	7	18	245	7.3
55-59	53	3	71	5	8	124	6.5
60-64	92	7	73	6	13	165	7.9
65-69	41	4	59	6	10	100	10.0
70-74	54	4	36	8	12	90	13.3
75-79	31	5	17	8	13	48	27.1
80-84	32	8	17	5	13	49	26.5
85-89	6	0	10	0	0	16	0
90-94	2	1	7	2	3	9	33.3
95-100	4	0	2	1	1	6	16.7
Grand Total	893	71	892	77	149	1785	8.4

Figure 1.5 PREVALENCE OF POAG



The overall prevalence of glaucoma was 8.2% in females, 8.6% in males and 8.4% in the overall sample. Prevalence in the30-64 age group was 6.61%. This age group contributed 82.12% (1,467) to the total eligible sample population and only 21 were found ineligible. Prevalence rose irregularly from age 65years to 16.4% (52/318) for age group 65-100. This latter group formed only 17.82% (318) of the eligible sample population and most of the ineligibles (37) commonly due to dense cataracts were also in this group. In view of the above the 0-64 age group was used to estimate the prevalence.

The Prevalence of POAG in 30-64 age group was 6.61% with a 95% confidence interval of 5.46%- 7.76%

Statistical Testing of hypothesis

The figure derived by Quigley (1996) for Prevalence of POAG in Europeans, 2.42%, was used as it is derived from several Caucasian studies worldwide and gives the average.

The null hypothesis (Ho) states that: There is no difference in prevalence of POAG between Caucasian and Ghanaians in the Akwapim South District. The alternate hypothesis ($H_{1)}$: is that the prevalence of POAG is higher in Ghanaians than Caucasians. For this study the statistic Z is 10.44. For z values greater than 3.00 Pvalue is less than 0.001 for one tail. The null hypothesis is therefore rejected. The alternative hypothesis that prevalence of POAG is higher in the study population than Caucasians is accepted.

From the present study a linear trendline equation with prevalence/age relationship gives r2=0.65(fig 1.6) whilst an exponential trendline has r2=0.7565 (Fig 1.7).

Figure 1-6: LINEAR TRENDLINE BY AGE

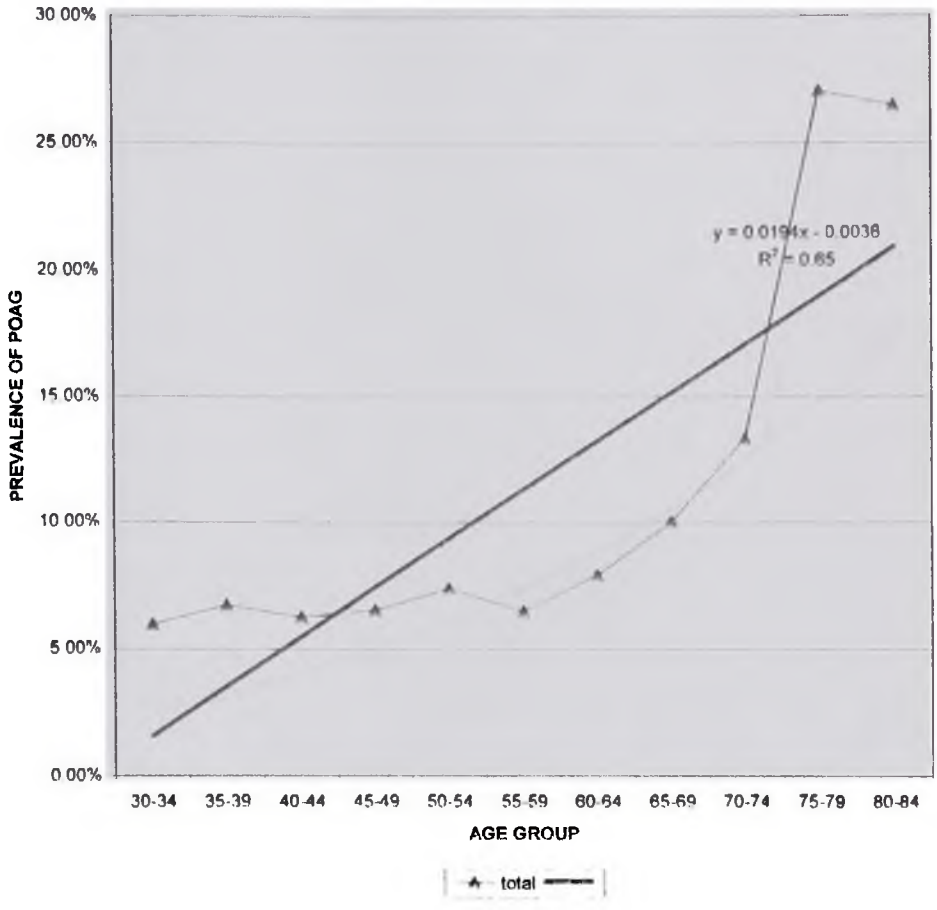
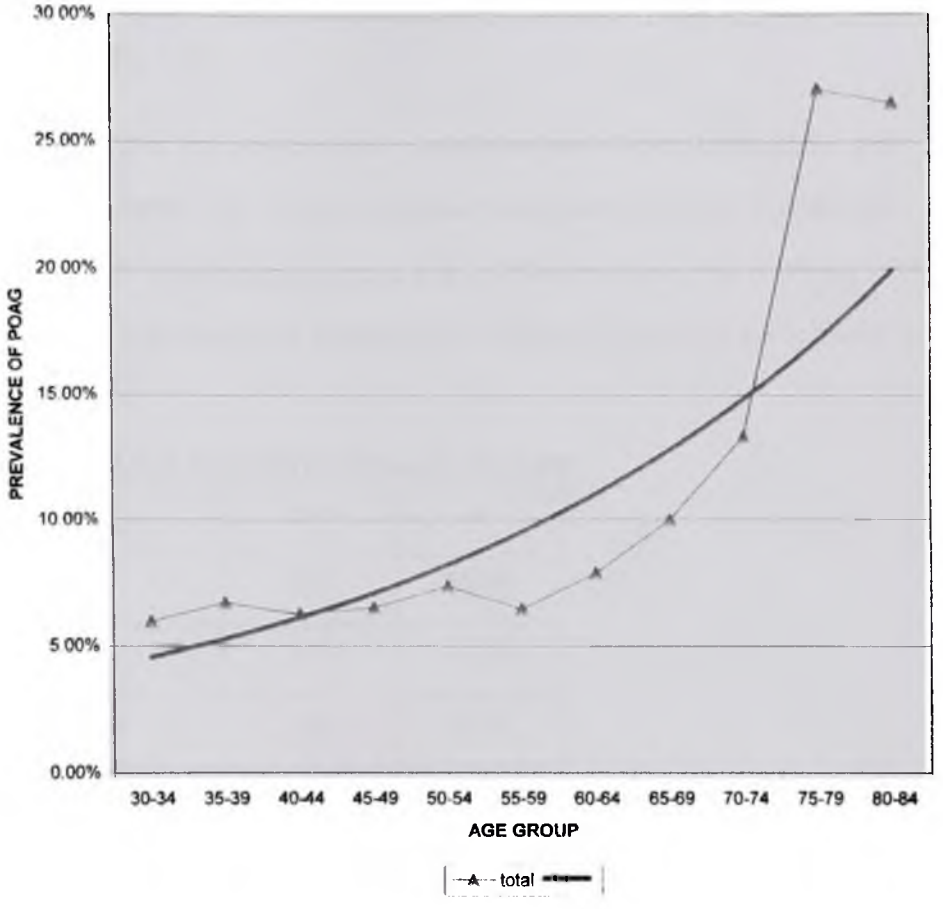


Figure 1-7: EXPONENTIAL TREND LINE BY AGE



Quigley's work on glaucoma world wide from which the prevalence was quoted for the statistical analysis also found on analysis of surveys of POAG among African derived people that the prevalence/age relation is linear with r^2 =0.52.

From the present study a linear trendline equation gives r^2=0.65(fig 1.6) This derivation though better correlation than Quigley's an exponential trendline however gives better correlation than a linear For the exponential trendline r^2=0.7565 (Fig 1.7).

The major tribes that participated in the survey were Akwapim(55.25%) and Ewe(15.3%)(table 1.6). There were fewer participants from the Ga/Adangbe group a more heterogeneous group with 5 different tribes. Also relatively young participants from one large extended Ga family with glaucoma participated thus

Table 1-6: SELF REPORTED ETHNIC GROUPS

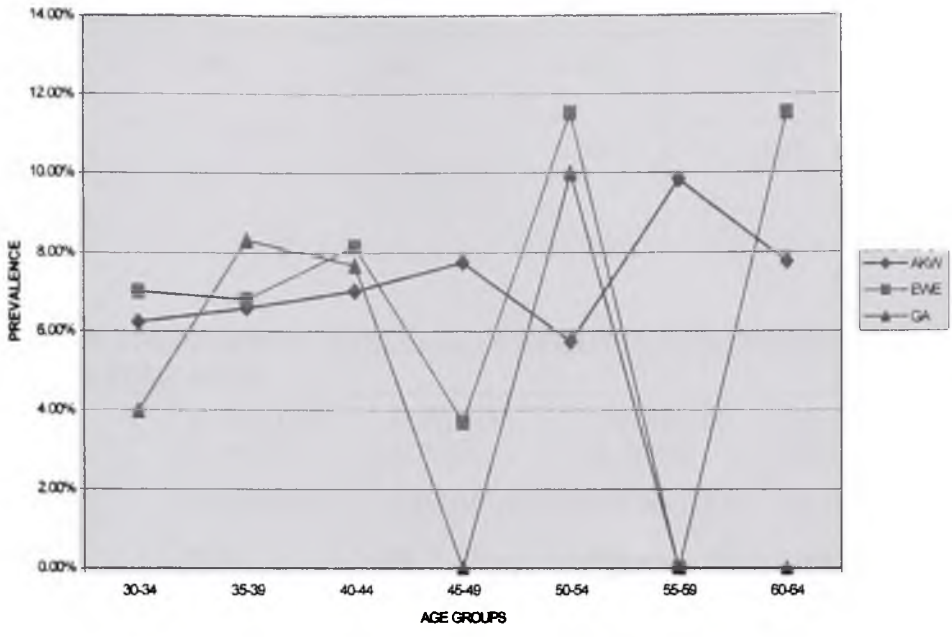
TRIBES	Total	%
Akwapim	985	55.18
Ewe	273	15.29
Ga/Adangbe	163	9.13
Northern Ghana	120	6.72
Others	244	13.67
GRAND TOTAL	1785	99.99

giving a relatively high prevalence for the 30-39 year age group (table 1.7 figure 1.7).

Table 1-7: PREVALENCE OF GLAUCOMA BY SELF REPORTED ETHNICITY

TRIBES	30-39	40-64	>64	Total
Akwapim	6.41% (15/234)	7.36% (39/530)	17.65% (39/221	9.44% (93/985)
Ewe	6.93% (7/101)	7.915% (11/139)	18.18% (6/33)	8.79% (24/273)
Ga/Adangbe	8% (4/50)	5.10% (5/98)	6.67% 1/15	6.75% (11/163)
Pooled all non Akwapim	5.78% 14/242	6.29% 29/461	13.40% 13/97	7.00% 56/800

Figure 1-8: PREVALENCE BY ETHNIC GROUP



Still fewer people (total 120) from tribes of the Northern part of Ghana participated and they were a very heterogeneous group. There were several other homogenous tribes but their numbers were too small. Therefore only the Ewe and Akwapim tribes were compared. There was no significant difference between the prevalence of the Akwapim and Ewe tribes. In this population P values were more than 0.7 for age groups 30-39, 40-64, 65 and above and all ages combined (table 1.8).

When all the non Akwapim tribes were pooled there was still no significant difference at the 5% level (tables 1.7 &1.8)

Table 1-8 Ethnicity

Ethnicity	30-39	40-64	64<	overall
Akwapim/ Ewe	0.86	0.82	0.94	0.74
Akwapim/ Non Akwapim	0.78	0.51	0.35	0.06

Table 1-9: PREVALENCE: of Glaucoma BARBADOS/AKWAPIM SOUTH BLACKS COMPARED

	BARBADOS BLACKS (OBSERVED)	AKWAPIM-SOUTH (OBSERVED)	BARBADOS BLACKS (EXPECTED)	AKWAPIM-SOUTH (EXPECTED)
POAG	302	98	298.495	101.505
Non POAG	4012	1369	4015.505	1365.495
Total	4314	1467		
CHITEST P VALUE 0.68				

Table 1-10: Prevalence of Glaucoma in different races from the literature

RACIAL ORIGIN	LOCATION	AGE	POAG%
Africa	Gambia-West Africa	30+	1.2
	Barbados-West Indies	40-84	7.1
	St Lucia-Caribbean	30+	8.8
	Baltimore-USA	40+	4.74
	Akwapim South	30-64	6.61
	Akwapim South	30+	8.4
European	Rotterdam, Netherlands	55+	1.10

RACIAL ORIGIN	LOCATION	AGE	POAG%
	Barbados-West Indies	40-84	0.8
	Baltimore, USA	40+	1.29
Australia	Sydney. Blue Mountains Eye Study	49+	3.0
Mixed race	Barbados-West Indies	40-84	3.3

Table 1-11 Normal Tension Glaucoma in different races from Literature

Study and location	Age range of subjects, yr	Prevalence of glaucoma, %	% of subjects with normal IOP
Akwapim-South Ghana	30-64	6.61	21
Gambia	30+	1.0	50%
Rotterdam Netherlands	55+	1.10	38.9
Hollows et al, Ferndale, Wales	55-70	0.47	35
Liebowitz et al, Framingham, Mass.	52-85	1.43	53
Stromberg, Skovde, Sweden	> 40	0.41	13
Stromberg, Dalby, Sweden	> 40	0.86	62
Bankes et al, Bedford, England	> 40	0.76	7
Armaly, Des Moines, Iowa	20-89	4.08	68

DISCUSSIONS

The prevalence of POAG in the30-64 age group was 6.61%. The 95% confidence interval was 5.46% to 7.76%. The values obtained from this study are relatively high. A prevalence of 2.42% in Caucasians was reported by Quigley (1996) when he reviewed studies world- wide.. Comparatively high prevalence rates of POAG has been documented in black populations in the West Indies particularly St Lucia:8.8% (Mason et al 1989) , Barbados :7.1%(Leske et al, 1994) and then in United States Baltimore :4.74% (Tielsch et al 1991). The Barbados study also found a prevalence of 0.8% in whites with a relatively much smaller sample size of 133. The Baltimore study found a prevalence of 1% in a larger sample size of 2,913 whites. Such high prevalences in a population-based study have not been documented in West Africa before this study. Indeed it has been speculated that though the population of Barbados was derived from West Africa there may be nutritional or environmental influences in Barbados which were absent in Africa. Furthermore, the subsequent additive effect of genes may have altered the prevalence of glaucoma in the Barbados population from the parent African population (Johnson, 1998). However this present study has shown that there is no significant difference between the prevalence of POAG in the Barbados black population and the present study population at the 5% level of significance (Pvalue 0.6, table 1.9). A recent population based study on blindness in Gambia, West Africa found a lower prevalence of 1.0% (Faal et al, 2000). However the Gambia study only looked at blindness due to glaucoma and not prevalence of glaucoma per se. Most other reports from West Africa are from hospital- based

data and or derived from blindness data. In Ghana relatively accurate figures of the prevalence of the various eye diseases are not available because Population-based surveys are more expensive and difficult to conduct than hospital-based studies (Quarcoopome 1991) and resources have been lacking. These observations apply to most countries in Africa. However though the methods, age ranges, and definitions differ from population studies they give an idea of relative prevalence of disease in different study groups (table 1.10) and give an indication of the relative demands on the hospital eye service.

Optic disc changes were a sensitive indicator for visual field loss. Glaucomatous optic disc changes, open angle, with either appropriate, visual field changes or high IOP fulfilled the criteria for diagnosis of POAG in this study. With availability of automated perimeters visual field tests should pick earlier changes than optic disc signs so that studies that did not test the visual field may result in lower values of prevalence. On the other hand very early field changes with no obvious clinical signs are difficult to classify and may inflate the value. In this study only established cases of glaucoma were used for the analyses.

The proportion of the POAG was 94% of all the glaucomas diagnosed in this study. These include 21% of normal tension glaucoma (NTG). Gonioscopy was not done routinely in most glaucoma studies in Ghana. It was therefore not possible to distinguish POAG from other types of chronic glaucoma in those

studies (Hagan et al, 1991; Wormald & Foster, 1990; Verrey et al,1990). Herndon et al (2001) performed examination including gonioscopy in 198 "glaucoma" patients in a private clinic in Ghana where visual fields were not performed routinely. They used a modified tangent screen with a laser pointer for a target to plot the visual fields. They found that the most common form of glaucoma was POAG in 44.2%. Primary Angle Closure Glaucoma was 6.6% and most (30.5%) were classified as glaucoma suspects. The clinic where the study was reported from has a high turnover of ophthalmologists with various levels of training and qualification, contracted for varying periods and it is possible that inter observer agreement was very variable.

An IOP of 21 mm Hg is the accepted upper limit of normal. However, glaucoma does not develop in many people with higher pressures but may develop in those with an IOP below 21 mm Hg. It is reported in an earlier study on intraocular pressures in Ghanaians that 8.65% of the population had intraocular pressures of 5 to 10mmHg (Ntim-Amponsah, 1996). Increases in intraocular pressures of 11 to 16 mm Hg will keep all these people in the normal range if high IOP alone is used as a major criterion for diagnosing glaucoma while for the particular individuals these IOP change would be significant increases.

Herndon et al (2001) and Verrey et al(1990) used high intraocular pressure as a criteria for diagnosing glaucoma. By definition , therefore, they did not include the normal tension glaucomas (NTG). Others did not define investigation criteria

for diagnosis of glaucoma (Hagan et al 1991) as such it is not possible to tell whether they included NTG or not. In the Gambian national study on blindness 50% of the POAG were of normal tension type. Other studies report different proportions of NTG in various populations (table 1.8) from 7% to 53%. Stomberg reports differences in the same country Sweden as 13% in the Skovde study and 62% in the Dalby study (Stromberg, . statistical analysis showed that among people over 60 years old, up to 3.7% of those with an IOP of 16 to 19 mm Hg will have glaucomatous visual field defects in 5 years. Armaly et al's, 1980).

The sensitivity of the optic nerve to any given level of pressure determines progression to glaucoma. Known risk factors for progression include age, IOP, diabetes, myopia, black race and vascular problems (e.g. hypertension). In people with frank glaucoma, there is some evidence that visual field loss is directly related to IOP and that eyes showing the fastest rate of loss are in an earlier stage of the disease.

Awareness of the proportion of the population who have NTG is of clinical importance. It reinforces the concept that high IOP as a risk factor for glaucoma rather than a *sine qua non* for diagnosis. Also glaucomatous optic neuropathy and visual field defect progresses in some cases where the intraocular pressure appears to be in the statistical normal range. Some progress more rapidly than others. The collaborative Normal Tension glaucoma study (2001) group showed

in a cohort study of 160 patients with NTG that approximately half of the cases showed a confirmed localized visual field deterioration by 7 years.

There was no significant difference between the prevalence of POAG in male and female (Chi-square test P value 0.64, 30-64year age group and 0.66, 30-100 years). This study therefore does not demonstrate any gender difference in prevalence of POAG. The results on gender variation from different prevalence studies are inconsistent but it appears there are no true gender differences in the prevalence of POAG (Mitchel et al ,1996; Johnson, 1998). Few show gender difference. In the Rotterdam study the prevalence was higher in male than female (Dielemans, 1994) men having 3 times higher risk of having POAG than women (odds ratio, 3.6). Wormald and Foster (1990) found in a hospital study in North-Eastern Ghana that there was a male preponderance of 65% of Chronic glaucoma , Verrey et al (1990) found a male preponderance of 71% in Northern Ghana, but Herndon et al (2001) found a female preponderance of 51% in the Emmanuel Eye clinic in Accra. This could demonstrate bias usually associated with hospital attendances and records. Local factors that influence access to eye care may influence these statistics.

By age 30 years prevalence was already high (6.0%). This confirms clinical observation by many clinicians in West Africa and elsewhere that the onset of POAG is earlier in blacks than Caucasians. Verrey et al (1990) had found in the

hospital study in Northern Ghana that 21.48% of patients with chronic glaucoma were in the 10-29 year age group. This study, the clinical experience of the principal investigator, and personal communication with Ophthalmologists practicing in West Africa cited point to further research to determine the right age at which screening for glaucoma should start especially when there is a positive family history. POAG is asymptomatic in the early stages and often detected accidentally during routine eye examinations and outreach screening programs. About 90% of the optic nerve fibres are lost before symptoms of visual loss set in. Finding this right age has important implication for clinicians as the 35 and 40 ages suggested in some textbooks (Newell, Kanski) and even 30 suggested in an article (Quiggley,1996) may still need to be revised downwards.

There was an increased prevalence of glaucoma with age. Although there were relatively few subjects in the over 75 year group, and a significant proportion of these were ineligible for analysis on account of cataracts there still was an increased prevalence of POAG with age Quigley's review of published data on glaucoma prevalence to determine the relationship of POAG with age in persons of European, African, and Asian origin found a linear trend for Africans and Asians and an exponential trend for Europeans. The linear trendline equation for age prevalence derived from this study gives r2=0.65 compared to Quigley's r2=0.52.The better fit graph for trend analysis in this study, however, is an exponential trend with r2=0.7565. The present study, in contrast to Quigley's, therefore, finds an exponential trendline for prevalence of glaucoma with age in

an African population. No ethnic variation was observed in the prevalence of glaucoma between the 2 most highly represented tribes i.e. the Akwapims and the Ewes in this study. It is noteworthy that there were relatively fewer participants from the Ewe tribe compared to the Akwapims. This is not unexpected because of the known origins of these different tribes. It is probable that there have been intermarriages between the different tribes within the region. However the level of inter-tribal marriages were not ascertained (or tested) during this study. A multicentre population study in the different regions of Ghana(representing the different tribal dominances) will provide more complete data on the tribal differences in the prevalence of POAG in Ghana.

CHAPTER TWO:

RISK FACTORS FOR DEVELOPING ADVANCED POAG

Introduction

Chronic glaucoma is often called "the silent thief of sight", because the afflicted person has no warning sign, no hint that anything is wrong. There is progressive optic nerve damage over several years. It is known that the disease gradually destroys first the outer fibers of the optic nerve, which reduces peripheral vision - the top, sides, and bottom areas of vision and adjacent to fixation -but not central vision so the victim sees and is able to read without difficulty. By the time the victim notices loss of peripheral vision, permanent damage has already occurred. If the glaucoma is not controlled, destruction can progress until tunnel vision develops, and the person is only able to see objects that are straight ahead. The last nerve fibers destroyed are those responsible for central vision. When this occurs, the glaucoma victim's vision becomes impaired and eventually he becomes totally blind. The symptom of visual impairment therefore comes late in the course of POAG.

In developed countries, most people with glaucoma get treatment in time to preserve their vision. Elsewhere in the world diagnosis is late, treatment is less available, and glaucoma ranks as one of the leading causes of blindness. Even if people with glaucoma do not become blind, vision can be significantly impaired. One study that reviewed the literature worldwide showed that in developed countries, fewer than 50% of those with glaucoma are aware of their disease and in the developing world, the rate of known disease is even lower(Quigley, 1996) . From Chapter 1 as many as 93% in the the Akwapim South district study were

newly diagnosed cases who were not aware that they had glaucoma. The prevalence of POAG increases with intraocular pressure and age. Like so many other diseases, glaucoma tends to run in families; different genes, however, are involved in different families (Mackey & Stone, 1998). Other conditions associated with glaucoma are Diabetes Mellitus, extreme myopia, people on prolonged steroid medication and previous intraocular surgery (Kanski, 1994). Individuals present with various stages of the condition at the time of diagnosis. Unfortunately some present with some involvement of central vision or even blindness. Why some people have early stages of POAG and others have advanced disease is a subject of various studies. It has also been observed that factors other than chronology (i.e. late presentation of long standing disease) are responsible for advanced features of POAG at diagnosis. Identification of factors in Ghanaians associated with increased risk of visual field loss in glaucoma other than time, if they exist will help in planning strategies to reduce visual loss and blindness from glaucoma.

This investigation evaluates what factors are associated with increased risk of visual field loss from glaucoma at diagnosis. Exposures of interest included those already established as major risk factors for glaucoma which were IOP, age, and family history. In addition, occupation ethnic diagnosis of diabetes

mellitus, hypertension, sickle cell disease, previous eye examination were of interest

Material and methods

The study was a cross-sectional design recruiting

1. individuals diagnosed with POAG in the Akwapim South district Population-based Survey in Chapter 1 (total 58) and

2. newly diagnosed cases of glaucoma from the hospital-based population who the principal investigator attended to at clinics in the Korle-Bu Teaching Hospital and Trust Hospitals in Accra(total 158).

After the diagnosis was made the patients were recruited if they satisfied the criteria for a case or a control, and gave consent to be included in the study. None of the eligible subjects declined inclusion in the study

The criteria for a Case was patients with cup/disc ratio>0.8 and or visual field with absolute scotoma(s) within 5 degrees of fixation.

The criteria for a control was patient with cup/disc ratio of 0.5 or greater or difference of 0.2 or more between c/d and no absolute scotomas within 20 degrees of fixation of the visual field.

Background routine demographic information, personal and family general and ocular history was taken.

Information including age, sex, family history of glaucoma, medical history including diagnosis and treatment of diabetes, hypertension and sickle cell disease as well as previous ocular history were obtained. Examination included IOP, visual fields (Humphrey 24-2) and fundus examination with detailed disc assessment. Resources could not support the measurement of blood pressure, random or fasting blood sugars, or sickle cell tests (sickling status or Hb electrophoresis). A patient was recorded as diabetic therefore, if there was a positive history of diabetes, on treatment including diet alone, tablets and or insulin. Similarly he was considered hypertensive. if there was a positive history of current treatment for hypertension and to have sickle cell disease if there was a positive history of sickle cell disease confirmed by Hb electrophoresis[4] The data record sheet used for this study is reproduced in appendix 2.1

[4] Another protocol designed to determine if the vascular diseases; hypertension, diabetes and sickle cell disease are associated with progression in visual field loss is awaiting funding.

Appendix 2.1 : Record sheet for Glaucoma patients

Glaucoma Clinical Data for Risk factor analysis

Serial #:

ID:

Last Name: **Age:** **Sex**

First Name: **Occupation:**

Middle Name: **Ethnicity:**

CLINICAL DATA

Hx	**FHx:**
Age dx	
Max IOP	
RVA	**R - ANG**
LVA	**L - ANG**
R - REF	**Disc D:**
L - REF	**VF :**
R - CD	**R VFD:**
L - CD	**L VFD:**
DIAGNOSIS:	**LAST EX-WHO**
	LAST EX-WHEN

CASE CONTRO

Sample size: Sample size determined which would give 80% chance of detecting as statistically significance at the 5% level a doubling in the odds of late attendance in a factor present among 10% of the controls is 110 cases, 110 controls.

The associations between risk factors and glaucoma were assessed by calculating odds ratio in univariate analysis and adjusted odd's ratio by multiple logistic regression model. The model included age, sex, family history, IOP, occupational grouping, and tribe.

Results

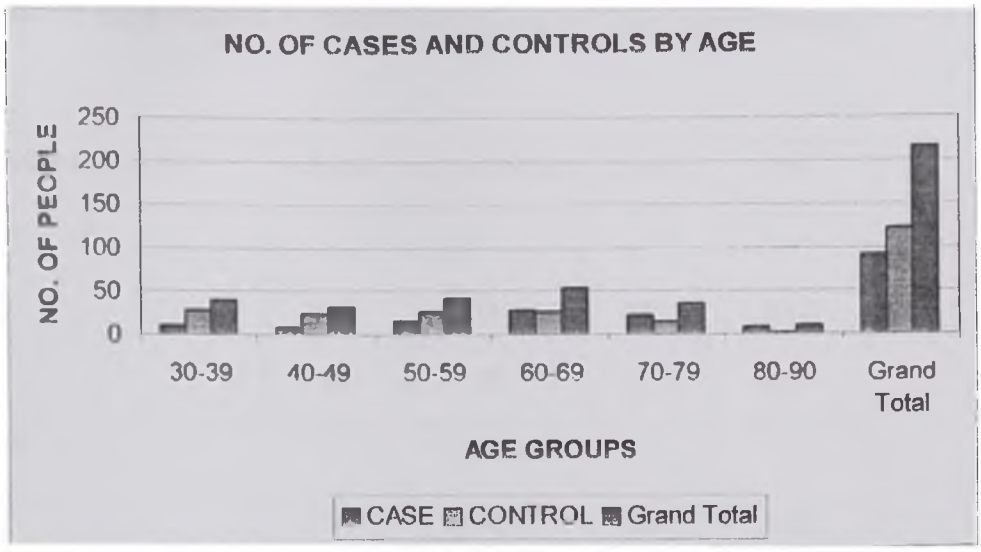
Two hundred and sixteen subjects were recruited for this part of the study. Ninety three (93) were cases and 123 were controls. There were 66 female controls and 57 male controls. There were 44 female cases and 49 male cases. There was no significant difference between the number of male and female recruited by chi-squared test giving p value 0.8. The age group (table 2.1, fig 2.1) and gender distribution (table 2.2) of the sample are illustrated.

Table 2.1 Composition of sample by age in Glaucoma patients

Age:	CASE	CONTROL	Grand Total	%
30-39	11	29	40	18.5
40-49	8	25	33	15.3
50-59	16	26	42	19.4
60-69	28	26	54	25
70-79	22	15	37	17.1
80-90	8	2	10	4.6
Grand Total	93	123	216	

Table 2.2 Gender Distribution in Glaucoma patients

	30-39		40-49		50-59		60-69		70-79		80-90		Grand Total
GENDER	F	M	F	M	F	M	F	M	F	M	F	M	
CASE	6	5	3	5	4	12	16	12	12	10	3	5	93
CONTROL	15	14	15	10	12	14	12	14	10	5	2		123
Grand Total	21	19	18	15	16	26	28	26	22	15	5	5	216
%													



The mean age of diagnosis of glaucoma was 54 years, median 56 and standard deviation 14.8. For the control group the mean age was 54 years and the median 53 years and standard deviation 15.2. The mean age of diagnosis for the cases was 57, median age 61 and standard deviation 14.8. Sixteen (16) patients made up of 5 cases and 11 controls had JPOAG. Two hundred patients consisting of 88 cases and 112 controls had APOAG. There were 15.3%(33patients) with NTG, 79.6% (172 patients) HTG, and the remaining 5.1% (11 patients) had incomplete data entering or poor cooperation of patients who were blind during IOP measurement. Table 2.3 shows the studied factors by case-control status. For simplicity the dependent (response) variables are grouped into 2 responses for analysis. Univariate analysis is illustrated in Table 2.4 for the age groups and table 2.5 the study factors with odds ratio and confidence intervals.

Table 2.3 Study factors in glaucoma patients by Case-control Status

STUDY FACTOR	CASES	CONTROLS	Total	%
SEX				
M	49	66	115	53.2
F	44	57	101	46.7
AGE				
>60	54	40	94	43.5
30-60	39	83	122	56.5
IOP[1]				
<32	39	83	122	59.5
>31	48	35	83	40.5
FAMILY HISTORY				
PRESENT	9	24	33	15.3
ABSENT	84	99	183	84.7
FAMILY HISTORY				
FIRST DEGREE	9	20	29	13.4
SECOND DEGREE	0	2	2	0.9
1st & 2nd DEGREE	0	2	2	0.9
OCCUPATION				
I,II,111N	53	77	130	60.2

STUDY FACTOR	CASES	CONTROLS	Total	%
IIIM,1V,V	40	46	86	39.8
ETHNICITY				
AKAN	47	68	115	53.2
NON-AKAN	46	55	101	46.8
EWE	17	22	39	18.1
NON EWE	76	101	177	81.9
GA	25	28	53	24.5
NON GA	68	95	163	75.5
NORTHERN TRIBES	4	5	9	4.2
SOUTHERN TRIBES	89	118	207	95.8
SYSTEMIC DISEASE[2]				
Hypertension	1	3	4	1.9
Diabetes	1	1	2	0.9
Hypertension& diabetes	2	0	2	0.9
Asthma	0	2	2	0.9

[1] Total 205 on account of incomplete records on IOP (5 cases & 6 controls).

[2] Medical history given by patient

Table 2.4 Odds Ratio:univariate analysis for age in glaucoma patients

Age:	CASE	CONTROL	Grand Total	%	OR	95% CI
30-39	11	29	40	18.5	1	
40-49	8	25	33	15.3	0.84	0.29-2.42
50-59	16	26	42	19.4	1.62	0.64-4.12
60-69	28	26	54	25	2.84	1.18-6.81
70-79	22	15	37	17.1	3.87	1.49-10.05
80-90	8	2	10	4.6	10.55	1.93-57.60
Grand Total	93	123	216			

Table 2.5:Glaucoma patients:Odds ratio for study factors:-Univariate analysis

STUDY FACTOR	CASES	CONTROLS	Total No.	OR
SEX				
M	49	66	115	1.29
F	44	57	101	
AGE				
>60	54	40	94	2.87
30-60	39	83	122	0.35
IOP[1]				
<32	39	83	122	O.34
>31	48	35	83	2.92
FAMILY HISTORY				
PRESENT	9	24	33	2.07
ABSENT	84	99	183	0.48
FAMILY HISTORY				
FIRST DEGREE	9	20	29	
SECOND DEGREE	0[2]	2	2	
1st & 2nd DEGREE	0	2	2	
OCCUPATION				
I,II,111N	53	77	130	0.79
IIIM,1V,V	40	46	86	1.26
ETHNICITY				
AKAN	47	68	115	0.83
NON-AKAN	46	55	101	1.21
EWE	17	22	39	1.03
NON EWE	76	101	177	0.97
GA	25	28	53	1.27
NON GA	68	95	163	0.79

STUDY FACTOR	CASES	CONTROLS	Total No.	OR
NORTHERN	4	5	9	1.06
TRIBES	89	118	207	0.94
SOUTHERN TRIBES				
SYSTEMIC DISEASE[3]	1	3	4	
Hypertension	1	1	2	
Diabetes	2	0	2	
Hypertension& diabetes	0	2	2	
Asthma				

Table: 2.6 shows the adjusted odds ratio of glaucoma by multiple logistic regression model.

Table: 2.6 Glaucoma patients: Adjusted odds ratio of glaucoma by multiple logistic regression model

Study factor	Case	Control	Adjusted odds ratio	95% CI	p-value
Age (years)					
30-39	11	29	1.00		
40-49	8	25	0.84	0.28, 2.55	0.7643
50-59	16	26	1.75	0.65, 4.67	0.2677
60-69	28	26	2.53	1.01, 6.31	0.0473
70-90	30	17	5.16	1.97, 13.51	0.0008
FH of glaucoma					
Negative	84	99	1.00		
Positive	9	24	0.61	0.25, 1.49	0.2766
Occupation					
Skilled	53	77	1.00		
unskilled	40	46	1.12	0.60, 2 08	0 7207
Sex					
Female	44	66	1.00		
Male	49	57	1.28	0.70, 2.34	0.4253
Ethnicity					
AKAN	47	68	1.00		
EWE	17	22	1.26	0.56, 2.82	0.5828
GA	25	28	1.13	0.54, 2.37	0.7432
NORTH	4	5	1.71	0.38, 7.68	0.4829
Max IOP					
<32	45	88	1.00		
>31	48	35	2.66	1.45, 4.91	0.0017

There were only 3 eyes in 2 patients with myopia >5.00DS. Refraction results are illustrated in table 2.

Positive systemic medical history obtained in 10 patients. It included Hypertension in 4, diabetes mellitus in 2, both diabetes and hypertension 2, and asthma 2.

The question designed to find the time interval between the last time the subjects had an eye examination by an eye care personnel was abandoned because the validity of the responses were low. Most people could not distinguish between eye care workers, other healthcare staff, and people with no formal training who sold spectacles. Since referrals to the hospital eye service in Ghana are usually from the mass screening exercises of ophthalmic nurses and a few practicing optometrists there should be no significant difference in the case mix from the 2 sources used in this project. The patients were chosen with standard criteria and inclusion of an approximately equal numbers of cases and controls would remove any bias.

The following associations are inferential from table 2.5. A person without a family history of glaucoma is about twice more likely to present late than one with a family history. This is so for first degree relations especially vertical although this finding did not reach statistical significance in the multiple regression model in table 2.7. Other weaker associations not significant are unskilled occupations more than skilled, male more than female present with advanced glaucoma.

Table 2.7 REFRACTIVE ERROR IN GLAUCOMAPATIENTS

SHERICAL EQUIVALENT	OD		OS	
	CASE	CONTROL	CASE	CONTROL
<-5.00	1(1.1%)	1(0.8%)	O	1 (0.9%)
-2.75- (-5.00)	4 (4.3%)	4 (3.2%)	4 (4.3%)	5 (4.1%)
-0.25-(-2.5)	14(15.1 %)	28 (22.8%)	9 (9.7%)	29 (23.6%)
0	43 (46.2%)	59 (48.0%)	37 (39.8%)	57 (46.3%)
0.25-2.5	19 (20.4%)	27 (22.0)	22 (23.7%)	28 (22.8%)
2.75-5.00	2 (2.2%)	4 (3.2%)	4 (4.3%)	3 (2.4%)
>5.00	0	0	0	0
NPL	10 (10.7%)	0	17 (18.3%)	0
TOTAL	93 (100%)	123 9(100%)	93 (100%)	123 (100)

With adjusted odds ratio for glaucoma associations by multiple logistic regression model the IOP and age were found to be significant. Adjusted odd's ratio by

multiple logistic regression model showed that Initial IOP> 30mmHg in a patient was more likely to present with advanced glaucoma (OR 2.66, 95% confidence interval 1.45, 4.91, p value 0.0017) than lower pressures. Ageing 60-69 years (OR 2.53, 95% confidence interval 1.01, 6.31, p value 0.0473)and 70-90 years (OR 5.16, 95% confidence interval 1.97, 13.51, p value 0.0008).

Discussion

The present study attempts to elucidate the risk factors associated with late presentation in our environment. The population survey alone did not yield adequate sample size for the intended analysis. Since referrals to the hospital eye service in Ghana are usually from the mass screening exercises of ophthalmic nurses there should be no significant difference in the case mix from the 2 sources used in this project. The patients were chosen with standard criteria and an approximately equal numbers of cases and controls included would minimise bias.

This study confirms the effect of raised IOP on visual loss and is consistent with results of previous studies (Armaly et al, 1980; David et al, 1987; Hart et al, 1979;Frazer et al 1999). Higher IOPs lead to more rapid visual loss and thus an increased likelihood of late presentation(Armaly et al, 1980; David et al, 1987; Hart et al, 1979). One study calculated that for untreated diseases, IOP of 21-25 was likely to progress from early field changes to end stage in approximately 14 years whereas IOPs higher than 30mmHg had a shorter interval of 3 years to end stage. This supports the evidence that IOP is a major risk factor related to glaucomatous optic neuropathy. The odds ratio for raised IOPs higher than 31mmHg, however has another clinical implication that it provides a measure of relative urgency required in managing patients with higher IOP's than 31mmHg as they stand 3 times more chance of having rapid optic nerve damage. However this relative risk does not apply to patients with NTG since by definition,

their IOPs will be in the normal range. In the Wormald study (1994) 74% of newly diagnosed cases of glaucoma in the population had IOPs less than 21mmHg whilst approximately 50% in the Baltimore study (1991) and 54% in the Roscommon study (Coffey et al, 1993) had IOPs less than 21mmHg.

Unsurprisingly ageing also has a major contribution to the visual field loss. Jay and Murdoch,1993, suggested that the difference in average age at presentation for the early stage of glaucoma (comparable to our controls) and the late stage (comparable to our advanced disease) may provide an estimate of the average rate of progression of field loss before diagnosis and treatment. If this hypothesis is true then the small difference of 3 years between the mean ages for the controls and cases may indicate that the rate of progression of field loss is rapid in our study group. Furthermore, the rising trend for advanced disease with age is steeper in the present study than previously reported

by Frazer et al, 1999. This viewpoint confirms the general conception that POAG in people of African origin runs a more aggressive course than in the Caucasian. Put in the right perspective, an African patient of 60 years or older age with an IOP>30mm Hg is very likely to progress to an advanced or end stage glaucoma than other patients of non-African origin.

One reason for people presenting late with glaucoma is the infrequency of eye examination in the population. Since screening for glaucoma requires trained

personnel it would be desirable to determine the caliber of eye care personnel who offered the eye care service to the recruits. This will help to ascertain whether this service provider was capable of glaucoma detection or not. Some people without any formal training sell spectacles, non-ophthalmic staff without any specialized training in eye care provide eye care services to patients with eye problems. Some even consult chemical sellers (Ch 3&4) as "doctors" when they have eye problems. In the United Kingdom the optometrist plays an important role in glaucoma detection. A previous study has shown that 90% of patients with glaucoma are referred to the hospitals on the basis of abnormal findings by optometrists (Sheldrick et al, 1994). In KBTH referrals are usually from mass screening exercises by Ophthalmic nurses providing outreach services or attached to hospitals and clinics where there are no Ophthalmologists. They base their diagnosis on high IOPs(measured with the schiotz tonometer) and or optic disc changes (by direct ophthalmoscopy). In a private hospital in Accra many glaucoma patients were diagnosed during routine medical examination requested by employers (Ntim-Amponsah, 2001).

It was interesting to know that family history of glaucoma cuts down the risk of presenting late by half. This positive Family history of glaucoma does not reach statistic significance level in the multiple regression model. This is probably because the family history data in this study may be incomplete since some of the patients may be unaware of the family history. Family history is a major risk factor for glaucoma. It is most likely that it is protective against late presentation

because of increased awareness among family members and early screening. Indeed in Ghana ophthalmologists encourage family screening for relatives of glaucoma patients. The count for positive family history for 2nd degree relatives was very low. In the light of socio-cultural behaviour it is however not surprising as people generally do not like other relatives to know about their medical conditions. This factor is important when interpreting these results. It is very likely that this may not be the true situation. This is underscored in another study, unpublished) on family screening for glaucoma genes that the principal investigator is also involved, it was found that the probands found it acceptable to inform their children of their condition easily. It was more difficult to inform siblings and very difficult for about 75% of the people to inform other relatives of their condition and bring them for screening. Though some patients reported multiple family members affected over 80% responses were a vertical pattern (i.e. children, parents, grandparents) and only 21% responses were in siblings. This observation is contrary to the findings from other studies where the chances of other sibs being affected is higher than children being affected (Kanski,1994). The low responses on 2nd degree (uncles and cousins) positive history is undesirable because the children tend to be too young to get glaucoma and therefore screening some of them is not cost-effective except in the case of JPOAG. However the older sibs of the parents would be more likely to be affected as it is well established that glaucoma risk is higher in the elderly. Therefore screening older sibs of the parents would be more cost-effective. This information will be useful when considering methods of improving the turn out for

glaucoma screening because the barrier against communication on this issue has to be taken into consideration.

There was no effect of gender on glaucoma visual loss seen in this study although there was a slight male preponderance. These findings may be related to the low level of awareness of glaucoma in the population irrespective of sex.

Many people did not know their blood pressure, diabetes mellitus and sickle cell status. Diabetes, Hypertension, and sickle cell disease are systemic diseases of interest when considering the target disease since these vascular diseases are known to impair ocular microvascular circulation. The association of systemic diseases: diabetes and hypertension as a risk factor for glaucoma in black populations have been previously evaluated (Tielsch et al, 1993 Wormald et al 1991). The Wormald study found diabetes to be associated with POAG in a univariate analysis but this association was confounded by other factors whilst hypertension was found to be associated in the uni- and multi-variate analysis. The Baltimore group (Tielsch et al,1993) only reported a weak association of glaucoma with hypertension. However, no studies exist in the literature where the assoc of these systemic diseases with glaucoma have been evaluated. Unfortunately, the resources available for the present study were limited. A further population based study in the region is recommended to evaluate the

association of diabetes, hypertension, and sickle cell disease with glaucoma and visual loss.

The statistical inferences on the factors which did not contribute significant risks may be attributed to low level of awareness and knowledge of glaucoma (chapter 3) as IOP is the only factor which is independent of awareness. The low power and small sample size may also have contributed.

CHAPTER THREE:

AWARENESS, KNOWLEDGE, AND HEALTH SEEKING BEHAVIOUR FOR EYE CARE.

Introduction

Peoples' awareness and knowledge of a disease determines their response to a disease. As there are often no early symptoms for glaucoma, community awareness of this disease is often lacking. Even in developed countries patients' awareness of glaucoma is low and this knowledge is related to education (Attebo et al, 1987). This situation is bound to be worse in communities like those in Ghana where glaucoma has no local name. Even in developed countries, patient awareness of glaucoma is low unless the individual or a close relative suffers from the condition (Attebo, 1987).The awareness was further related to the level of education(Gasch et al, 2000). The need for screening people at risk will allow timely diagnosis and more effective therapy before advanced visual field loss has occurred. Individuals in an informed community is more likely to present earlier with visual symptoms before irreversible visual loss has occurred and are likely to comply better with recommended therapy (Attebo et al, 1997).

The aims of this study were:-

1. To determine the awareness of glaucoma and other common blinding eye diseases in the Akwapim South district community.

2. To stimulate the awareness of eye health issues in the community, especially glaucoma.

Materials and methods

The study population was the same as described in Ch 1. Research assistants administered a questionnaire (appendix 3 1) to collect information on demographic data from the same sample in Chapter 1. The details of the questionnaire included age, sex, and occupation. The respondent's definition/understanding of blindness, causes of blindness known to him, or cause of action taken in face of an eye disease, past history of eye disease and the individual's knowledge and attitudes to glaucoma were sought. Also demographic data and awareness, knowledge and health seeking behaviour related to eye care.

APPENDIX 3.1 GLAUCOMA SURVEY.

TOWN_____ House identification: _____

1. Name _____
2. SEX : M/ F
3. Age _____
4. Ethnic Origin _____
5. Occupation_____
6. Does anybody in your family have glaucoma: YES /NO/ Don't Know
7. Who is a blind person?
8. What causes blindness in adults?

a . Cataract b."Kooko" c. Glaucoma d.old age e Injury f. Other

(If kooko is one describe it_____)

9. Have you had an eye disease before? YES / NO
10. If YES to 9 above what did you do about it?

a) Clinic b) Drug store c) Herbalist d) Self medication- Western drug

e) Self medication-herb f) Other

11. What is glaucoma?

(12-15 for only those who know glaucoma).

12. How did you get to know about it?

a) Radio b) TV c) Graphic / Papers d) Relatives e) Other

13. Is Glaucoma inherited? YES / NO / Don't Know

14. From what age group is there a high chance of getting glaucoma?

What is the end result of glaucoma?

Results

One thousand five hundred and thirty seven (1537/1785, 86%) of respondents gave a past history of an eye disease.

Eye care sought by those who had eye disease in the past in descending order were:

Clinic or hospital, drugstore, self medication with Western medicine, self medication with herbs and consulting the herbalist (table 3.1).

Table 3.1 EYE CARE SOUGHT FOR EYE DISEASES SUFFERED

Service	% respondents
Clinic	47
Drugstore	23
Self med-drug	13
Self med-herb	11
Herbalist	2
nil	4
TOTAL	100

Few of the respondents also used other remedies as follows: sea water, sugar, breast milk, cassava juice, salt, and ice.

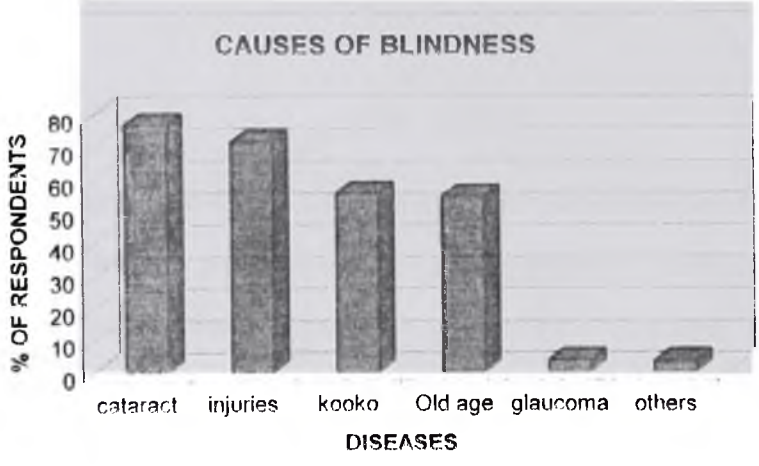
The majority of the people, 99.1% respondents, defined blindness as a person who does not perceive any vision at all. Few, 0.2%, thought a person whose vision is very poor or cannot see anything at all can be considered blind. The remaining records were incomplete on answering this question.

The causes of blindness that respondents are aware of are indicated in table 3.2 and figure 3.1.

Table 3.2 Causes of blindness respondents mentioned

causes	% of respondents
Cataract	77.2
Injuries	71.9
Kooko	55.7
Old Age	54.7
Glaucoma	3.6
Others	3.3

Figure 3.1 Causes of blindness given by respondents in population



Cataract ranked as the most common cause of blindness respondents were aware of (77.2% of respondents) followed closely by eye injuries (71.9%). More than half the respondents were also aware of "kooko" (55.7%) and old age related (54.7%). Only 3.6% were aware that glaucoma causes blindness. Other causes given were onchocerciasis, smoke, poor diet and diabetes.

"Kooko" is the indigenous name for piles however many other diseases are attributed to "kooko". Respondents who thought "kooko" is a cause of blindness explained "ocular kooko " as a growth from the anal region which may extend to the eye (35%), itchy eyes(35%), ubiquitous disease that can affect any part of the body (23%), blurred vision (6%), effect of too much dietary carbohydrate and sugar (5%).

From observation of herbalists' activities in the country it appears that many have one preparation which is supposed to cure so many ailments. Indeed herbal medicine collected from 4 people during the survey for curing cataract and from 2 herbalists had kooko listed among the indications for use. Kooko appears to be an ill defined disease that manifests in several different ways. From observation of herbalists' activities in the country it appears that many have one preparation which is supposed to cure so many ailments.

Twenty people had relations with glaucoma: 15 first degree relations and 5 second degree relations. Only 1% (23/1785) of the population knew it may be

hereditary. About 3.6% (64/1785) were aware of glaucoma as an eye disease but only 0.8% (15/1785) knew that the disease glaucoma is related to optic nerve damage and, or intraocular pressure. Univariate analysis of age, sex, and occupational against knowledge by logistic regression model showed that a person in the higher occupational levels was 9 times more likely to understand glaucoma than the lower levels (OR 0.11, 95% CI 0.04-0.3, Pvalue 0.0001, table3.3) .

Table 3.3 Univariate analysis of age, sex, and occupational against knowledge of glaucoma by logistic regression model

Variable	knowledge	non-knowledge	Odds Ratio (OR)	95% CI	p-value
Age					
30-50	8	1025	1.00		
>=51	7	745	1.20	0.43, 3.33	0.7211
Sex					
Female	8	885	1.00		
Male	7	885	0.88	0.3[illegible], 2.42	0.7972
Occupational					
1=(Managerial, Professional, Skilled NM)	9	253	1.00		
2=(Skilled M, Semi-skilled, Unskilled)	6	1532	0.11	0.04, 0.30	<0.0001

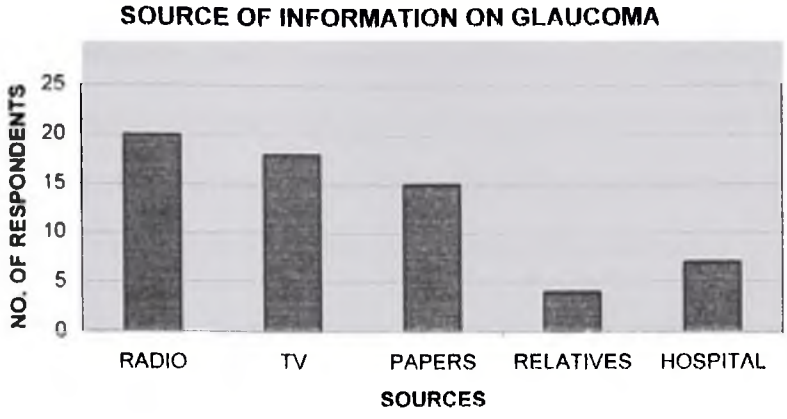
About 18.6% of subjects who participated were walking around with low vision, 6% with visual acuity worse than 20/200 thought their vision was blurred and only the 0.85% with PL and NPL considered themselves as blind (table 3.4).

Table 3.4 DEFECTIVE VISION IN POPULATION (BETTER EYE)

VA	%
<20/70	18.6
<20/200	7.1
PL	0.5
NPL	0.35
NPL&PL	0 85

Among the few who had heard of glaucoma before, they heard about glaucoma from the following one or more of the following information sources: radio, 20; Television ,18; newspapers ,15; hospital staff ,7; and relatives ,4; (figure 3.2).

Figure 3.2: Source of information on Glaucoma



Age at high risk of getting glaucoma given by respondents were childhood, 4; 20-34 years, 3; 35-70 years, 21. Forty-four (44) respondents said the end result of glaucoma is blindness.

Discussion

Common causes of blindness that more than 50% of the respondents were aware of were cataract, eye injuries, "kooko", and old age. Cataract is often obvious and has local names amongst the different tribes. It is so common that one would expect a much higher percentage than that of 77.2% recorded. In an Australian study 98% was recorded (Attebo et al 1997).

The major occupation in this district is farming. Various types of injuries are associated with agricultural activities and visual prognosis is often poor as these wounds usually get infected and result in endophthalmitis. Corneal scarring and phthisis bulbi often result are frequent end results. However blindness resulting is usually unilateral and it is rare to have bilateral blindness from injuries. It is not surprising that awareness of eye injuries causing blindness was so high but in this circumstance the blindness referred to is unilateral.

More than half of the respondents considered "kooko" as a cause of blindness and/ or itching. "Kooko", the local name for piles appears to be an ubiquitous disease with myriads of symptoms from head to toe. Other ocular features attributed to "kooko" were growths, and blurred vision. The dusty environment and frequently associated eye irritation often gives rise to itching and conjunctival degeneration growths (pterygium and pingueculum). This study confirms clinical experience that Haemorrhoids is only one of the manifestations of kooko in the Akwapim South district. This has important implication for all physicians to explore diseases self diagnosed as kooko by non-medical personnel even when it is referred to the anal region of. The quantification of the magnitude of blindness attributed to "kooko" in this study is important in planning strategies for health education to increase awareness of prevalent eye diseases and their aetiology.

Awareness of glaucoma blindness is very low in this population. Glaucoma is difficult to explain in the local Ghanaian languages and has no local name for it unlike cataract or corneal scar. Attebo et al's study (1997) in a Metropolitan

Australian population recorded an awareness of cataract of 98% and glaucoma 93% as common causes of blindness in the study population, levels much higher than our study. That study related awareness to educational level, occupational prestige and knowledge of other eye diseases and concluded that the knowledge increased with higher education and occupational prestige. A Cross-sectional study to ascertain determinants of glaucoma awareness, in a United States population visiting a general eye clinic found that glaucoma awareness was as high as 72% overall (Gasch et al 2000). Hispanics, African Americans, and those with less than a college education were m ore likely to be unfamiliar with the disease. Survey attributes associated with an increased likelihood of being unaware of glaucoma were African American race (OR = 1.69, Hispanic ethnicity (OR = 2.13), and less than a college education (OR = 1.67). Age was also a determinant of glaucoma awareness (for ages 50–64 years, OR = 0.60 and for ages 65–79 years, OR = 0.56 compared with ages less than 35 years Although the educational level was not recorded in our project occupational levels in general are related to education in this district. Thus from inference our study population has lower levels of education and occupational prestige.

People in the higher levels of occupation were 9 times more likely to have a reasonable knowledge of glaucoma than the lower levels of occupation.

In the Akwapim-South survey as many as 93% were newly diagnosed cases who were not aware that they had glaucoma. In the Rotterdam study 52.9% of the

patients (Dielemans,1994), in The Blue Mountains Eye Study 51% (Mitchell et al,1996) POAG had not been diagnosed as pertains in most developed countries. Quigley's review of literature worldwide (1996) showed that in developed countries, fewer than 50% of those with glaucoma are aware of their disease. In the developing world, the rate of known disease is even lower. Glaucoma is a difficult disease to explain in the Ghanaian local languages to patients. It does not appear there are precise words for "pressure" and "nerve". It is possible that some of the apparent 93% newly diagnosed may have been diagnosed before but they did not have an insight into their condition, were not aware they had glaucoma, and had discontinued treatment. It may not be easy for subjects to know of other relatives who have glaucoma with good visual acuity. It is therefore not surprising that only 1% of the total population knew that POAG runs in families. The 7.4 % with positive history of first degree relations affected obtained in the POAG population was made up of 6 who were already aware and 5 families who were discovered during the survey. The low level of awareness in the Akwapim-South district also makes it difficult to get a reliable family history of glaucoma. It is likely that the actual magnitude of positive family history is higher.

In the present study 99.8% defined blindness as inability to perceive any vision at all not even light. It appears a significant number of participants in the study population had subnormal vision. Appropriate correction of refractive errors would have improved the vision of many of them including some of those who

were already wearing spectacles as their refractive errors were under-corrected. The legal definition of blindness in Australia is vision less than 6/60 and a study in Australia found that refractive errors were responsible for 27% of blindness in a population study (Taylor, 2000). It was not feasible to refract all the participants of the study manually to determine the magnitude of refractive errors with the resources available but clinical experience and reports on eye care in Ghana indicate that refractive errors are common in Ghana as elsewhere (National Eye Care Report, 2000). It would have been more scientific to quantify visual loss that can be rectified with the simple provision of a simple device as an appropriate pair of spectacles. The provision of an autorefractometer for the elderly would have been more desirable than the manual focometer used for the study. The participants found it difficult to use the focometer generally. It has been noticed in a Nigerian study that visual disability is left to assume a high degree before help is sought (Olurin 1973). The study attributed this to high rate of illiteracy and carelessness that make patients unaware of early changes of vision. It is not unusual for patients to be found blind at the first presentation with cataract or refractive error in our environment even though these conditions can easily be treated with good visual outcome. Clinical experience and communication with other Ophthalmologists in the West Africa sub-region also supports this result that people tolerate low vision once they are able to move round confidently. An earlier hospital based study conducted in the Aburi eye clinic in this district showed that patients with glaucoma presented with more visual loss and blindness than patients that presented with glaucoma at a city

eye clinic (Ntim-Amponsah,1998). Vision 2020, the global initiative to eliminate visual impairment less than 6/18(20/70) by the year 2020 and "give all people the right to sight" was launched in Ghana in year 2000. This information will be useful for raising the awareness of the people and get community participation to help achieve the goal of the Vision 2020 initiative.

Harmful traditional eye practices (HTEP) usually with herbs and other concoctions present at an unacceptable level in this community. Some of the cases of cornea scarring and phthisis bulbi found during the survey could be attributed to HTEP The literature provides supporting evidence that corneal damage and blindness have resulted from traditional eye preparations (Courtright, Lewallen, Kanjaloti, Divala,1994; Yorston& Allen,1994). It is interesting that self-medication of traditional eye preparations is commoner than that prescribed by herbalists. This finding is significant when planning to reduce blindness caused by traditional eye medicine. Many elderly people in Africa have some knowledge of how to treat common ailments by using herbs and real traditional healers are consulted for complaints other than the most rudimentary (Courtright et al 2000). The service providers targeted should not be only the herbalists but also non-herbalists in the community who have knowledge of herbal medicine most importantly as well as education of the public about avoiding self medication should be promoted.

Although there were 2 eye clinics in the district, some of the referred cases preferred to go to Mampong if they had been treated there previously or to Korle-Bu Teaching Hospital in Accra where they believed they would get the best treatment. The proximity of the eye clinic in Aburi was not an advantage for those who wanted to go elsewhere.

Drugstores are important service providers for our rural folk and programs aimed at Prevention of blindness will be facilitated if they are involved and trained to recognize cases which need referral.

CHAPTER FOUR:

ALTERNATE EYE CARE SERVICE PROVIDERS

Introduction

One of the impediments to reducing blindness is the problem of access to appropriate eye care services. In any community where there is inadequacy of healthcare facilities the population tends to seek alternate facilities or providers to take care of their needs. Even when the services are available some people may not use them. Some in such population will prefer as well to self medicate Western and indigenous herbal preparations.

The health institutions situated in the Akwapim South district are 1 government hospital, 4 private clinics, and 2 optical centres at Nsawam, 1 health centre at Pakro, and 1 mission general and eye clinic at Aburi. There is 1 ophthalmologist and 1 ophthalmic nurse at Aburi and 1 ophthalmic nurse at Nsawam. These serve more than the population of the district which is 120,500 (2000 census) Nsawam is a major commercial center, easily accessible, and has a relatively big hospital serving not only the district but also the other districts with which it shares boundaries. These are Akwapim North district in the North, Ga district in the South and East, Suhum Kraboa Coaltar and Akim districts in the West. It is likely that substantial information and services for eye care is sought outside the hospitals and clinics.

There are several chemical shops and herbalists who provide eye care services in the district. Traditional healers have been a part of most African cultures. They live and work even in the most rural villages; they are already in place.(Courtright& Lewallen, 1997; Bimal, 1997; Harjinder,1997). Traditional

healers consist of herbalists, diviners and other types. The purpose of this study was not to delve into the different healers but to include herbalists. It is also common knowledge that people buy drugs from hawkers, chemical shops and pharmacy shops without consulting an appropriate authority for clinical examination and diagnosis before treatment. The numerical strength of these chemical shops and herbalists who also live in the community make them ideally placed to be patronized by the community as eye care service providers. It is therefore difficult to disregard the role of these other partners in eye care in our Ghanaian communities.

Little has been documented on the extent of information and services for which eye care is sought outside the hospitals and clinics. It is also helpful to know the background and training of those who interfere indulge eye care.

The objectives of this study were

1. To determine the background characteristics of chemical sellers and herbalists
2. To determine the knowledge on eye diseases and those treated by herbalists and chemical sellers who share the burden of providing eye care services in the Akwapim-South district.
3. The level of operation of chemical sellers and herbalists.

Materials and methods

The towns covered in Chapter 1were used for this study. Members of the community and the herbalists themselves were informants who helped to identify other herbalists in the area. Information was collected by a questionnaire administered by 3 research assistants. Interviews of the herbalist were conducted in the absence of the principal investigator. The principal investigator went round the towns identifying chemical shops, finding what drugs they sold and the basis for selling the drugs to the patients in an informal way.

The research assistants administered a separate questionnaire afterwards to herbalists (appendix 4.1) and chemical sellers (appendix 4.2) in the district from December 2000 to January 2001. The details for herbalists included age sex, education, and additional occupation. Other details were trainers and trainees of the respondent, duration of practice, eye diseases and number treated within past year, route of administration of herbal preparation. The principal investigator also interviewed 10 herbalists and 20 chemical sellers in the district . The details for chemical shops also included age, sex, education, and additional occupation. Other details were training and its duration before appointment, inservice training and desire and choice of further training.

Appendix 4.1 : Questionnaire for herbalists

HERBALISTS- INTERVIEWS

1. WHO DOES HERBALIST TREAT?
   A) EYE DISEASE ONLY
   B) OTHER DISEASES
   C) EYE & OTHER DISEASES.
2. WHAT EYE DISEASES CAN HE TREAT? LIST

3. ROUTE OF ADMINISTRATION OF DRUGS USED-

A)PUT INTO EYE B)TAKEN BY MOUTH C)ENEMA D)OTHER

4. HOW MANY EYE DISEASES HERBALIST TREATED DURING YEAR 2000

5. AGE AT ONSET OF HERBAL PRACTICE:

6. OTHER OCCUPATION:

7. WHO TRAINED HERBALIST?

8. HOW MANY PEOPLE HAS HERBALIST TRAINED?
9. SEX: M /F
10. ETHNIC GROUP:

11. AGE:

12. EDUCATION:

13. A) NONE B)PRIMARY C)MIDDLE D)SECONDARY
E)OTHER

14. TOWN:

15. NAME

APPENDIX 4.2 QUESTIONNAIRE FOR DRUG STORES

1. Town Drug Store Situated:
2. Sex: Male/ Female
3. Other Occupation:
4. What Eye Diseases Do You Treat? Explain The Disease

Name Of Disease	Explain

5. No. Years Practiced At Drug Store:
6. Did You Have Any Training To Work In Drug Store? Yes/ No
7. If Yes To #6 Who Trained You?
8. If Yes To #6 What Training Did You Have?
9. If Yes To #6 How Long Was Your Training?
10. Did You Have Any Further Training In The Last 3 Years? Yes/ No
11. If Yes To #10 How Many Times
12. Would You Like Some More Training? Yes/ No
13. If Yes To # 12 What Training Will You Like?
14. Age
15. Level Of Education Reached:
16. Who Owns The Store?

Results:

Twenty one drug stores (Table 4.1) and 60 herbalists (Table 4.2) were identified.

The map in figure 1 shows the location of the chemical shops and herbalists.

Table 4.1: Location of Chemical shops

Town	#shops	Eye drugs sold
NSAWAM	10	Chloramphenicol gentamycin
ABURI	4	Chloramphenicol gentamycin
KITASE	2	Chloramphenicol gentamycin
OBOADAKA	1	Chloramphenicol Gentamycin
POKROM	1	Gentamycin
NTOASO	0	
AHWEREASE	1	Chloramphenicol Gentamycin
KONKONURU	0	
ADAMROBE	0	
AHODWO	0	
BEREKUSO	0	
DOBRO	0	
FOTOBI	1	Chloramphenicol
OBODAN	0	
AMANFRO	1	None
TOTAL	**21**	

Table 4.2 DISTRIBUTION OF HERBALISTS

Town/village	No. herbalists	# treating eye disease
ABURI	10	9
ADAMROBE	3	3
AHODWO	6	4
AHW EREASE	5	3
AMANFRO	1	1
DOBLO[2]	3	2
GYANKAMA	5	3
KITASE	6	4
KONKONURU[1]	2	1
NSAWAM	9	6
OBOADAKA	2	2
POKROM	3	2
Grand Total	55	40

Ten males and 4 female chemical sellers responded to the questionnaire. The mean age was 34 years and the age ranged from 18 to 71 with a standard deviation of 15.35, median 30, mode 18. They had practiced from 4 months to 49 years with a mean of 10 years, median 7, mode 10 and standard deviation 12.4. The drug stores were manned by attendants who had no formal training on eye diseases. These attendants gave topical antibiotic eye preparations to all eye problems as first line drugs. If there was no improvement then they would advise the patient to go to the hospital. Two cases of perforating eye injuries were seen in Aburi Eye clinic during the study. They were using eye drops sold to them when they consulted chemical sellers. The eyes had become irreversibly

blind at the time they consulted our team. When the principal investigator went in as a customer and conducted a brief informal interview the shop attendants provided some information on eye care services. However when the questionnaire was being administered all the respondents said they had instructions not to treat eye diseases that they carry out. None of them answered the question no 4 on eye diseases they treat as they claimed they did not treat any. Twelve had had some training on reading prescriptions, treatment of malaria and diarrhoea by pharmacists or on the job at other drug stores. Two had no training. One person owned the shop, 2 were running it for their relatives and the remaining 10 were employed to run the shops. All of them were literates. Educational background was middle school 4, junior secondary school 1, GCE O-Level 3, senior secondary school 5, and training college 1 (table 4.3). All of them would like more training. Three would like to be trained as pharmacists, 3 in eye diseases, and one each in dispensing, medicine, first aid, general health care, giving injections, management, own chemical shop and any relevant training. The large number of 7 non-respondents points out the bias of these responses.

Sixty herbalists were identified. Fifty-five herbalists were interviewed and 5 declined to participate. There were 11 female and 44 male giving a female to male ratio of 1:4. Their ages ranged from 20 to 89 years with a mean age of 57, median 59 and standard deviation 17.11. The distribution by location is displayed in table 4.2. Their educational background was primary school 2,

middle school 17, secondary 4, training college 3, vocational/commercial 3, Arabic school 1, mass adult education 7 (table 4.4).

Table 4.3 EDUCATIONAL LEVEL - CHEMICAL SELLERS

Level of education	Number of respondents
Middle school	4
Junior Secondary	1
GCE O-Level	3
Senior Secondary	5
Training college	1
No answer	7
Total	21

Table 4.4 EDUCATIONAL LEVEL OF HERBALISTS

LEVEL REACHED	#RESPONDENTS
NIL	21
PRIMARY SCHOOL	2
MIDDLE SCHOOL	17
SECONDARY SCHOOL	4
VOCATIONAL/COMMERCIAL	3
ARABIC	1
ADULT LITERARY CLASSES	7

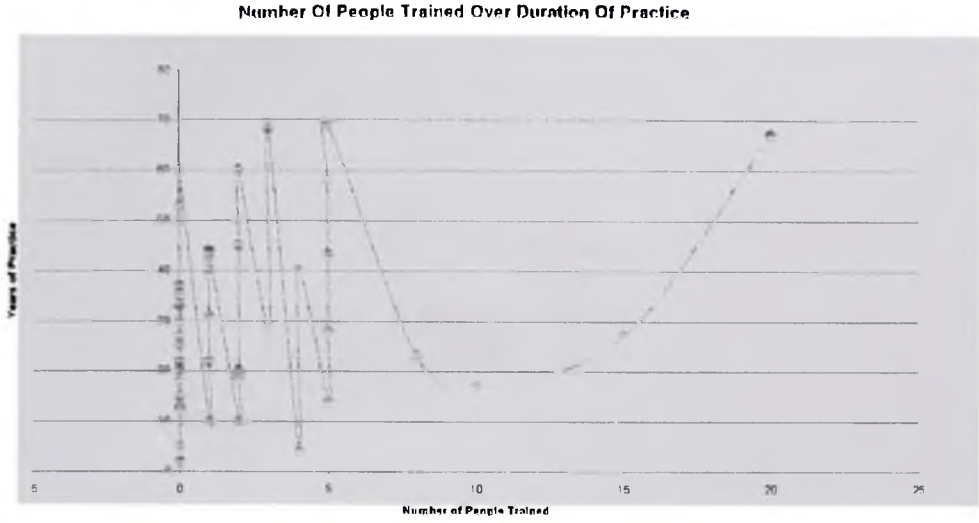
The duration of practice was 2 to 69 years with an average of 30 years and median of 27 years, Figure 4.3. Most of them had learnt the practice from relations: from 29 parents , 10 grandparents, 3 sibs, 2 husbands, and 7 claimed

they received direct divine training (table 4.5). The number of people trained had no relation with duration of practice and many did not train any body (fig 4.4).

Table 4.5 TRAINER OF HERBALIST

TRAINER	No.	%
PARENTS	29	52.72
GRANDPARENTS	10	18.18
UNCLE	4	7.27
SIBS	3	5.45
SPOUSE	2	3.63
REVELATION	7	12.72
TOTAL	55	100

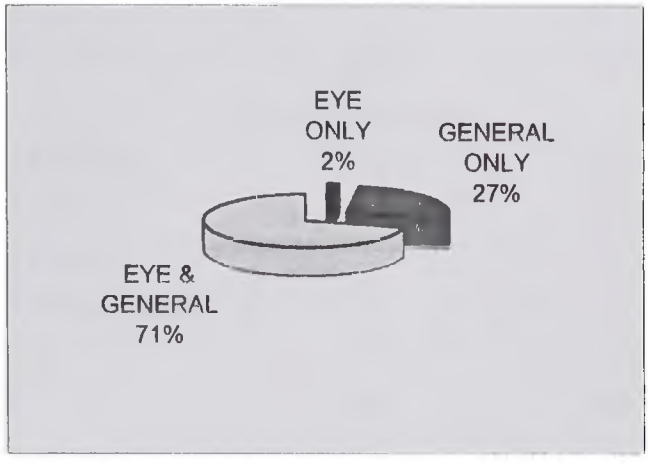
Figure 4.4 NO. OF PEOPLE TRAINED BY HERBALISTS



There was only one herbalist who treated only cataract. Thirty- nine herbalists treated several diseases including eye diseases and the remaining 15 did not treat eye diseases (Fig 4.5). The eye diseases the herbalists claimed as being able to treat are treated were cataract, eye injuries, "kooko", and Apollo, (fig 4.6). The conditions they listed they treat are cataract 82%, eye injuries 82%, kooko 75%,and Apollo 28%. Injuries were diagnoses from the history. Cataract was the next most defined diagnosis but it was confused with corneal opacity. The herbalists referred to a "small cataract" or the" true cataract" in the center of the pupil that is easy to treat and a "large cataract" which extended over the iris and is resistant to treatment. It appears that the latter is a corneal opacity.

Figure 4.5

TYPE OF DISEASES TREATED BY HERBALISTS



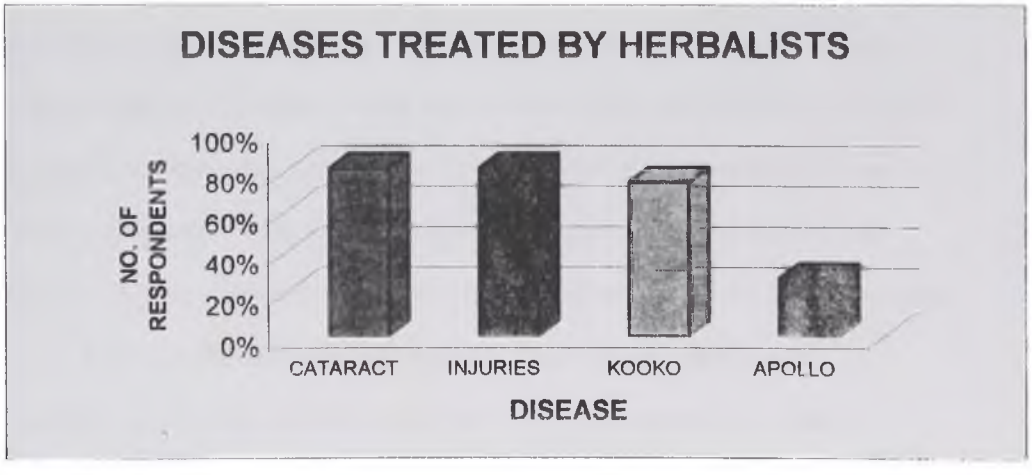


Figure 4.6

The routes of administration of the herbal medicine were instillation into the eye and nose (50%), instillation into the eye 25%, oral and eye 10%, oral and nasal, and ocular 10% and only oral only5% of respondents (table 4.6).

Table 4.6 ROUTE OF ADMINISTRATION OF HERBAL MEDICINE

ROUTE	N0. 0F RESPONDENTS	%
OCULAR & NASAL	20	50
OCULAR ONLY	10	25
OCULAR & ORAL	4	10
OCULAR, NASAL, ORAL	4	10
ORAL ONLY	2	5
TOTAL	**40**	**100**

Discussion

The number of chemical shops and herbalists in this district grossly outweighs the number of eye care personnel in the hospital, clinics and optical centers. General medical practitioners in the district also provide some services for minor ailments of the eye. Eye care sought by those who had eye disease in the past in descending order were: Clinic or hospital, drugstore, self medication with Western medicine, self medication with herbs and consulting the herbalist (table 3.1).). It is not surprising that nearly half (47%) of respondents used hospital/clinic services while the other half (49%) used chemical stores, herbalists, or self -prescribed medication from the last 2 service providers. This data confirms the view that significant eye care services are also provided by

chemical sellers and herbalists. It also indicates that the people patronised the services of these alternate service providers as much as they patronised the hospitals and clinics using chi square test (P value 0.78).

It was surprising to find out that though the herbalists made an attempt to categorise type of eye diseases they treat the drug stores give antibiotic eye drops for all eye conditions. In a predominantly agricultural district where eye injuries are common a thorough examination would be necessary to make the correct diagnosis and start the appropriate treatment early in order to prevent avoidable visual loss. Indeed some may even require urgent surgery like the 2 perforating eye injuries that consulted our team.

Although the herbalists alleged they treat cataract, eye injuries, appollo and kooko it was doubtful if the diagnoses are precise. Cataracts are probably confused with corneal opacities both of which cause "a white spot". The "large" or "true" cataract which covers the iris and is difficult to treat is most probably corneal opacity. It is important to differentiate a corneal scar from cataract that may receive the same treatment from the herbalists. It may be worth while trying to teach the herbalists the difference between cataracts and corneal opacities which require different treatments. An earlier study in traditional methods of treatment of cataract postulated that herbal medicine may cause zonulyses and dislocate the lens or cause phacolysis leaving behind the lens capsule. Modern

advances in cataract surgery with intraocular lens implants corrects the severe visual disability of high refractive error when the cataract is removed. However if the phacolytic property of the herbal medicine could be scientifically tested and its benefits/risk found to be desirable it would revolutionalise cataract operation by cutting down time for surgery and possibly cut down costs of surgery which runs into some thousands of dollars in the developing countries. Zonulysis is however not desirable in modern cataract surgery as it is associated with serious complications. Although there are claims for herbal treatment of cataract and some plants have been documented (Ntim-Amponsah C T.,1995) further scientific studies are required to establish the effect of these herbs on the eye and confirm that they actually treat cataract . In Ghana barriers to uptake of eye surgery include fear , cost, and lack of faith in the outcome (Ntim Amponsah,, 1997). A publication on Collaboration with traditional healers (Courtright et al,2000) suggests that traditional healers can significantly influence some of the barriers that prevent people from accepting cataract surgery. The objective is to train traditional healers to recognise and refer cataract patients for surgery. However cataract is the commonest cause of blindness from which these herbalists make a living. Unless there is clear understanding of how the referral will work to the benefit of the herbalist the herbalist may be suspicious thinking he is turning over patients and indeed his livelihood to biomedicine. It was therefore not surprising that none of the herbalists the principal investigator contacted was prepared to give samples of herbs used but would give the products for a fee.

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Apollo presents with red eyes. In our communities Apollo is often used as a synonym for red eyes although it is only one of the causes of red eyes. Herbalists do not distinguish between different diseases which result in a red eye. Else where the red eye is the commonest eye condition traditional healers treat and it is one of the diseases the healers have the most potential for helping or harming (Courtright et al, 2000). The harm may occur if substances that lead to cornea destruction are instilled into the eye or there is delay in referring for the appropriate treatment. They suggest training the healers to understand the dangers of instilling substances directly into the eye and refer patients that are not responding to treatment after 3 days. Traditional birth attendants (TBA) who are also herbalists are more likely to see more of neonatal conjunctivitis. Healers who are TBAs often recognise the link between disease in mother and the new born (Courtright et al ,2000). TBAs may also see more childhood conditions like congenital cataract, congenital glaucoma and retinoblastoma (Ntim-Amponsah, C.T., 1996). TBAs already receive training from the Ministry of Health and additional training to understand early referrals of neonates with abnormal looking eyes may help prevention of childhood blindness.

Most of the red eyes treated are likely to be infective conjunctivitis, the commonest cause of red eyes in the community. Although some herbs have been documented for treating conjunctivitis at the Mampong Centre for Research

into Plant Medicine (Oku Ampofo, personal communication) the anti microbial nature of these drugs are yet to be determined. The chemical sellers would easily treat conjunctivitis since all they sell for eye care are antibiotic eye drops.

Kooko remained as ill defined as the responses from the participants in Chapter 3. Only 1 herbalist mentioned that he treated glaucoma after it has been diagnosed by the clinician. However further interview by the principal investigator revealed that he was only aware that glaucoma exists but had no knowledge of it. He claimed he used not only herbs but also some supernatural means in addition to cure glaucoma. Although this is the only herbalist who mentioned the target disease this study looks at only herbs which are easier to evaluate than the supernatural.

The most popular route of administration is instillation into the eye in 95% of respondents. Topical administration of the herbal preparation accounts for the undesirable cornea and conjunctiva effects. This confirms why damaging effects on the cornea and blindness results from TEM. It would have been more helpful to know and analyse the plants used but herbalists were not keen on showing us the plants and at best would only provide the preparation if even the plant grew around the herbalist's house. The practice of herbal medicine seems to be passed on to family members (table 4.5). There is no correlation between the duration of practice by herbalists and number of people they train (figure 4.4).

Some even practice over 40 years without imparting their knowledge to anyone. Any useful information may therefore be lost. Among the reasons why herbal medicine is not shared readily with other people is that some of the herbs can be very poisonous and therefore the herbalist must be convinced that whoever the knowledge is imparted to will not use it to cause harm (Quarm K, personal communication) Also the impression of fear of the herbalists not getting adequate compensation was evident from the ones that I interviewed and requested samples of herbs used for treating eye diseases. None of them provided the plant but preferred to give away the product that did not give away the identity of the plant.

From Chapter 3 self medication with herbal preparations was much higher than consultation of herbalists. Some of these are due to herbal medicine sold all over the place by peddlers who also are well known to carry on brisk business at lorry parks and on moving commercial vehicles. Harmful traditional eye practices (HTEP) usually with herbs and other concoctions prevail in this community. Some of the cases of cornea scarring and phthisis bulbi found during the survey were attributed to HTEP The principal investigator's experience from running an eye clinic in this district and the literature is evidence that corneal damage and blindness have resulted from traditional eye preparations (Courtright et al, 1994; Yorston & Forster 1994). It is interesting that self-medication of traditional eye preparations is commoner than that prescribed by herbalists. Because of this when planning to reduce blindness caused by traditional eye medicine, the

service providers targeted should not only the herbalists but also non-herbalists in the community who have knowledge of herbal medicine as well as education of the public.

An impression from the literature is that Traditional healers have been a part of the health delivery system in most African cultures. They live and work even in the most rural villages; they are already in place (Courtright,& Lewallen, 1997) They are respected by the community who patronise their services. This study confirmed the large numbers of traditional healers who live among the people however patronage by direct consultation was low in this community. Indeed the average number of patients seen per herbalist within the year 2000 was 5. There were 15 who did not attend to any patients at all. It is likely the numbers are even fewer as there were 4 of the herbalists who most probably inflated the number of patients they saw to 20 and 30.

All the chemical sellers were literate while nearly half of the herbalists had had no formal education at al. This difference needs consideration in planning eye care programs to address chemical sellers and herbalists especially as glaucoma and its pathophysiology uses terms not found in the local languages. For instance teaching materials which are pictorial rather than written will suit both chemical sellers and herbalists while written material will not be appropriate for most herbalists.

Konkonuru is alleged to have the renowned herbalists. Four herbalists declined participation in the project. One herbalist abandoned the questionnaire when the eye specialist joined the research assistant to continue administering the questionnaire.

Figure 4.1 Map showing location of chemical shops& herbalists

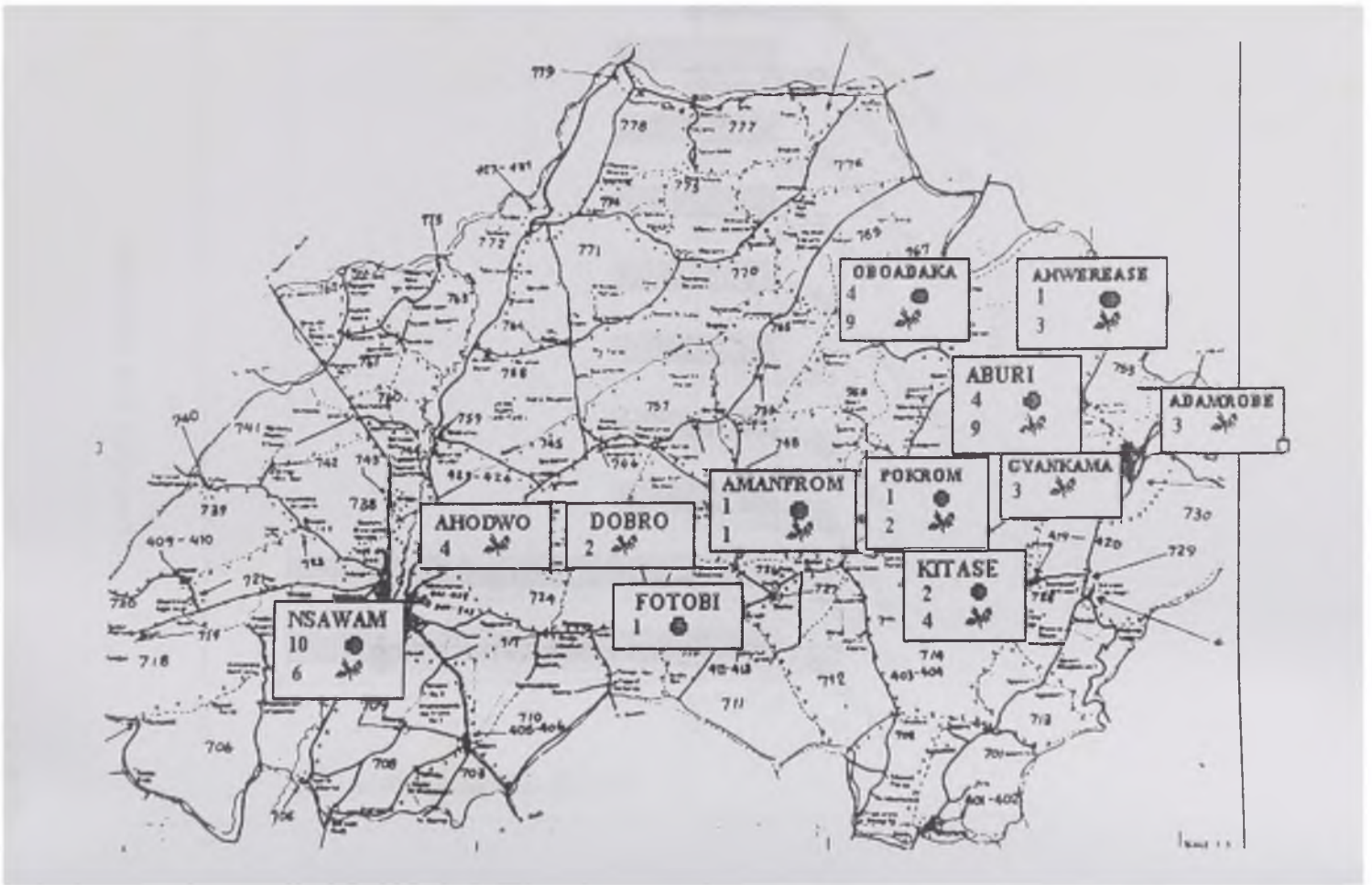


Figure 4.2

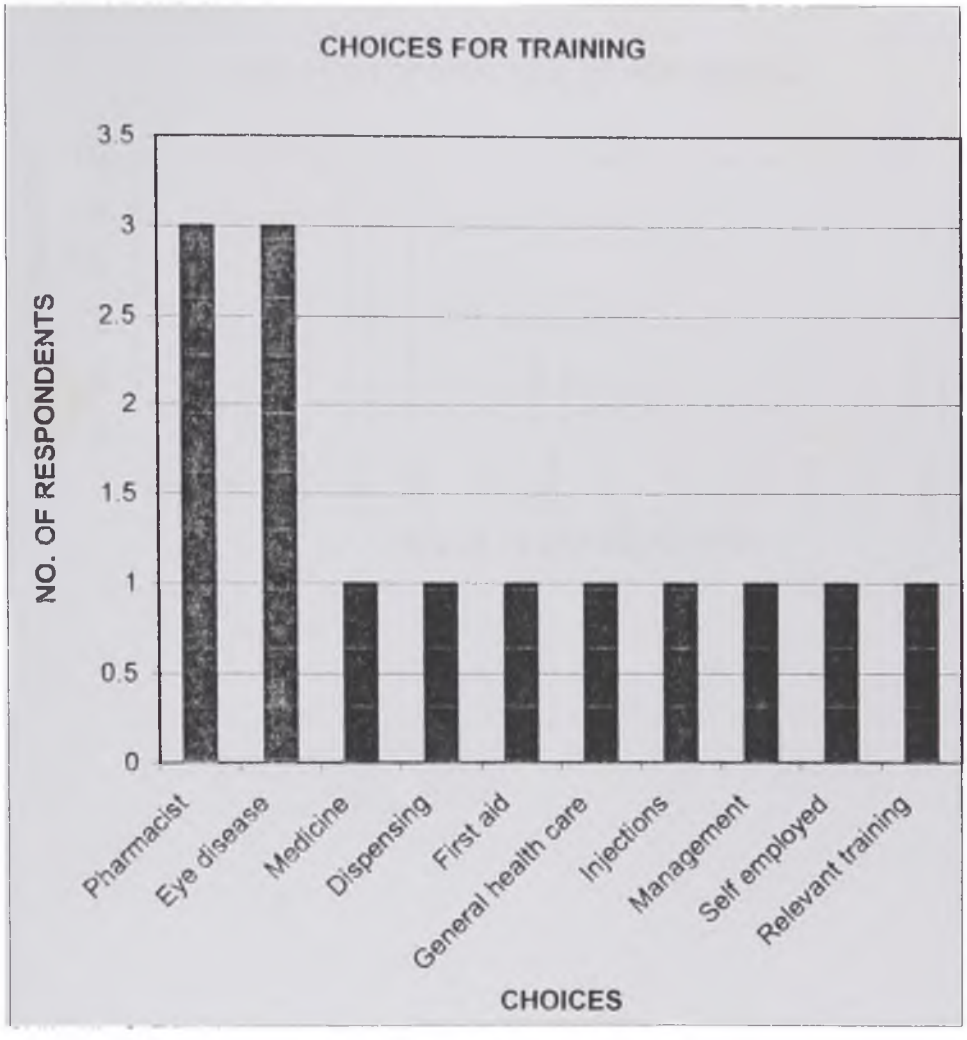
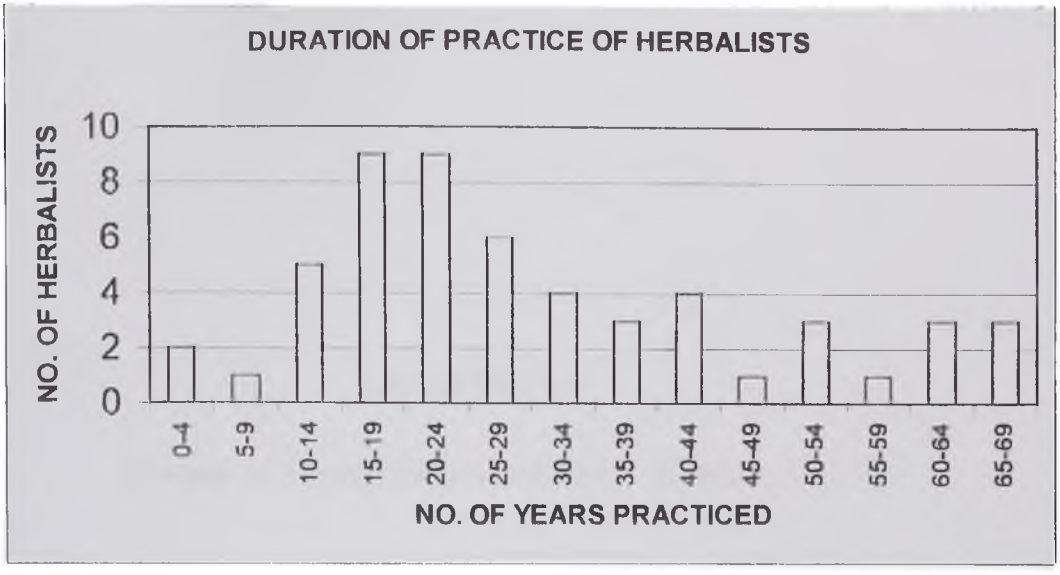


Figure 4.3 DURATION OF HERBAL PRACTICE:



CHAPTER FIVE:

REVIEW OF CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The prevalence of POAG was higher in the study population than in Caucasians but was similar to that in Barbados blacks. The onset of POAG started earlier before the age of 30 in the study population. The trendline for prevalence/age was exponential.

No significant ethnic differences were found.

MIOP >31mmHg was the most important risk factor in addition to aging >60 years, associated with glaucomatous optic nerve damage.

The awareness and knowledge of glaucoma was very low in the study population.

Chemists and herbalists and those who self medicate interfered with provision of appropriate eye care services to a large extent.

Discussion

Determination of the real magnitude of glaucoma in the West African population by scientific epidemiological studies has not received much attention. This opinion is based on literature search and a discussion at a forum held with ophthalmologists present at the annual meeting of the West African College of Surgeons held in Yaoundé, Cameroon in February, 2002. Logistics was an obvious limitation but there is also perhaps due to the impression that the

average ophthalmologist is so institutional oriented that he hardly saw beyond the hospital population. The community that is so essential in prevention of blindness has been effectively ignored. This may not be deliberate but essentially due to inadequate number of eye care personnel. Yet since glaucoma is asymptomatic and tends to run in families it follows that for every case of glaucoma diagnosed in the hospital, it is likely there are more undiagnosed early cases in the family and the community in general. There is a low level of awareness and knowledge about the disease in the community as evident from this study and thus lack of awareness strongly associated by lower levels of occupation/education.

There is little doubt that glaucoma constitutes the second cause of global blindness and new surveys suggest that even Quigley's projection (1996) of 6.7 million people blind from glaucoma in the year 2000 appears to be an underestimate (Johnson G J, 2001). This is not surprising as most populations are aging and there has not been straightforward ways of dealing with this condition in large populations within prevention of blindness programs (Johnson G J, 2001)). Indeed glaucoma is not one of the priorities for disease control in the first 5 years of vision 2020 initiative. However because of the burden of blindness caused by glaucoma and the progress made in controlling some of the major causes of blindness it is likely that it will be included in the next 5 years strategy for vision 2020. It is therefore very important to make preparations for case detection and treatment that can be applied to the population. There have

been new developments in various aspects of glaucoma. These include diagnosis, genetics and relationship of intraocular pressure to progression of the disease and treatment.

Local terminology:

The absence of specific local terms that refer to glaucoma, nerve and pressure in Africa makes it difficult to talk about the disease in the vernacular. Cook (2001) has initiated the move to find a term when he refers to it as "black blindness" referring to the black pupil with reduced vision (Cook 2001).

Risk factors:

It is generally expressed in the literature on glaucoma that the aetiology of POAG is multifactorial resulting from a combination of identified and unidentified genetic factors, endogenous and exogenous environmental factors.

Genetics:

The familial tendency and multifactorial aetiological basis of glaucoma continue to stimulate research into the genetic basis of glaucoma. So far one gene namely myocillin/TIGR (trabecular meshwork inducible glucocorticoid response) gene at the GLCIA locus on chromosome 1q21-q31 is known. However several

loci and many mutations have been identified in ethnically diverse populations worldwide. In a study in which the principal investigator is involved, 47 unrelated subjects of Caucasian, Hispanic and African ancestries with juvenile glaucoma or adult onset POAG were screened for mutations in TIGR/MYOC. Mutations were found in 7 unrelated subjects, including a Glu352Lys mutation in a Ghanaian individual with ocular hypertension. (**R. M. Ayala-Lugo** et al, 2001). In principle once mutations have been identified in Ghanaian families it paves the way to develope this knowledge for identification of persons at risk of developing glaucoma, early diagnosis and management of glaucoma in Ghanaians too. Since the mutation discovered so far is responsible for a small fraction (5% of POAG) the most useful role of pre-symptomatic diagnosis of people at risk will be in large families with early onset, severe disease where early diagnosis improves prognosis and also allow for genetic counseling. Eventually this may lead to new treatments that prevent or cure the disease.

Pathogenesis of optic neuropathy

IOP has long been recognized in the pathogenesis of glaucoma optic neuropathy. The role of IOP independent mechanisms are increasingly recognized especially from the vascular perspective. However there is no single test to evaluate metabolism of the optic nerve head. The Normal Tension Glaucoma study showed that 20% of cases in which IOP is controlled have progressive visual field loss whereas 40% who do not receive treatment remain stable (Drance et al, 2001). Hence treatment agents that do not only reduce IOP

but also improve ocular blood flow or are neuroprotective are on the increase. The study on factors associated with advanced presentation of glaucoma has clearly demonstrated the relationship of IOP as a major risk factor to progression of the disease and also the strength of association in the Ghanaian. This knowledge is very crucial in setting guidelines for treatment of patients with glaucoma to minimize progression of visual field loss. Measurement of IOP is relatively simple and less expensive compared to the more sophisticated examinations mentioned earlier on.

Diagnosis:

The traditional methods used for diagnosis are IOP, optic nerve head assessment and perimetry. Scanning laser tomography and scanning laser polarimetry are currently the most advanced imaging devices for assessing the optic disc and neuroretinal rim, and, retinal nerve fibre layer respectively. These may be useful in early diagnosis before obvious visual field loss. Currently this technology appears sophisticated and is quite expensive but Johnson (2001) suggests that it may turn out to be the most cost-effective method of screening large populations for POAG, and also to meet the rigorous requirements for a satisfactory screening test. Obviously such technology is not likely to be available in developing countries where the burden of POAG is relatively higher.

Cook developed a simpler method in rural South Africa that enables case detection at the primary health care level. In persons aged over 40 years reduced visual acuity in one or both eyes + black pupil= "black blindness"/ visual loss ("glaucoma" →refer to secondary level) (Cook C, 2001). Cook acknowledges that many of those referred by these criteria are more likely to have refractive errors or other pathology that can be dealt with at the secondary level. Though the sensitivity, specificity, and validity will be low this simple method would detect those with moderate to advanced glaucoma who really need urgent treatment. It will however miss persons with both cataract (the commonest cause of blindness) and glaucoma which may coexist as both are associated with aging and the cataract gives a white pupil. In Ghana most of the screening is done by Ophthalmic nurses using high IOP and optic disc cupping as the criteria for detection of cases and then referring to ophthalmologists. Although there has been no studies to assess the sensitivity and specificity of their method these are obviously higher than Cook's formula. However Cook's method is a more practical method of dealing with large populations with the disadvantages of limited or non- existent resources including human resources. Marrying the 2 methods will result in a wider coverage of the population and a more cost effective way of using resources but detection of moderate to advanced cases only. Routine medical examination requested by employers has also helped in early detection of glaucoma. These simple exercises will also improve general eye care.

Treatment

Treatment of the disease is carried out predominantly at the tertiary level. The objective of the treatment is to lower IOP below the critical level that stops progression of optic nerve fibre loss. Several factors are taken into consideration to determine the target IOP. Medical treatment is most popular. It is more acceptable to the patient but is life-long, tends to be expensive and patient compliance is poor. Surgery is not readily acceptable and may fail but is less expensive than medical treatment in the long run and achieves better control. Scarring produced by the healing process is the main determinant of surgery outcome. Currently glaucoma filtering surgery with adjunctive anti scarring therapy is considered the best single intervention that lowers IOP and slows down disease progression. Currently Laser treatment is available only in the Korle-Bu Teaching Hospital and has a poor long term success rate. Follow up is irregular because of the poor knowledge and access. Patients tend to move from clinic to clinic in search of cure and since the pretreatment IOP is not known in many of these migrant cases the best target pressure cannot be set. This is worse in patients with NTG who require a lower target IOP than high tension patients.

Recommendations

Increasing awareness and knowledge:

Manuals for school health education have concentrated on first aid for eye injuries. Knowledge of common causes of blindness could be added when

reviewing these manuals to which the principal investigator is a contributor. Just as HIV and AIDS which have no vernacular names nerve, pressure and glaucoma could be maintained. Increased public awareness of the potential benefits of regular eye examination through education and community participation in developing strategies will improve awareness. Public Health education in the news media need focus on the important eye diseases.

Improving case finding

Routine eye examination requested by employers as part of medical examinations should be encouraged.

Research to determine the sensitivity of case finding by IOP measurement and funduscopy by ophthalmic nurses and if indicated, workshops used to improve these skills. Further research into vascular and other risk factors which are associated with progression of glaucomatous optic neuropathy.

Adopt Cook's method of using primary health care workers to identify people with "black pupils and reduced vision" from lower ages of 25-30 years and refer.

Should treatment be medical or surgical?

Increased knowledge of the disease is likely to improve the acceptance rate of surgery especially in those who cannot afford medical treatment, high risk of progressive visual loss and poor compliance.

Advocacy to keep cost of glaucoma drugs as low as possible for instance through tax exemption and medical insurance.

Improve Follow up

Glaucoma Patients register could be kept so that they are contacted if they fail to attend for follow up.

The main problems are identifying patients who require intervention and the infrastructure to deal with those identified. The strategies recommended above for identification of patients are simple and practical but the infrastructure, though improving, is limited by gross financial constraints.

REFERENCES

Adu Darko Michael. Common causes of blindness in Southern Ghana as seen in Komfo Anokye teaching hospital in Kumasi. Ghana Medical J. 1991; 25(1&2):280-284

Akafo S K, Hagan M. Causes of Childhood blindness in Southern Ghana-A blind school Survey. Ghana medical Journal 1990 24(2) 113

Alward W L M, Fingert J H , Sheffield VC The GLCIA Gene in adult Onset Primary Glaucoma Paper presented at the XXVIIIth International Congress of Ophthalmology in Amsterdam. June 21-26 1998. Abstract book (Supp) : 67

Armaly MF, Krueger DE, Maunder L et al: Biostatistical analysis of the Collaborative Glaucoma Study. I. Summary report of the risk factors for glaucomatous visual-field defects. *Arch Ophthalmol* 1980; 98: 2163-2171

Attebo K. Mitchell P. Cumming R. Smith W.
Knowledge and beliefs about common eye diseases. Australian & New Zealand Journal of Ophthalmology. 25(4):283-7, 1997 Nov.

Ayala-Lugo RM[1], A. Aledavood[1], S. E. Moroi[1], P R. Lichter[1], M. Higashi[1], C. A. Downs[1], E. Obeng-Nyarkoh[2], W. Bromley[2], C. Ntim-Amponsah[3], J. E. Richards[1]. *[1]W.K. Kellogg Eye Center, University of Michigan, Ann Arbor, MI; [2]Center for Human Genetics, Bar Harbor, ME; [3]University of Ghana, Accra, Ghana.* A Novel Mutation in TIGR/MYOC Gene in a Colombian Individual with Juvenile Glaucoma. Paper presented for ARVO meeting 2002.

Bimal P. Traditional healers as Eye team members in Nepal. Community Eye Health 1997 10(21) 4-5

Bonomi L. Marchini G. Marraffa M. Bernardi P. De Franco I. Perfetti S. Varotto A. population The Egna-Neumarkt Study. Ophthalmology. 105(2):209-15, 1998 Feb.Tenna V. Prevalence of glaucoma and intraocular pressure distribution in a defined

Collaborative Normal-Tension Glaucoma Study Group. Natural history of normal-tension glaucoma *Ophthalmology* (2001) 108: 247-253

Cook C. Chronic Glaucoma Case finding and Treatment in Rural Africa: Some questions and answers.
Community Eye Health. 2001; vol 14 (39) 33-34

Courtright P, Lewallen S, Kanjaloti S, Divala D J. Traditional Eye Medicine use among patients with corneal disease in rural Malawi. British Journal of Ophthalmology 1994; 78: 810-812

Courtright P, Lewallen S. Traditional healers in prevention of blindness. Community Eye Health 1997 10(21) 1-2

David R, Zangwill L, Stone D, Yassur Y. Epidemiology of intraocular pressure in a population screened for glaucoma. Br J Ophthalmology. 1987; 71:766-780

Dielemans I, Vingerling JR, Wolfs RC, Hofman A, Grobbee DE, and Jong PT. The of primary open-angle in a population-based study in The Netherlands. The Rotterdam Study. Ophthalmology, 1994 Vol 101, 1851-1855.

Drance et al Collaborative Normal Tension Glaucoma study. AJO 2001.

Faal H et al. National Survey of blindness and low vision in the Gambia: results. British J Ophthalmol 1989; 73: 82-7

Faal H, Chuka-Okosa C. Year 2000 National Survey on Blindness in Gambia. Personal communication

Fraser S., Bunce C., Wormald R. Retrospective analysis of risk factors for late presentation of chronic glaucoma.British Journal of Ophthalmology. 83(1):24-8, 1999 Jan.

Fraser S., Bunce C. Wormald R. Risk factors for late presentation in chronic glaucoma. Investigative Ophthalmology & Visual Science. 40(10):2251-7, 1999 Sep.

Gasch AT, Wang P, Pasquale LR. Determinants of awareness in a general eye clinic. *Ophthalmology* 2000; 107: 303-308

Ghana Statistical Service. 2,000 Population & housing Census Provisional Results. . August 2000.

Ghana Demographic and Health Survey Report 1998. Summary Report p16

Hagan M. 2000 Eye Care Report. Ministry of Health, Ghana

Hagan M, Akafo S, Acheampong F, Ackuaku E, Odame F, Oduro T, Mensah J. Primary Open Glaucoma at Korle-Bu Teaching Hospital. Ghana Medical Journal 1991;23 280-294

Harjinder s C. Integration of Traditional Healers into primary Eye care. Community Eye Health 1997 10(21) 3-4 Community Eye Health 1997 10(21) 1-2

Hart WM, Yablonski M, Kass MA, Becker B. Multivariate analysis of risk of glaucomatous visual field loss. Arch Ophthalmol. 1979;97:1455-1458

Herndon LW, Ababio-Danso B, Boateng J O, Challa P, Broomer B, Ridenhour P, Allingham RR. Types of glaucoma in a Ghanaian clinic. 2001 IOVS 42(4):s115.

Jay JL, Murdoch JR. The rate of visual field loss in untreated primary open angle glaucoma. British Journal of Ophthalmology. 1993; 77:176-178

Johnson G J. Editorial: The Adult Glaucomas. Community Eye Health. 2001; vol 14 (39) 33-34

Leske C M, Connell A M S, Schachat A P, Hyman L. The Barbados Eye Study. Archives of Ophthalmology. Vol 112. 1994; 821-829.

Leske M C, Nemesure *B, He O, Wu S-H,* Hejtmancik JF, Hennis A. Patterns of open-angle in the Barbados Family Study . *Ophthalmology* 2001; 108: 1015-1022

Livingston P M, Lee SE, De Paola C, Carson CA, Guest CS, Taylor HR. Knowledge of glaucoma, and its relationship to self-care practices, in a population sample. Aust NZJ Ophthalmology 1995 Feb;23(1):37-41

Mackey D A, Stone E M . Glaucoma Gene Mutation Screening: Experience with the Glaucoma Inheritance Study in Tasmanian (GIST) and comparison with results from the University of Iowa. Paper presented at the XXVIIIth International Congress of Ophthalmology. June 21-26 1998. Abstract book 2

Mason RP, Omofolasade K, Wilson MR, et al. National prevalence and risk factors of Glaucoma in St Lucia, West Indies. Ophthalmology. 1989;96:1363-1368.

Mitchell P, Smith W, Attebo K. Healey PR. of open-angle in Australia. The Blue Mountains Eye Study. Ophthalmology ;1996 Vol 103, 1661-1669,

Murdoch I. Epidemiology and Primary Open Angle Glaucoma. Community Eye Health. 1996 9(18) 19-22

Ntim-Amponsah C T. Traditional Methods of Treatment of Cataract seen at Korle-Bu Teaching Hospital. West African journal of Medicine 1995; 14(2): 84-87

Ntim-Amponsah, C. T. Ocular Tumours and problems in management: The Ghanaian experience. East African Medical Journal. 1996 73(3) 182-186

Ntim-Amponsah, C. T. Mean Intraocular Pressure- a study in Ghanaians. East African Medical Journal. 1996 73(8) 22-24

Ntim-Amponsah C.T. Patients' Attitudes towards eye Surgery. 1997. Paper presented at the Annual Conference of the West African College of Surgeons.

Ntim-Amponsah CT. Visual loss in Chronic Glaucoma- Urban vrs Rural-An African Study. Poster presented at the XXVIIIth International Congress of Ophthalmology in Amsterdam. June 21-26 1998. Abstract P23: 67

Olurin O. Causes of blindness in Nigeria- a study of 1,000 hospital patients. West African Medical Journal. 1973; 22 97

Quarcoopome C O. Editorial: eye Diseases in Ghana. Ghana Medical Journal 1991. June (1&2) 266

Quarm K. Traditional medicine, Ministry of health, Ghana. personal Communication

Quigley HA. Number of people with glaucoma worldwide British Journal of Ophthalmology. 80(5):389-93, 1996 May.

Richards JE, Lichter PR, Boehnke M, Uro JLA, Torrez D, Wong D, Johnson AT. Mapping of a gene for autosomal dominant juvenile-onset open-angle glaucoma to chromosome 1q. Am J Hum Genet 1994 54:
62-70.

Safarazi M, Child A, Trabooulsi E I et al Molecular Genetics of Adult-Onset Primary Open Angle Glaucoma (POAG). Paper presented at the XXVIIIth International Congress of Ophthalmology. June 21-26 1998. Abstract book :2

Sheldrick JH, Ng C, Austin DJ, Rosenthal AR. An analysis of referral routes and diagnostic accuracy in cases of suspected glaucoma. Ophthalmic Epidemiology. 1994;1:31-38

Stein C E, Kalache A. Ageing; A Global Perspective. Community Eye Health. 1999 (12) 29:1-4

Stilma J S. Causes and prevalence of blindness in the Northern province of Sierra Leone. Documenta Ophthalmologica 1983; 56:115-22

Taylor H R. Refractive Errors: Magnitude of the Need. Community Eye Health 2000 13(33) 1-2

Tenkorang. 2000 Annual report of Akwapim South District.

Tielsch JM, Sommer A. Katz J,Royal RM, Quigley HA, Javitt J, Racialvariations in the prevalence of primary Open Angle glaucoma: The Baltimore Eye Survey. JAMA 1991; 266:369-374.

Thygeson John. European Glaucoma Society. Guest lecture. Conference on Glaucoma and Launching of Xalatan in Africa, Mauritius, June 1999

Tuck MW. Crick RP. Screening for glaucoma. Why is the disease underdetected?. Drugs & Aging. 10(1):1-9, 1997 Jan.

Verrey JD, FosterA, Wormald R, Akuamoa C. Chronic glaucoma in Northern Ghana. A retrospective study of 397 patients. Eye 1990; 4 115-120

Yorston D, Foster Allen. Traditional eye medicines and corneal ulceration in Tanzania. Journal of tropical medicine and Hygiene 1994; 97:211-214

Weale R. Epidemiology: Ageing and the Eye. Community Eye Health. 1999 (12) 29:4-5

Wormald R, Foster A. Clinical and pathological features of Chronic glaucoma in North-East Ghana. Eye 1990; 4 107

BIBLIOGRAPHY

Courtright P, Chirambo M, Lewallen S, Harjinder C, Kanjaloti S. Collaboration with African Traditional Healers for the Prevention of Blindness. 2000. World Scientific Publication Co. Pte. Ltd. Singapore

Johnson G J. The Epidemiology of Eye Disease. Ed by Johnson G J, Minassian D C, Weale R. Ch 8 p176. Chapman & Hall Medical. Lippincott-Raven Publishers. USA 1998

Kanski J J 3rd edition Clinical Ophthalmology Ch 8 p250 Butterworth-Heinemann, Glasgow 1994.

Newell FW. Ed 5th Ophthalmology principles and concepts. Ch 20 p345. CV Mosby. Missouri

News Release. VA Optometrists Fight the silent Thief of sight. http:www.va.gov/pressur/index/htm