THE PREVALENCE, PATTERN AND ASSOCIATIONS OF DIABETIC RETINOPATHY IN BLACK AFRICAN DIABETIC PATIENTS ATTENDING MEDICAL DIABETES CLINIC AT KENYATTA NATIONAL HOSPITAL.

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DECLARATION

This dissertation is my original work and has not been presented for a degree in any other university.

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APPROVAL

This dissertation has been submitted for examination with our approval as university supervisors.

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ABBREVIATIONS

AAO	American Academy of ophthalmology
CSME	Clinically Significant Macula Oedema
DCCT	Diabetes Control and Complication Trial
DM	Diabetic Mellitus
DR	Diabetic Retinopathy
DRS	Diabetic Retinopathy Study
EDTRS	Early Treatment Diabetes Retinopathy Study
FLA	Fluorescein Angiography
HbA1c	Glycated haemoglobin
IRMA	Retinal Micro-vascular Abnormalities
KNH	Kenyatta National Hospital
NDDG	National Diabetes Data group
NHRPDR	Non High Risk Proliferative Diabetic Retinopathy
NPBWG	National Prevention of Blindness Working Group
NVD	Neo-vascularisation at the disc
NVE	Neo-vascularisation elsewhere
OCO/CS	Ophthalmic Clinical Officer/Cataract surgeon
POAG	Primary open Angle Glaucoma
RBS	Random Blood Sugar
UON	University of Nairobi
USA	United States of America
WHO	World Health Organisation

ABSTRACT

Introduction: Over the last ten years, there has been a rise in the number of patients with Diabetes mellitus and the risk of visual loss from Diabetic retinopathy. A study on the magnitude and pattern of DR carried out at Kenyatta National Hospital in 1999 showed the prevalence of DR to be high (49.8%) [9]. Recommendations following this study have been implemented to various extents. Since then, there have also been changes in the treatment of DM. This is a ten-year review of the situation of DR at KNH reflecting dynamics in epidemiology and management of diabetes mellitus and diabetic retinopathy.

Aim: To determine the prevalence, pattern and associations of diabetic retinopathy in black African diabetic patients attending medical Diabetes Clinic at KNH.

Design: A cross-sectional hospital based study was carried out from March 2011 to September 2011. A total of 213 patients were selected using systematic sampling. Blood pressure and blood sugars were taken. A detailed ocular examination was done and HbA1c was assessed. DR was graded using ETDRS guidelines (Appendix 4).

Results: The prevalence of DR in patients attending KNH medical diabetes clinic was found to be 31.9%. Of these, 8.8% had Clinically significant Macula Oedema. A study done in 1999 by Kariuki et al at KNH found the prevalence of DR to be 49.8% with 40.3% of these having CSME and majority of the patients with DR having NPDR without macula oedema. Out of the 213 patients studied, 2 patients had NPDR not amenable to photocoagulation. Those who had previous fundus examination were 47.2% and 5.5% of the total number of patients had received laser treatment for either PDR or CSME. In the study by Kariuki et al in 199 at KNH, only 18% of the patients had previous fundus examination[9].None had ever been screened for DR and none had ever had laser treatment. There was a statistically significant association between duration of DM and development of DR. Patients with higher systolic and diastolic blood pressure had a higher prevalence of DR. Patients with high levels of HbA1c had more severe DR. However, this was also not statistically significant. Duration of DM had significant association with DR($p<0.001$).

Conclusion: The prevalence of DR in patients attending medical diabetes clinic was 31.9%. This was lower than the prevalence in a previous study (49.8%). Those previous fundus examination by an ophthalmologist were 47.2%.In the previous study, only 18%

had previous fundus examination. Most of the patients with no diabetic retinopathy had high HbA1c, while others with high grades of DR had normal HbA1c.This could have been due to due to poor glucose control at the beginning of treatment, predisposing patient to developing DR despite good glycaemic control later in their treatment, thus showing the need for strict glycaemic control right from the beginning of treatment.

1. INTRODUCTION

Diabetic retinopathy is one of the most detrimental complications of Diabetic mellitus and is responsible for 5% of global blindness. This is approximately 2.5 million people worldwide.[2]

Visual disability causes enormous socio-economic burden due to cost of health care. This is made worse by the fact that it leads to lack of productivity and great misery to the individual. This burden is usually passed onto the family and community with untold retardation of economic progress and eventually leads to poverty. The annual cost of treating retinopathy-associated DR in the USA is estimated at more than 620 million dollars.[3] DR is therefore a serious threat to socio-economic development.

There has been a rise in the number of patients with diabetes mellitus over the last ten years.[1] In fact, the number in Kenya has more than doubled, therefore increasing the number of patient at risk of blindness from DR.[1] Due to its initially asymptomatic nature, DR is usually diagnosed at a late stage. Intervention at this stage does often not restore vision as there is already extensive damage to the visual system.

Studies done in Africa have shown that the prevalence of diabetic retinopathy is high.[6,7,8] In 1999, the prevalence of DR in KNH was found to be 49.8 %.[9] Early detection and treatment of the vascular retinal changes has been shown to prevent or slow progression of blindness and visual impairment from DR.[4] Over the last ten years, newly diagnosed DM patients at KNH have been referred to the eye clinic where they are screened for DR. Appropriate treatment and follow-up is the done depending on the findings.

The last study done to determine the prevalence of DR at KNH was done in 1999. No other study has been done following this to find out the current prevalence. This study is a ten year review of the prevalence of diabetic retinopathy, its patterns and associations among Black African patients attending medical diabetes clinic at KNH.

2. LITERATURE REVIEW

2.1 DIABETES MELLITUS

2.1.1 Definition

Diabetes mellitus comprises of a group of common metabolic disorders that share the phenotype of hyperglycaemia.[5]

Several distinct types of DM exist and are caused by a complex interaction of genetics, environmental factors. [5]

The metabolic dys-regulation leads to pathophysiological changes in multiple organ systems. These include the eyes, kidneys, nerves, heart and blood vessels.[5]

2.1.2 Classification

With better understanding of the pathophysiology of glucose metabolism, new classifications of diabetes based on aetiologies and clinical staging have been recommended by the WHO and American Diabetes Association.[10]

Type 1 diabetes: 5% of all persons with diagnosed diabetes onset are under 30 years of age. Autoimmune or idiopathic destructive disease in beta-cells of the pancreas leads to absolute insulin deficiency.

Type 2 diabetes: This originates from insulin resistance and relative insulin deficiency or from a secretory defect. It is the most common form of diabetes.

Other types: These include various genetic defects in insulin action, diseases of beta-cell function, genetic defects in insulin action, diseases of exocrine pancreas and medication use.

Gestational diabetes mellitus: This is defined as hyperglycaemia during pregnancy in an individual not previously known to have diabetes. Approximately 3% of all pregnancies are associated with gestational diabetes mellitus.

2.1.3 Epidemiology

The prevalence of DM varies widely in different populations and continuing to rise. It is currently estimated at 6% world-wide.[10]

The US National Diabetes Data group (NDDG) estimated the prevalence of diabetes to be 6.6% among whites.[10]Theprevalence of diabetes in USA was found to be higher in blacks than in whites. Among the rural Bantu of Tanzania, prevalence was 1% and double in their urban counterparts. [11] In developing countries, three quarters of all people with diabetes are under 65 years of age. A high proportion of adult patients with diabetes is younger than 44 years and is estimated to be 25%. In industrialised countries, more than half of all people with diabetes are older than 65, only 8% of adults of adults with diabetes are younger than 44 years old.[12]

It is predicted that the number of adults with DM in the world will rise from 150 million in 2000 to 300 million in 2025. In industrialized countries the number will increase by one third, while in developing countries the number will be more than double.[10] Current trends in obesity suggest that these projections are conservative and that the increase in the prevalence of DM will even be greater.[10]

The prevalence of diabetes in persons 35 – 64 years in sub – Saharan Africa in 2000 was estimated 3 – 5%. The number of people estimated to have diabetes by WHO in Kenya in 2000 was 183.000 and this was projected to increase to 498,000 by the year 2030. The US census bureau in its international database in 2004 estimated that Kenya had 691,169 newly diagnosed diabetics whereas 1,940. 124 had undiagnosed diabetes[5] and hence more patients at risk of diabetic retinopathy.[1]

2.1.4 Diagnosis

Symptoms of diabetes include polydipsia, polyuria, recurrent infections and unexplained weight loss. In severe cases, drowsiness, coma and high levels of glycosuria are usually present. DM can be diagnosed in three ways according to the Expert Committee on the Diagnosis and Classification of Diabetes Mellitus (2002).[13]

1. Symptom of diabetes plus casual plasma glucose greater or equal to 11.1mmol/l.
2. Fasting Plasma glucose > or equal to 7mmol/l.
3. 2 hour Plasma Glucose > or equal to 11.1mmol/l during an oral glucose tolerance test.

2.1.5 Treatment

The common modes of treatment include: dietary control, weight reduction, exercise, oral glucose lowering agents, insulin. A poly-pragmatic approach is taken in treatment. Patient education forms an important part of treatment.[14]

2.1.6 Ocular complications

Diabetes Mellitus is associated with several ocular complications of which diabetic retinopathy has the most important effects on the visual system.
Other complications include: cataracts, ischemic neuropathies, and glaucoma.

2.2 DIABETIC RETINOPATHY

2.2.1 Definition

Diabetic retinopathy (DR) can be defined as damage to the micro-vascular system of the retina due to prolonged hyperglycaemia. It occurs both in type 1 and type 2 Diabetes Mellitus.

2.2.2 Epidemiology

Diabetic retinopathy develops in nearly all persons with type 1 diabetes and more than 77% of those with type 2 who survive over 20 years with diabetes[2]. It is a frequent cause of severe visual impairment and blindness both, in developed countries and increasingly also in developing countries.[2]

The Wisconsin epidemiologic study of diabetic retinopathy concluded that 3.6% of patients with type 1 diabetes, and 1.6% with type 2 diabetes, were legally blind. For type 1 diabetes, blindness was mostly (86%) related to diabetic retinopathy. For type 2 diabetes, blindness was related to DR in 33% of the cases.[1]

WHO has estimated that that DR is responsible for 4.8% of the 37 million cases of blindness throughout the world.[2]It is a leading cause of new onset blindness in industrialized countries and a more frequent cause of blindness in middle-income countries.[11]It accounts for 5 – 10% blindness in the intermediate economies.[2]

Studies suggest that the prevalence of diabetic retinopathy among African diabetics could be higher than in other races.[14]This could be due to poor glycaemia control, which is related to mode of treatment. In the study by Kariuki et al at KNH, the type of insulin used by the patient was either soluble insulin or Lente insulin. None of the study patients was on multiple subcutaneous injections or the insulin pump. Dietary control was not strict since most patients were not sufficiently trained to calculate caloric intake. Follow up intervals were also very long (up to a year) owing to the large number of diabetic patients and

limited resources. Most patients tested their blood sugars only during their clinic attendance. None of the patients was monitoring their blood sugars at home.[9]

In 1999 Kariuki found the prevalence of diabetic retinopathy to be 49.8% in patients attending the diabetic medical clinic at KNH in Kenya. Macular oedema was present in 40.3% of the patients with diabetic retinopathy, of whom 67.2% had clinically significant macula oedema. The type of diabetes had no significant relationship to the severity of diabetic retinopathy.[9] In the study, there was no statistical significance between the sex of the patient and diabetic retinopathy.[9] Githeko in 2008 reported the prevalence of DR to be 18.3% in rural hospitals. 49% had blinding conditions.[16] Gichuhi found that most patients with Primary Open Angle Glaucoma or ocular hypertension did not show any DR.[17] Wachira reported no statistically significance difference in the prevalence of diabetic retinopathy between pregnant and non pregnant women of child bearing age in Nairobi.[18]

The prevalence of blindness in Kenya is 0.7%. Over 80% is due to curable and preventable causes. Diabetic retinopathy is estimated to be responsible for 3% of blindness.[19]
Ekuwam found a skewed distribution of facilities and services for management of diabetes mellitus and diabetic retinopathy in Kenya. Most of the DR services were facility based rather than community based. Most (98.6%) clinicians referred patients for DR screening only when they have ocular complains, which may be too late to reverse visual loss or stabilize vision.[20]

Studies carried out in the region have found the prevalence of DR to be high. A population based study In Democratic Republic of Congo found the prevalence of DR to be 32%[21]. In a population based study carried out in Ethiopia (Addis Ababa), the prevalence was 37.8% in 2001.[22] In 2009, in a study done at Jimma hospital Ethiopia, the prevalence was 41.4%.[6] A population based study reported a prevalence of 25% was reported.[23] In 2008, in a hospital- based study in three hospitals in Kigali Rwanda the prevalence was 28.2%.[7]

2.2.3 Risk Factors

2.2.3.1 Duration of Diabetes

Duration of diabetes mellitus is the single most important factor in development of diabetic retinopathy. Longer duration of diabetes is associated with higher prevalence of diabetic retinopathy.[24] Dandona et al found that 87.5% of patients with diabetes for more than 15 years had diabetic retinopathy as compared to 18.9% who had diabetes for less than 15 years.[25]

2.2.3.2 Glycaemia Control

Development and progression of diabetic retinopathy is influenced by hyperglycaemia.[24,26]Chronic hyperglycaemia was associated with the presence or progression of micro-vascular complications in both types of diabetics. The DCCT showed a 76% reduction of diabetic retinopathy in patients with intensive glucose control. However, once proliferation develops, glucose control will not improve retinopathy.[47]

2.2.3.3 Systemic hypertension

Higher diastolic pressure in younger people and higher systolic pressure in older persons are associated with an increased risk of diabetic retinopathy. [24, 27]

2.2.3.4 Renal Disease

Severe nephropathy is associated with worsening of diabetic retinopathy. There is a relationship between micro-albuminaemia, proteinuria and retinopathy. [28, 29, 30]

2.2.3.5 Pregnancy

Pregnancy is occasionally associated with rapid progression of DR. Predicating factors include poor pregnancy control of diabetes, too rapid control during the early stages of pregnancy, and the development of pre-eclampsia and fluid imbalance.[31, 41]

2.2.3.6 Other risk factors

Other risk factors associated with DR include: High serum lipids, alcohol, anaemia, and obesity.[29, 32 – 38]

2.2.4 Pathogenesis

Diabetic retinopathy is a micro-angiopathy affecting the retinal pre-capillary arterioles, capillaries and post-capillary venules with features of both, micro-vascular occlusion and leakage. Hyperglycaemia appears to initiate the following down-stream vascular events:

1. Capillaropathy
2. Haematological changes
3. Micro-vascular occlusion

Factors which have been implicated in the mechanism for DR include: Aldose-reductase induction, myo-inositol depletion, non-enzymatic glycation and free radical damage. The retina, kidneys and nerves are all freely permeable to glucose and are therefore the major tissues affected. Growth factors may influence the progression of complications by altering the innate glucose regulatory mechanism.

Reduction in the number of pericytes leads to localised weaknesses in the vessel wall causing saccular pouches of capillary wall distension, clinically seen as micro-aneurysms. Loss of pericytes may lead to endothelial cell proliferation with formation of cellular micro-aneurysms. Diffuse oedema is caused by extensive capillary leakage. Localized retinal oedema is caused by focal leakage from micro-aneurysms and dilated capillary segments. Chronic localized retinal oedema leads to deposition of hard exudates at the junction of healthy and oedematous retina. Hard exudates are composed of lipoprotein and lipid filled macrophages, typically surrounding leaking micro-vascular lesions, forming a circinate pattern. They may get absorbed spontaneously into surrounding healthy capillaries or enlarge due to chronic extravasation.

Micro-vascular occlusion is due to thickening of capillary endothelial cell damage and proliferation, changes in red cells leading to defective oxygen transport and increased

stickiness and aggregation of platelets capillary non-perfusion leads to retinal hypoxia, which then leads to retinal ischemia. Initially, the non-perfused area is located in the mid retinal periphery. Retinal hypoxia leads to formation of arterio-venous shunts associated with significant capillary occlusion, which run from venules to arterioles, referred to as intra retinal micro-vascular abnormalities (IRMA) and neo-vascularisation, which is due to a vaso-formative substance, elaborated by the hypoxic retinal tissue in an attempt to re-vascularise hypoxic retina. This substance promotes neo-vascularisation.

2.2.5 Classification

The Diabetic Retinopathy Study (DRS) and Early treatment of Diabetic Retinopathy Study ETDRS classified DR into 9 stages. (Appendix 4)

2.2.6 Screening

Early diabetic eye disease is asymptomatic. Preventing blindness from DR relies on early detection of asymptomatic disease by fundus examination and instituting appropriate treatment. Timely treatment has been proven to prevent vision loss from diabetic retinopathy in the vast majority of patients.[24, 37,43-46] Lower incidence of diabetic retinopathy is reported where screening programs have been implemented.

2.2.7 Treatment

The Diabetic Retinopathy Study demonstrated that pan retinal laser photocoagulation reduces the risk of severe visual loss due to PDR by as much as 60%[42]. The Early Treatment Diabetic Retinopathy Study showed that pan retinal laser can reduce the risk of severe visual loss to less than 2%. It also showed that focal laser photocoagulation can reduce the risk of moderate visual loss from macula oedema by 50%.[43] The Diabetic Retinopathy Vitrectomy Study provided insight into the timing of vitrectomy surgery in eyes with non-resolving vitreous haemorrhage. It highlighted that in certain situations, early vitrectomy

resulted in better vision.[45,46] Intensive control of blood glucose as reflected in measurement of glycosylated haemoglobin reduces the risk of progression of DR.[47]

3. PROBLEM STATEMENT

The number of people with DM has risen over the last ten years. The number in Kenya has more than doubled over the same period.[1] WHO estimates that the number of people with DM will rise from 183,000 in 2000 to 498,000 in 2030.

Diabetic Retinopathy is one of the complications of DM and is estimated to be responsible for 4.8% of global blindness.[2] Visual loss leads to loss of productivity and eventually to poverty. DR is asymptomatic at the initial stage and early detection and treatment of the condition, is essential in preventing progression to blindness.[4]

A study carried out in KNH in 1999 showed the prevalence of DR to be high (49.8%).[7] Various recommendations were made following this study, and have been implemented to various extents:

1. At KNH, screening for DR in patients with DM has been started.
2. There is a regular DR and vitreal-retinal clinic at the KNH eye clinic.
3. Laser treatment has been introduced in KNH and has been used to treat DR.
4. HbA1c has been used as a tool for measuring long term control of blood sugar at KNH eye clinic.
5. Teaching of under-graduate, clinical officers nurses and paramedics has increased in order to improve awareness and management of DR
6. Involvement of nutritionist in management of DM
7. Measures have been put in place at a national level to facilitate early detection and treatments of DR.

Treatment modalities for DM have also changed over the last 10 years.

This study was a ten year review of the current situation of DR at KNH considering all these changes.

4. RATIONALE

The current prevalence of DR at KNH is not known. In 1999 the prevalence of diabetic retinopathy in black African patients attending the medical diabetes clinic at KNH was 49.8%.[7] Over the last ten years several developments have taken place, which are likely to have influenced the current situation of DR. These include:

- The number of people with Diabetes mellitus and hence at risk of diabetes retinopathy has risen.
- Changes in lifestyle, with increasing urbanisation
- Increased advocacy by the government and other organisations to promote public awareness of diabetes mellitus, its complications and management.[10]
- Improved availability of services: There has been screening for diabetic retinopathy and laser treatment has been used to treat DR in KNH
- Better collaboration between health care providers, especially physicians and ophthalmologists.
- Better training of health care workers.

A review of the prevalence of DR among patients attending medical diabetes clinic is therefore relevant considering these changes.

5. OBJECTIVES

4.1 General objective

To determine the prevalence, pattern and associations of diabetic retinopathy among Black African Diabetic patients attending the medical diabetes clinic at KNH.

4.2 Specific objectives

1. To determine the prevalence of diabetic retinopathy in patients attending the medical diabetes clinic in KNH.

2. To determine the pattern of diabetic retinopathy

    2.1 Demographics
    2.2 Diagnosis
    2.3 Treatment
    2.4 Type of diabetes

3. To determine the association between DR and the following selected risk factors:

    3.1 Duration of diabetes
    3.2 Glycaemic control-HbA1c and FBS
    3.3 Type of diabetes
    3.4 Mode of treatment
    3.5 Sex of the patient
    3.6 Blood pressure control

4. To compare the results with those of a previous studycarried out at KNH.

5. METHODOLOGY

6.1 Study design

A cross-sectional hospital based study.

6.2 Reference population

Black African patients with diabetes in Kenya.

6.3 Source population

Black African patients attending the medical diabetes clinic at KNH.

6.4 Study population

Black African patients with diabetes attending the medical diabetes clinic at KNH during the period of the study.

6.5 Study setting

Kenyatta National Hospital (KNH), being a National Referral and Teaching Hospital, caters for patients referred from all over the country. KNH runs a medical diabetic outpatient clinic from Monday through Friday.

6.6 Study period

This study was carried out from March 2011 to September 2011.

6.7 Sample size

The sample size was determined using the following formula:

$n = NZ^2P\ (1-P)/D^2\ (N-1) + Z^2P\ (1-P)$

n= required sample size

N= Total population (This was a finite population. Calculation was done by getting the total number of patients expected to attend the diabetic clinic during the estimated period of data collection which was one month. A representative sample from these was then calculated).

P= prevalence of DR in people attending (estimated at 49.8%, taking into consideration the last study done at KNH)

D = precision of the study set at 0.05

Zcrit is the $_{cut}$ of points along the x- axis of the standard normal probability distribution that represents probabilities matching the 95% confidence interval (1.96)

After substituting the above formula, n≈ 213 patients.

Thus, the required minimum sample size was 213 patients.

6.8 Sampling criteria

The average number of patients attending the diabetic clinic from Monday through Thursday is 20. On Friday, averages of 70 patients attend the clinic. A total number of 450patients attended the clinic during the three-week period of study. Systematic sampling method was used. The formula used was k=N/n where k=sampling interval, N=total population (450), n=sample population (213). On substitution: 450/213=2.1 Thus, every 2ndpatient was assessed.

6.9 Inclusion criteria

1 Diagnosed diabetic patients from the medical diabetic clinic.
2 Patients who gave Informed consent in writing.
3 Adequate visualization of fundus with well dilated pupils to allow bio-microscopy.
4 Patients of Black African origin

6.10 Exclusion criteria

1 Opaque media not allowing adequate visualization of the fundus for grading.
2 Diabetic children less than 12 years. This is because DR rarely develops before puberty. 12 years is taken as the age at puberty.

3 Patients who failed to give consent.

4 Patients with retinopathy of other origin

5 Patients not of Black African origin

6.11 procedure

Pre – run examinations and grading of diabetic retinopathy were done with the supervisors prior to the study to minimize intra and inter-observer variation.

Patients were recruited from the medical diabetic clinic after the visit to the physician. Using the register, every 2nd patient was picked and consent obtained.

Random blood sugar was obtained, and blood pressure taken after 5 – 10 minutes of rest. Hypertension was defined as systolic BP of ≥ 140mmHg and a diastolic BP of ≥90 mmHg.

Demographic data was taken. This included: Age, sex, type of diabetes, duration of diabetes (the time period to the nearest month between current age at examination and the age at diagnosis). Mode and duration of treatment was established and history of previous fundus examination by the ophthalmologist or any other eye care specialist was noted.

Best corrected visual acuity was determined. This was done by objective refraction and subjective refraction. Visual acuity was taken using a snellen chart. Anterior segment examination was then done using a slit lamp bio-microscope (HAAG-STREIT BERN 900 Switzerland).

Pupils were then dilated using Tropicamide 1% eye drops repeated at 5-minute interval with further addition when necessary until the pupils were fully dilated.

Indirect ophthalmoscopy and slit lamp bio-microscopy were performed and any diabetic retinopathy was graded according to the DRS and EDTRS classification (Appendix 4). The fundus findings were confirmed by the consultant present at the clinic at the time of study

and also when they came for their follow-up visits. Blood sample was then taken for measurement of HbA1c.

The findings and implications were discussed with the patients after which they were given the appropriate treatment and follow-up.

WHO classification for Diabetic Retinopathy was adopted in this study (appendix 4)

6.12 Data management

Data was coded. Analysis was carried out using the Statistical Package for Social Sciences (SPSS version 17)

6.13 Sources of error

Inter - observer variation: this was minimized by confirmation of findings by the consultants when the patients come for booked appointments. Pre – run examinations and grading of diabetic retinopathy were done with the supervisors prior to the study.

6.14 Ethical consideration

Ethical approval was obtained from the KNH-Ethics and research committee. All the people assisting in the study, or involved in any way were made aware of legal and ethical duties in terms of ensuring strict confidentiality of personal information. Written informed consent was taken before participation (appendix 5).Use of patient identifiable information was avoided. Identity was disguised by use of codes and patient details were anonymous. Further treatment was recommended whenever necessary for all patients and all procedures were done only where there was medical indication.

The study availed the participants the chance to have a full ocular examination and treatment. This was of benefit to the patient. All these patients were booked into the eye clinic.

RESULTS

Two hundred and thirteen (213) diabetic patients attending the medical diabetic clinic at Kenyatta National Hospital were examined for diabetic retinopathy. Diabetic retinopathy was then graded by ETDRS classification. Demographic characteristics and type of diabetes were ascertained. Blood pressure, random blood sugar and HbA1c was measured and correlated with DR.

Demographic characteristics

Table 1: Demographic characteristics (patients n=213)

Variable		Frequency (%)
Age in years		
Mean (SD)	54.5	13.8
Min-Max	20.0	86.0
TOTAL		**99.8%**
Sex		
Male	66	31.0
Female	147	69.0
TOTAL	**213**	**99.0%**

The mean age of the patients was 54.5 years (±13.8 years) and ranged between 20 years and 86 years. Majority of the patients were females 147 (69%). The number of men was 66 (31%).

Table 2: Characteristics of patients with DM (n=213)

Variable	Frequency	(%)
Type of diabetes		
Type 1	32	15.0
Type 2	181	85.0
TOTAL	**213**	**100.0**
Duration of diabetes (years)		
Median(IQR)	7.0 (2.0 – 12.0)	
Min-Max	<1 – 40	
Previous fundus examination		
Yes	102	47.9
No	111	52.1
TOTAL	**213**	**100.0**

Most of the patients had type 2 diabetes (85%). The median duration of diabetes was 7 years. The duration of diabetes among the patients ranged from less than a year to 40 years.

Treatment of DM

Figure 1: treatment sequences and combinations for DM (patients n=213)

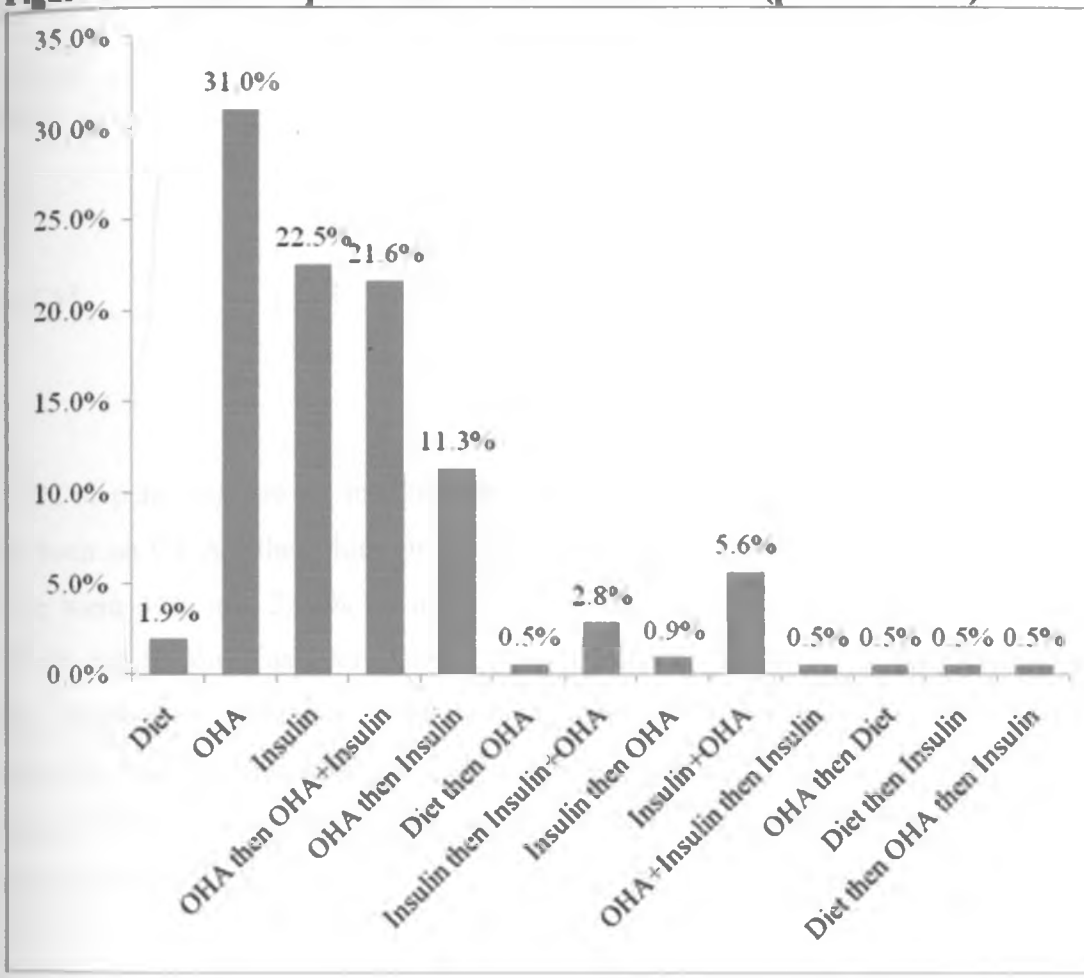


Table 3: Treatment modalities of diabetes (patients n=213)

Variable	n	(%)	Duration of treatment (years) Median (IQR)	Minimum – Maximum
Insulin				
Yes	138	64.8	3.5 (1.0-9.0)	<1 – 34 years
No	75	35.2		
TOTAL	**213**	**100.0**		
O.H.A				
Yes	159	74.6	5.0 (2 -10.0)	< 1 – 31 years
No	54	25.4		
TOTAL	**213**	**100.0**		

64.8% of patients were on insulin, either alone or in combination with OHA. Those that had been on OHA either alone or in combination with insulin were 74.6 Th.ose on OHA alone were 31% and 22.5% on insulin alone. Other patients (21.6%) had been on OHA initially but insulin was later added to their treatment. Another 11.5% changed to insulin after a period of treatment with only OHA. Those on insulin, whether alone or with other treatment, had been on insulin for a median duration of 3.5 years. The patients on OHA alone or with another treatment had been on OHA for a median duration of 5 years. Only 4 patients (1.9%) were on diet alone.

Visual acuity

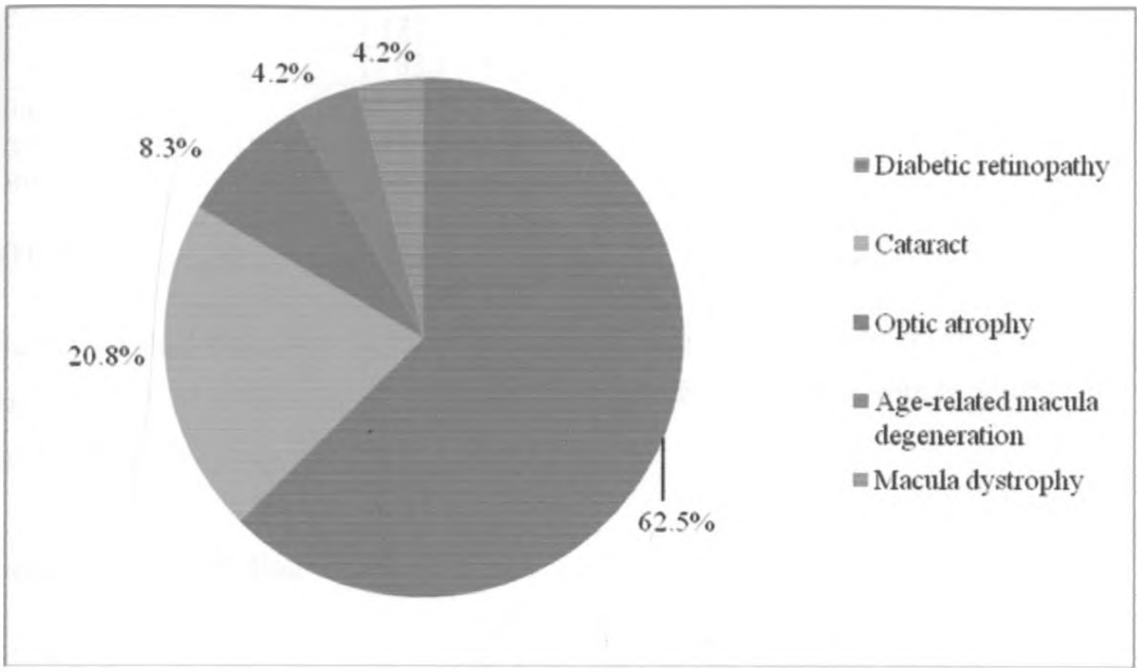
Table 4: Visual acuity (patients n=213)

Vision	**Frequency**	**(%)**
Normal	188	88.3
Visual impairment	6	2.8
Severe visual impairment	4	1.9
Blind	15	7.0
TOTAL	**213**	**100.0**

Table 5: Causes of visual loss (patients n=25)

Causes	Number of patients
Diabetic retinopathy	18
Cataract	4
Optic atrophy	1
Age-related macula degeneration	1
Macular dystrophy	1
TOTAL	**25**

Figure 2: Causes of visual impairment (patients n=25)



The number of patients who were found to be blind was 15 (7%) of these, 12 had DR, while that of visual impairment was 4.7% .A number of patients who had visual impairment unrelated to DR. There were 4 patients with cataract as the main cause of visual loss vision. The cataract in these patients was not dense enough to preclude examination of the fundus, but cause visual impairment in the patient. One patient had optic atrophy, one had age related macula degeneration and the other had bilateral macula dystrophy.

Blood pressure

Table 6: Blood pressure (patients n=213)

Variable	Mean (SD)	Minimum-Maximum
BP Systolic pressure	135.5 (21.4)	91.0-220
BP Diastolic pressure	83.8 (12.1)	77.0 – 90.0
Blood pressure		
Hypertensive	134 (63.2%)	
Normal	69 (36.8%)	
TOTAL	**213 (100.0%)**	

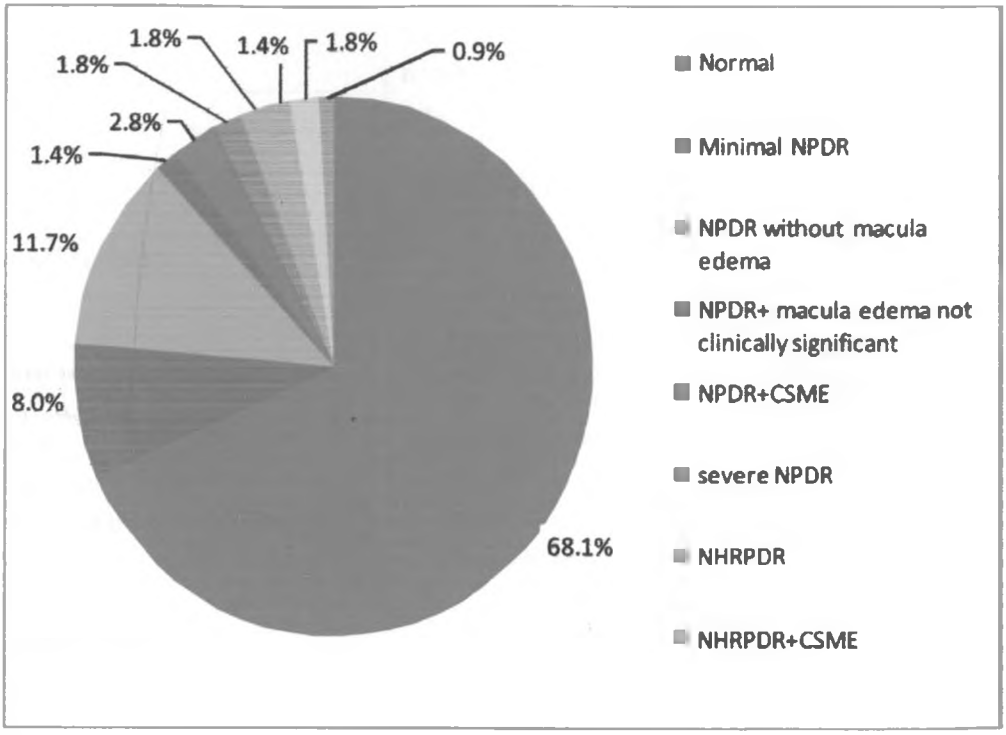
The patients had mean systolic blood pressure of 135.5mmHg (±21.4mmHg) and diastolic blood pressure of 83.8mmHg (±12.1mmHg). The number of patients with hypertension was 134(63.2%).

Prevalence and grading of DR

Table 7: Prevalence and grading of diabetic retinopathy (patients n=213)

Variable	Frequency	(%)
Diabetic retinopathy		
Yes	68	31.9
No	145	68.1
TOTAL	**213**	**100.0**
Grade of diabetic retinopathy on worse eye		
Normal	145	68.1
Minimal NPDR	17	8.0
NPDR without Macular Edema	24	11.7
NPDR + Macular Edema that is not clinically significant	3	1.4
NPDR With CSME	6	2.8
Severe NPDR (pre-proliferative)	4	1.8
NHRPDR	4	1.8
NHRPDR with CSME	3	1.4
HRPDR	4	1.8
HRPDR not amenable with photocoagulation	2	0.9
TOTAL	**212**	**99.4**

Figure 3: Grading of DR (patients n=213)



Prevalence of diabetic retinopathy was 31.9% among the patients studied. Majority of patients with DR had NPDR without macula edema (11.7%), minimal NPDR (8%) and NPDR with CSME (4.2%). The higher grades of DR occurred in fewer numbers of patients, with 2 patients having HRPDR not amenable to photocoagulation

Random blood sugar and HbA1c

Table 8: RBS and HbA1c (n=213)

Variable	Mean (SD)	Minimum-Maximum
Fasting blood sugar	10.0 (4.9)	3.5-31.0
HbA1c	7.9 (1.9)	4.4-13.2

The patients had a mean random blood sugar of 10µg/ml ranging between 3.5 and 31.0µg/ml. The mean HbA1c was 7.9% and it ranged from 4.4% to 13.2%.

Factors associated with diabetic retinopathy

Table 9: Factors associated with diabetic retinopathy (patients n=213)

Variable	Diabetic retinopathy		OR (95% CI)	P value
	Yes n=68	No n=145		
Age	56.2 (13.1)	53.7 (14.1)	-	0.215
Sex				
Male	13 (19.7%)	53 (80.3%)	0.4 (0.2-0.8)	0.010
Female	55 (37.4%)	92 (62.6%)		
Type of diabetes				
Type 1	11 (34.4%)	21 (65.6%)	1.1 (0.5-2.5)	0.747
Type 2	57 (31.5%)	124 (68.5%)		
Duration of diabetes	11.0 (4.0-15.0)	5.0 (2.0-0.0)	-	<0.001
Visual acuity				
Normal	5 (29.8%)	132 (70.2%)	1.0	
Visual impairment	4 (60.0%)	2 (40.0%)		0.998
Severe visual impairment	2 (50.0%)	2 (50.0%)		
Blind	12 (80.0%)	3 (20.0%)	18.1 (2.2-148.5)	0.007
Patients with visual loss	18 (72%)	7 (28%)	-	0.002
Random blood sugar	10.0 (4.7)	10.0 (5.0)	-	0.944
HbA1c	8.1% (1.8)	7.8% (1.9)	-	0.678
Blood pressure				
Hypertensive	47 (35.1%)	87 (64.9%)	1.6 (0.8 2.9)	0.154
Normal	20 (25.6%)	58 (74.4%)		
Systolic BP				
Hypertensive	30 (34.9%)	56 (65.1%)	1.3 (0.7-2.3)	0.396
Normal	37 (29.4%)	89 (70.6%)		
Diastolic BP				
Hypertensive	30 (36.1%)	53 (63.9%)	1.4 (0.8-2.5)	0.254
Normal	37 (28.7%)	92 (71.3%)		

HbA1c adjusted for duration of diabetes.

Type and duration of diabetes

The patients diagnosed with DR had a longer median duration of diabetes (11 years) than the patients without DR (5 years), P<0.001. Prevalence of DR was 34.4% in type 1 DM and 31.5% in type 2 diabetes (p=0.747)

Visual acuity

Among the patients who were blind, 12 (80%) had DR, while 3(20%) were blind from other causes. (0.007)

Blood pressure

The prevalence of DR was higher among the hypertensive patients (35.1%) than in the normal group (25.6%), OR 1.6 (0.9-2.9), P=0.154.

Patient's gender and age

Prevalence of diabetic retinopathy was lower in males (19.7%) than females (37.4%), OR 0.4 (0.2-0.8), P=0.010. Age was not significantly different between the patients with DR (56.2 years) and those without DR (53.7 years), P=0.215.

Treatment of diabetes and diabetes retinopathy

Figure 4: Treatment sequence and DR (patients n=213)

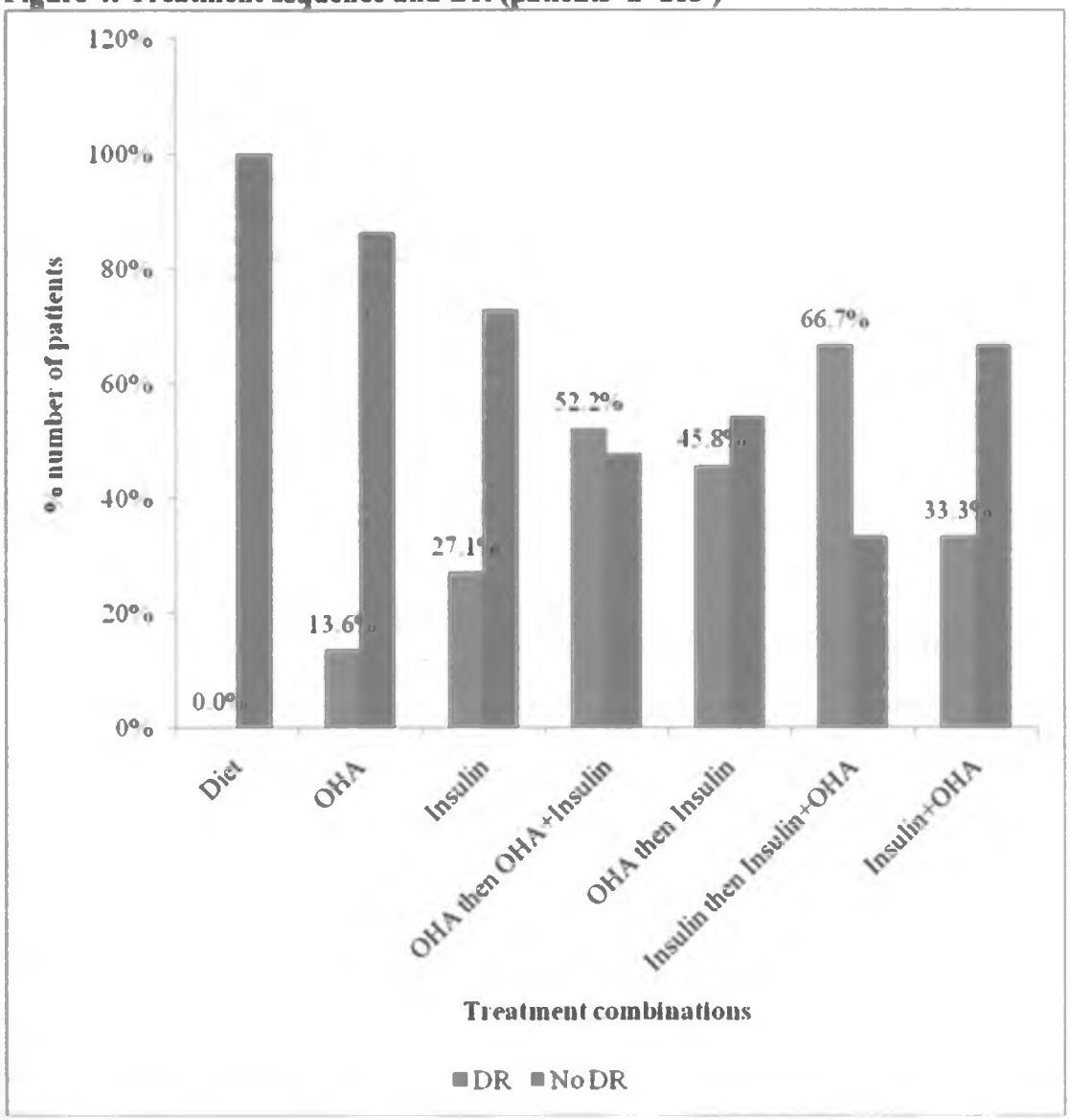


Table 10: Treatment modality and DR (patients n=213)

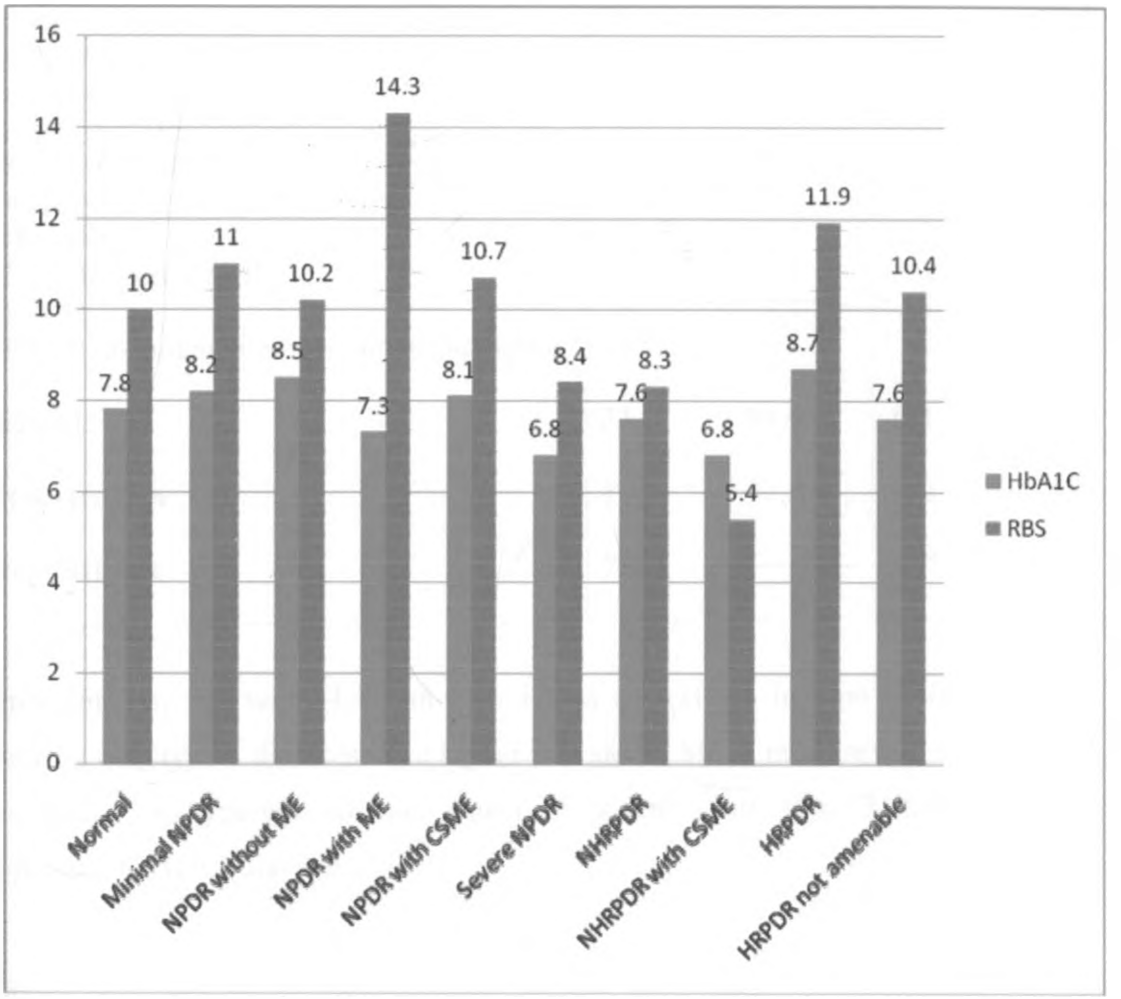
Variable	Diabetic retinopathy				OR (95% CI)	P value	TOTAL
	Yes	%	No	%			
OHA alone							
Yes	9	13.6	57	86.4	0.2 (0.1-0.5)	<0.001	100.(
No	59	40.1	88	59.9			100.(
TOTAL	**68**		**145**				**213**
Insulin alone							
Yes	13	27.1	35	72.9	0.7 (0.4-1.5)	0.414	100.(
No	55	33.3	110	66.7			100.(
TOTAL	**68**		**145**				**213**
Median duration OHA before insulin in pts on combined treatment	7.0 (0.0 -12.0)		4.0 (1.0 - 6.0)		-	0.621	

Table 11: Treatment modalities (patients n=213)

Treatment	Duration of treatment, Median (IQR)	
	O.H.A alone	Insulin
OHA	5.0 (2.0-8.0)	-
OHA then OHA + insulin	10.0 (5.0-13.0)	3.0 (1.0-7.0)
OHA then Insulin	5.0 (1.5-9.0)	3.0 (2.0-8.0)

Among the patients on diet control alone, none had DR. Patients on OHA alone had a significantly lower prevalence of DR (13.6%) as compared to patients on insulin or combined treatment. Patients on combined treatment (insulin and OHA) had a prevalence of 40.1%, OR 0.2 (0.1-0.5), p<0.001. Patients on insulin alone had prevalence of 27.1% OR 0.7 (0.4-1.5), p=0.414. Among patients on combination treatment, the duration of OHA before initiation of insulin was significantly higher (7 years) in patients with DR than in those without DR (4 years). P=0.621.

Figure 5: RBS, HbA1c and grading of DR (patients n=213)



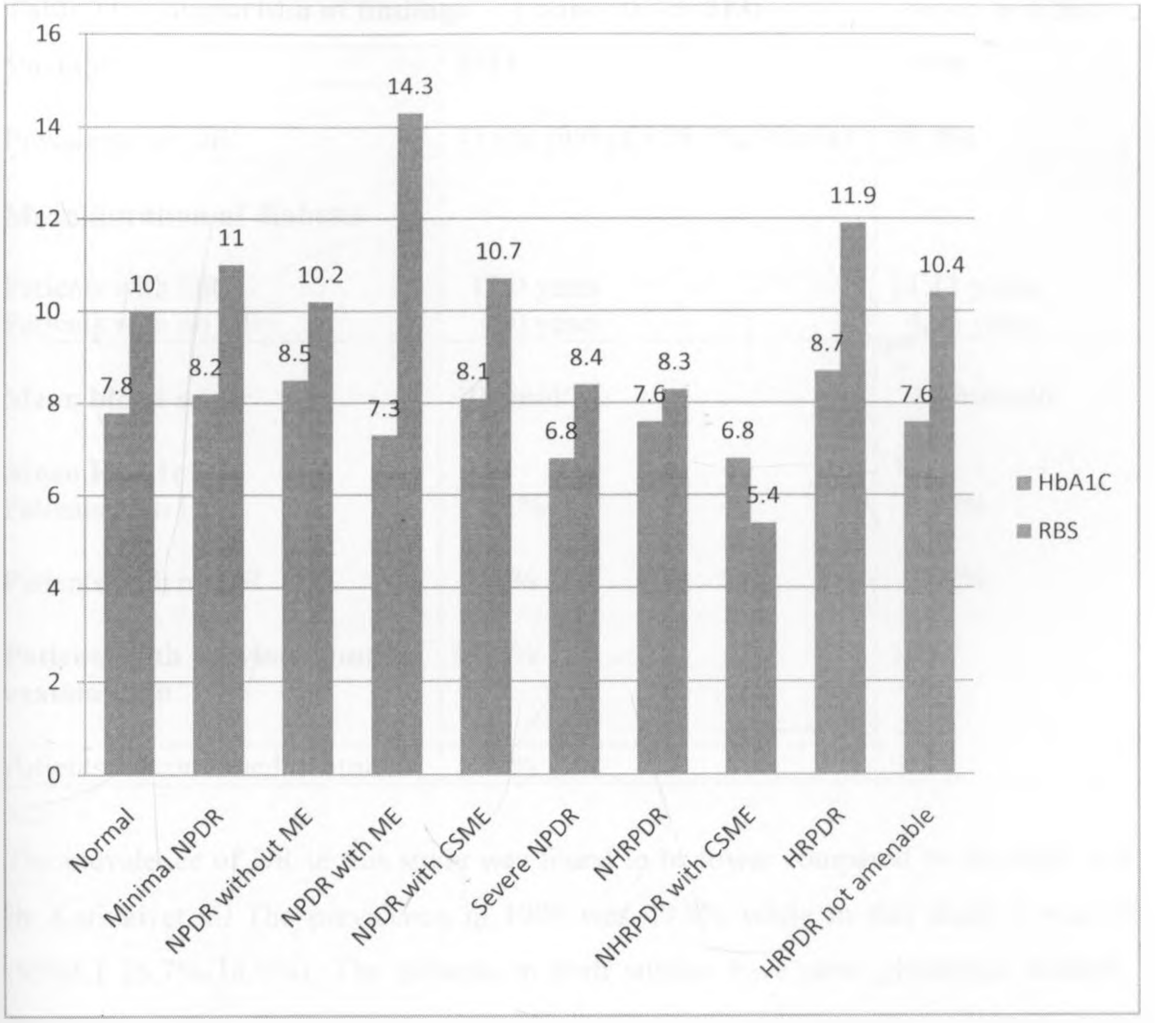
The mean RBS was 10mmol/l in patients with DR and also those with no DR. The mean HbA1c was 7.8%. The mean was higher in patients with DR (8.1%) than in those without DR (7.8%) p=0.403

Table 12: Comparison of type 1 & type 2 diabetes (patients n=213)

	n=32		n=181	
	Type 1	%	Type 2	%
Prevalence of DR	11	34.4	57	31.5
Grade worse eye				
Normal	21	65.6	124	68.5
Minimal NPDR	1	3.1	15	8.3
NPDR without ME	5	15.6	20	11.0
NPDR with ME	0	0	3	1.7
NPDR with CSME	2	6.3	4	2.2
Severe NPDR (Pre-proliferative)	0	0	4	2.2
NHRPDR	1	3.1	3	1.7
NHRPDR with CSME	0	0.0	3	1.7
HRPDR	1	3.1	3	1.7
HRPDR not amenable with photocoagulation	1	3.1	2	1.1
TOTAL	**32**	**99.9**	**181**	**100.1**
Hypertension	12	37.5	122	57.2
Mean HbA1c	7.9%		8.0%	

Prevalence of DR was 34.4% in type 1 DM and 31.5% in type 2 diabetes ($p=0.747$). Patients with type 1 diabetes have higher prevalence of the more severe forms of DR. The prevalence of hypertension was higher in patients with type 2 diabetes (67.4%) as compared to type 1 diabetes (57.2%)

Figure 5: RBS, HbA1c and grading of DR (patients n=213)



The mean RBS was 10mmol/l in patients with DR and also those with no DR. The mean HbA1c was 7.8%. The mean was higher in patients with DR (8.1%) than in those without DR (7.8%) p=0.403

Table 13: Comparison of findings (patients n=213) (eyes n=1202)

Variable	2011	1999
Prevalence of DR	31.9% (95% CI 25.7%-38.6%)	49.8%
Mean duration of diabetes		
Patients with DR	11.0 years	11.11 years
Patients with no DR	7.0 years	4.06 years
Mean blood sugar	10mmol/l	9.89mmol/l
Mean HbA1c		
Patients with DR	8.1%	9.57%
Patients with no DR	7.8%	7.92%
Patients with previous fundus examination	47.9%	18%
Patients on combined treatment	21.6%	9%

The prevalence of DR in this study was found to be lower compared to the study at KNH by Kariuki et al. The prevalence in 1999 was 49.8% while in this study it was 31.9% (95%CI 25.7%-38.6%). The patients in both studies have poor glycaemic control. The lower prevalence of DR could however be due to improved treatment of DM as shown by the higher number of patients on combination treatment (OHA and insulin) with 21.6% in 2011 and 9% in 1999 being on combination treatment.

DISCUSSION

With the rising number of DM patients worldwide, it has become necessary to institute measures to prevent diabetes mellitus, improve on existing treatment modalities and also to diagnose, control and treat complications of DM. Screening of DM patients for DR is an important tool in the management of patients with DR, considering that DR is asymptomatic in its initial stages[24,37,43].

Management of DM is dynamic. With better understanding of the pathogenesis of DM, there have been many changes in the treatment of the disease. The expanding field of inquiry into DR is likely to be the source of future break-through in treatment.

Despite this advancement in management of diabetes, the rate of complications such as DR remains high in developing countries. This is in part due to poor management of the disease, late diagnosis and poor compliance. A large number of patients in this study were on fixed doses of mixtard insulin and none was on insulin pump. The number of patients on mixtard insulin either alone or in combination was 138 (64.8%). In addition, only 10% of the patients were monitoring their blood sugar at home.

Ekuwam, in a situation analysis of DR services in Kenya in 2008, found a skewed distribution of facilities and services for management of DM and DR and that most of these services were facility based. In the study, it was found that a high proportion of clinicians referred patients for DR screening only when they had ocular complaints.[20]

In this study, among the 213 patients examined, 68 (31.9%) were found to have DR. Of the patients with DR, 9(13.2%) had CSME. The number of patients with DR who were already on follow-up at the eye clinic was 50(73.5%). Majority of patients with DR had NPDR without macula edema (11.7%), minimal NPDR (7.5%) and NPDR with CSME (4.2%). The higher grades of DR occurred in fewer numbers of patients, with 2 patients having HRPDR not amenable to photocoagulation. Both patients had tractional retinal detachment

and under-went pars-plana vitrectomy. The number of patients who had laser treatment previously either for CSME or PDR was 11(5.2%).

Kariuki et al found a prevalence of DR of 49.8% at KNH 10 years ago, with 40.3% of patients with DR having CSME[9].The lower prevalence of DR in this study 31.9% (95%CI 25.7%-38.6%) compared to the previous one (49.8%) could be a reflection of changes in the mode of treatment for DM with improved glycaemic control in the patients. In addition to this, there is improvement in general awareness of the complications of diabetes[39].

There has been improvement in the inter-disciplinary management as evidenced by the larger number of patients that had been screened for DR compared to 10 years ago. Intensive weekly education at the KNH diabetes clinic has made patients aware on importance of compliance and proper glycaemic control. Introduction of daily clinics at the diabetic clinic has also made it possible for patients to have frequent reviews as opposed to the weekly clinics 10 years ago, which made follow-up periods long.

Studies done previously in other African countries have shown the prevalence of DR to be high. Most of the patients in these studies had no previous fundus examination. Guadie found a prevalence of 38% at Jimma hospital in Ethiopia. Only 14.5% of the patients had been screened previously for DR. Mutangana found a prevalence of 29.2% in three hospitals in Kigali Rwanda; only 39.4% of the patients had been screened previously for DR. In Cameroon, in a hospital-based study at Central Hospital of Yaoundé, the prevalence was found to be 49% in 2010 and only 19% had been screened previously for DR.[58]

Females 147(69%) were more than males 65(31%) in this study. The number of female patients with DR was 55 (37.4%). The number among males was found to be 13 (9.7%). Sex was found to significantly correlate with the risk of developing DR ($p=0.010$). This could be explained in part due to the fact that there were more females than males in the diabetic clinic. Although the effect of sex is inconsistent among population based studies, some studies have reported a higher prevalence of DR in women, with higher prevalence of macula oedema and vision threatening retinopathy. In type 1 diabetes, being female is

associated with higher prevalence of DR[48, 49, 50, 53, 54]. The finding could also be due to the larger number of women in this study as compared to men.

Poor glycaemic control is known to be a factor in accelerating the onset of complications of DM. In this study, the RBS did not correlate well with DR. The mean RBS was 10.0mmol among patients with DR and those without DR. (p=0.944). Most of the measurements were post-prandial blood sugars and were unreliable. Measurement of post-prandial blood sugar is common at the KNH diabetes clinic since it was observed that measurement of Fasting Blood Sugar impelled the patient to starve for long hours as most patients had to travel long distances to the clinic and this placed them at risk of hypoglycemia.The mean post-prandial blood sugar value was 10mmol/ml both in patients with DR and those without DR (p=0.944).Majority of the patients (90%) had their blood sugar measurements only during their diabetes clinic appointment. Only 21(10%) patients owned a glucometre and could therefore monitor their blood sugar at home. The other 192(90%) had their blood sugar measurements taken only during their visits to the diabetes clinic.

The mean HbA1c was 7.8%. The mean was higher in the patients with DR (8.1%) than those without DR (7.8%). However, this did not achieve statistically significant levels (p=0.403). The reference range for HbA1c was 4.5% - 7.0%. It was noted that some patients with advanced grades of DR had low levels of HbA1c, while some patients who had been recently diagnosed had no DR but had high levels of HbA1c. Two patients with end stage renal failure and on dialysis were found to have HbA1c of 5.5%.one patient had severe NPDR with CSME and the other PDR.

Generally, a rise in HbA1c is associated with a higher risk of DR[9, 47, 55]. The findings in this study could be as a result of poor initial as well as long-term glycaemic control in the patients. HbA1c shows the glycaemic control over the past three months and is thus a more reliable test than RBS, which is variable. A single HbA1c reading in patients who have been diabetic for many years should however be interpreted with caution. Abrupt improvement in blood sugar control is known to worsen pre-existing DR. This occurs after aggressive lowering of blood sugar on detection of complications, mostly by introducing

insulin or increasing its dosage. In such cases, serial HbA1c measurements would be more beneficial as they would show previous derangements in HbA1c, which predisposed the patient to DR in the first instance.

The patients with deranged HbA1c and normal eyes were the more recently diagnosed and had not yet developed complications. They were however at risk of developing complications due to the fact that their glycaemic control was poor early in their treatment. It is also important to consider that a seemingly 'normal' HbA1c could still be riddled with history of recent hypoglycaemia or spikes of hypergycaemia.

The epidemiology of diabetes intervention and complications trial (EDIC), which was done as a follow-up to the DCCT showed that despite having the same level of HbA1c, patients who had early intervention with initial intensive glycaemic[51, 52] control early in their treatment had delayed onset of DR as opposed to patients who had poor control initially and later started intensive therapy. This demonstrated the concept of 'metabolic memory', whereby Initial intensive therapy has prolonged benefit in delaying progression of retinopathy.[31,51] Generally, an increase in Hba1c is associated with higher risk of DR.[9, 47, 55]

Patients with higher grades of DR were either visually impaired or blind. Among the 15 patients who were blind, 12(80%) had DR. The other 3(20%) were blind from other causes ($p=0.007$). Other causes of visual loss were cataract in 6 patients, 1 patient had bilateral optic atrophy, one had age related macula degeneration in both eyes while the other one bilateral macula dystrophy. 69.4% patients with no DR had normal vision. Ten patients had undergone cataract surgery, all had visual loss. Diabetic retinopathy was found to cause visual loss (vision less than 6/18) in 18 (72%) patients out of the 25 who had visual loss in the study.

Duration of DM was found to be factor in development of DR. Patients with DR had a mean duration of DM of 11 years while those without DR were found to have a mean duration of 5 years ($p<0.001$). Kariuki et al had similar findings at KNH 10 years ago.[9] Several other studies have shown association between duration and DR .[9, 31, 52]

Hypertension was defined as systolic BP of ≥ 140mmHg and diastolic BP of≥ 90mmHg, in addition to all the patients on treatment for hypertension at the time of the study. The mean systolic and diastolic BP was found to be 135.5mmhg and 83.8mmhg respectively. The average period of treatment was 5.7 years. The number of patients on treatment for hypertension was 90, which, was 67.2% of the patients with hypertension. Treatment included use of angiotensin enzyme inhibitors, calcium channel blockers and beta-blockers, either alone or in combination. Patients with hypertension were found to have a higher prevalence of DR (35.1%) than those without hypertension (25.6%) p=0.154. The patients with lower systolic blood pressure had a lower prevalence of DR. Patients with high systolic BP 30 (34.9%) had higher prevalence of DR than those with normal systolic pressure 37 (29.4%). This was however not statistically significant (p=0.396).The number of patients with DR was also higher in patients with high diastolic pressure was 30 (36.1%) as compared to 37 (28.1%) in patients with normal diastolic blood pressure. However, this also did not achieve statistically significant levels(p=0.254). This could be due in part to the fact that most of the patients with hypertension were on antihypertensive treatment. All type 2 patients were on an ACE inhibitor, prescribed for its vaso-protective effect. This could have had a lowering effect on the blood pressure level. Most had borderline blood pressure. However, there were 38 had uncontrolled BP. A diagnosis of hypertension has been associated with DR but not all studies have found an association between hypertension and prevalence or progression of DR.[56]

The type of DR had no significant relationship with DR. DM type1 was diagnosed as any patient <30 years and DM type 2 in any patient > 30 years. The number of patients with type 1 DM was 32 (15%) and the prevalence of DR among these patients was 34.4%. Those with type2diabetes were 181 and the prevalence of DR among them was 31.5%. (p=0.747) Type 1 DM is associated with more severe forms of DR. The findings in this study could be a reflection of the level of blood sugar control in both groups predisposing them to similar risk of DR.

The type of treatment correlated well with DR. All patients were on some form of diet control. Those on OHA were 66 (31.0%). Patients on insulin alone were 48(22.5%) while 46(21.6%) were on both, OHA and insulin. They had initially been on OHA and had insulin introduced later in the course of treatment. Those on diet control alone were 4 (1.9%). The type of insulin used was mixtard insulin. All the patients were on fixed doses of insulin and none was on multiple daily doses or insulin pump.

None of the patients on diet control alone had Diabetic retinopathy. Patients on OHA alone had a prevalence of DR of 13.6%. Those on insulin alone had a prevalence of 27.1%, while Patients who were on OHA in combination with insulin were found to have more severe DR, with a prevalence of 40.1% ($p=<0.001$). This could be due to the poor glycaemic control in patients on OHA alone, necessitating combined treatment with Insulin. Metformin, an oral hypoglycaemic agent, had also been prescribed for its weight lowering effect. It had been prescribed for patients with high body mass index to aid in weight lowering in order to improve blood sugar control. It thus is expected then that some of the patients on combined treatment had poor glycaemic control hence at risk of DR. The prevalence of DR was higher in patients who had stayed longer on OHA before addition of insulin to their treatment, with a mean of 7 years in those with DR and 4 years in those without DR ($p=0.621$).

The number of patients who had had previous fundus examination was 102 (47.9%). Of these, 80 patients had been referred for routine fundus examination on diagnosis of DM while 22 had been referred due to ocular complaints. Screening had been done by an ophthalmologist. Of 111 who had not had previous examination, 20(18%) patients had been recently initiated into the KNH DM clinic from other facilities and had not yet booked an appointment at the KNH eye clinic. Another 30 patients (27%) reported that their appointments had been postponed at the eye clinic due to the limited number of patients screened per week. The remaining 61(55%) had not gone for fundus examination after referral, since they felt that they had no ocular problems. It was noted that despite the fact that a large proportion of patients had previous screening (102) for DR, 20 of these patients (19%) were not regular in their follow-up and some were even lost to follow-up.

In the study at KNH 10 years ago only 18% of patients had previous fundus examination, and all had presented to the ophthalmologist due to reduced vision. None had ever been referred for routine examination.[9] Following recommendation after the study 10 years ago, there has been regular screening of DM patients one day in a week and patients are booked for follow-up depending on findings at screening. This may explain the higher number of patients found to have previous fundus examination.

LIMITATIONS

1. The small sample size could have affected the results of the study

2. The classification of DM into type 1 and type 2 was clinical, It is likely that some patients in either group could have been classified wrongly

CONCLUSIONS

1. The prevalence of DR in Black African diabetic patients attending KNH medical clinic 1s 31.9%. This is lower than 10 years previous to this study.

2. The number of patients who had previous fundus examination was 47.9%. This is higher compared to 10 years ago (18%).

In view of the above, despite the fact that the prevalence of DM is rising as shown by global and national data, the situation of DR at KNH has improved significantly over the last ten years. This is likely to be a reflection of the effort put in place both at KNH eye clinic at the diabetic clinic, in dealing with the situation over the past 10 years. There has been improvement in interdisciplinary communication and collaboration in management of DR, especially among physicians, ophthalmologists and nutritionists. There has also been screening of newly diagnosed diabetic patients, which has enabled early treatment of DR. Increased capacity building at the eye clinic and diabetes clinic has enabled efficient treatment of patients with DM and DR. Overall, this has been a good example of translating research findings into practice.

RECOMMENDATIONS

The prevalence of DR at KNH in this study is significantly lower (31.9%) than the one 10 years ago (49.8%). This is an indication that the measures put in place for management of DM and DR have been effective. However more needs to be done to improve the situation further. Reinforcement of the measures already in place is also necessary in view of the rising number of patient with diabetes.

1 All new diabetic patients on diagnosis and all known diabetic patients must be screened regularly. This could be made more efficient by increasing the human resource at the clinic in form of doctors and nurses. Screening opportunities could also be offered twice a week instead of once. This will reduce the number of patients who have to be rebooked and hence get lost to follow-up.

2 Patient education:

- Every patient attending the DR clinic should be educated about DR. The need for regular follow-up should be emphasized and patients should be taught on the need for follow-up even after normal fundus examination.

- The importance of strict glycaemic control should be emphasized. Nutritionists and health educationists should be present at the DR clinic to take part in teaching the patients.

- Nurses at the eye clinic could take part in patient education by giving talks to the patients at the waiting bay in the morning during DR clinic days.

- Registrars/nurses could take part in the weekly DM education day at the DM clinic

3. HbA1c has been used to assess the risk of DR previously. Serial HbA1c measurements would be more reliable in assessing the trend in glycaemic control, as opposed to isolated readings which show control over a limited period of time.

REFERENCES

1. WHO website. *http;/www.who.int/diabetes/facts/worldfigures/en/index1.html* (Accessed June 2010).

2. Reshikoff S. Global data on visual impairment in the year 2002. *Bulletin of the world health organisation,* 2004;82:844-851.

3. Viswanath K, Murray DD, McGavin M. Diabetic retinopathy: Clinical findings and management. *J Comm Eye Health* 2003; 16:21-22.

4. Aiello LP. Angiogenic pathways in diabetic retinopathy. *N Eng J Med* 2005;35: 839-841.

5. Kasper D L, Fauci AS, Longo DL, BraudwaldE,Hauser SL, Jameson LJ, et al.Harrison's Principles Of Internal Medicine. Mc Graw-Hill Medical Companies USA. Edi 17th2007; 19:2152-2153.

6. Guadie SW, Kimani K, Ilako DR.Magnitude andpattern of Diabetic Retinopathy in Jimma university hospital, Jimma,Ethiopia 2009. *MMed dissertation. Department Of Ophthalmology, University of Nairobi.*

7. Mutangana FK, Kariuki MM, Karimurio J. The magnitude and pattern of diabetic retinopathy as seen at three hospitals in Kigali, Rwanda 2008*MMed dissertation. Department Of Ophthalmology, University of Nairobi.*

8. Nabatanzi C. the prevalence of diabetic retinopathy in Uganda. 1999*MMed dissertation Makerere University.*

9. Kariuki MM, Kollmann KHM, Adala HS. The prevalence, pattern and associations of diabetic retinopathy among black African diabetics attending medical diabetic clinic at KNH. *German Med Sci* 2004 DOC 04 dog SO 08.06.

10. International Diabetes Federation (IDF), Diabetes Atlas, 2nd and 3rd edition, updated Nov. 2006www.idf.org(Accessed May 2008).

11. King H, Rewers M. diabetes in adults is now a third world problem.*J CommEye Health*. 1996; 9:51.

12. Khatib OMN. Guidelines for the prevention, management and care of diabetes mellitus. EMRO Technical publication series. *Bull WHO*. 2006; 32:13 -14.

13. Alberti N, Zimmet F.The expert committee on the diagnosis and classification of diabetes mellitus, 1997, 2002.

14. American Academy of ophthalmology.Update on general medicine 1996-1997;1:143.

15. Alk W J, Ntsepo S, Mohamed P, Becker P J. Ethnic differences in the clinical and laboratory associations with retinopathy in adult onset diabetes: studies in patients of African, European and Indian origin. *N Eng J Med* 1997;1:31-37.

16. Githeko AK, Kollmann KHM, Adala HS. Prevalence, pattern and risk factors of diabetic retinopathy among patients attending rural health institutions in rural Kenya.*East Afr J*2007:13:4-10.

17. Gichuhi S, Kollmann KHM, Choksey PV. prevalence of primary open angle glaucoma among black African patients with diabetes mellitus. *German Med Sci*; 2004. DOC 04 dog SO 08.06.

18. Wachira JW, Kollmann KHM, Kimani K. Diabetic retinopathy in pregnant and non pregnant diabetic women of child bearing age in Nairobi Kenya 2006.*MMed Dissertation. Department Of Ophthalmology, University of Nairobi.*

19. Ministry of health national strategic plan for health care in Kenya 2005 – 2010. Department of ophthalmic services, Nairobi Kenya.

20. Ekuwam DN, Kollmann KHM, Masinde MS. Situation analysis of diabetic retinopathy services in Kenya 2008.*M.Med dissertation. Department Of Ophthalmology, University of Nairobi.*

21. Kaimbo DK, Kabongo BK, Missottten L. Ocular complications in diabetes mellitus in Zaire. *Bull Soc Belge Ophthalmol.*1995;25:107-113.

22. Seyoum B, Mengistu Z, Berharu P. Retinopathy in patients of Tiku Anbessa hospital diabetic clinic.*Ethiop Med. J.* 2001;39:123-131.

23. Mhando PA, Yudkin JS. The pattern of diabetic complications in African patients in Dar es Salaam. *Trop Geogr Med.* 1980; 32:317-323.

24. Klein R, Klein BEK, Moss SE.Visual impairment in diabetes. *Ophthalmol* 1984; 91:1- 9.

25. Dandona L, Dandona R, Naduvilath TJ, McCarty CA, Rao GN. Population based assessment of diabetic retinopathy in an urban population in Southern India. *Br JOphthalmol* 1999; 83:937-940.

26. Rema M, Premkumar S, Anitha B, Deepa R, Pradeepa R, Mohan V. The Chennai Urban Rural Epidemiological Study. Prevalence of diabetic retinopathy in urban India. *Invest Ophthalmol Vis Sci.* 2005; 46:2328-2333.

27. Kohner EM, Aldington SJ, Stratton IM, Manley SE, Hollman RR, Mathews DR, Turner RC. United Kingdom prospective diabetes study 30. Diabetic Retinopathy at diagnosis of non insulin dependent diabetes mellitus and associated risk factors. *Arch Ophthalmol*1998;116:297-303.

28. Cruikshanks KJ, Ritter LL, Klein R, Moss SE. The association of microalbuminuria with diabetic retinopathy. The Wisconsin epidemiologic study of diabetic retinopathy. *Ophthalmol*1993; 100:862-867.

29. Klein R, Moss SE, Klein BE. Is gross proteinuria a risk factor for the incidence of proliferative diabetic retinopathy? *Ophthalmol* 1993;100:1140-1146.

30. Mathiesen ER, Ronn B, Storm B, Foght H, Deckert T. The natural course of microalbuminuria in Insulin dependent diabetes: a 10 year prospective study. *Diabet Med*1995;12:482-487.

31. Diabetes control and complications trial research group. Effect of pregnancy on microvascular complications in the diabetes control and complications trial. *Diabetes Care* 2000;23:1084-1091.

32. Ferris FL , Chew KY, Hoogwerf BJ. Serum lipids and diabetic retinopathy. Early treatment diabetic retinopathy study research group.*Diabetes care* 1996;19;1291-1293.

33. Klein BEK, Moss SE, Klein R, Surawicz TS. The Wisconsin epidemiologic study of diabetic retinopathy, XIII: Relationship between serum cholesterol to retinopathy and hard exudates. *Ophthalmo*l 1991;98:1261-1265.

34. Young RJ, McCulloch DK, Prescott RJ, Clarke BF. Alcohol: Another risk factor for diabetic retinopathy? *Br Med J*1984;288:1035-1037.

35. Giuffre G, Lodato G, Dardanoni G. Prevalence and rrisk factors of DR in adult and elderly subjects:The Casteldaccia eye study. *Graefes Arch Clin Exp Ophthalmol* 2004;242:535-540.

36. Davis MD, Fisher MR, Gangnon RE, Barton F, Aiello LM, Chew EY et al. Risk factors for high risk proliferative diabetic retinopathy and severe visual loss: Early treatment diabetic retinopathy study report no. 8. *Invest Ophthalmol Vis Sci* 1998;39:233-252.

37. IaoQ,Keinanen-Kiukaaniemi S, Laara E. The relationship between haemoglobin levels and diabetic retinopathy. *J Clin Epidemiol* 1997;50:153-158.

38. Van Leiden HA, Dekker JM, Moll AC, Nijpels G. Blood pressure, lipids and obesity are associated with retinopathy: The Hoorn study. *Diabetes Care* 2002;25:1320-1325.

39. Kollmann KHM. Diabetes and the eye.*CHACK times*2009;6:8-11.

40. Taylor R. Practical community screening for diabetic retinopathy using mobile retina camera: Report of a 12 centre study. British diabetic association. Mobile retinal screening group. *Diabet Med* 1996;13:946-52.

41. Kanski JJ. Clinical Ophthalmology. A Systematic Approach. Butterworth Heinemann Ltd USA. Edi 6th2007;13:566-568.

42. Diabetic Retinopathy Study group (DRS).Photocoagulation treatment of proliferative diabetic retinopathy. Clinical application of DRS study findings. DRS report no 8. *Ophthalmol* 1981:88:583-600.

43. Early treatment of diabetic retinopathy study (ETDRS) research group. Photocoagulation for diabetic macula oedema. ETDRS report no1. *Arch Ophthalmol* 1985;103:1796-1806.

44. ETDRS study research group. Early photocoagulation for diabetic retinopathy,ETDRS. *Ophthalmol* 1998;101:766-785.

45. Diabetic retinopathy vitrectomy study (DRVS). Two year course of visual acuity in severe PDR with conventional management. DRVS report no 1. *Ophthalmol* 1985; 92:492-502.

46. Diabetic Retinopathy Vitrectomy Study. Early Vitrectomy for severe vitreous haemorrhage in diabetic retinopathy. Two year results of a randomised trial. DRVS report no 2. *Arch Ophthalmol* 1985;103:1644-1652

47. Diabetes Control and Complications Trial research group. Progression of retinopathy with intensive versus conventional treatment in the diabetes control and complications trial. *Ophthalmol* 1995;102:647-661.

48. Avan NH, Freedman BI, Adler SG, Iyengan SK, Chew EY, Davis MD et al. Heritability of the severity of diabetic retinopathy; the FIND-eye study, *investOphthal Vis Sci*, 2008;49:3839-3845.

49. Hietala K, Forsblom C, Summanen P ,Groop PH, on behalf of the FinnDiane study group. Heritability of proliferate diabetic retinopathy. *Diabetes*, 2008;57:2176-2180.

50. Hallman DM, Huber JC, Gonzalez VH, Klein BE, Klein R, Hanis CL. Familial aggregation ofseverity of diabetic retinopathy in Mexican Americans from Starr county, Texas, *Diabetes care*, 2005;28:1163-1168.

51. The diabetes control and complications trial/ Epidemiology of diabetes intervention & complications study. *N Eng J Med* 2005;353:2643-2653.

52. Klein R. Is intensive management of blood pressure to prevent visual loss in patients with type 2 diabetes indicated? *Arch Ophthalm 2004;122*:1707-1709.

53. Damji KF, Allingham RR. Molecular genetics is revolutionalizing our understanding of ophthalmic disease. *Am J Ophthalmol* 1997;124:530-543.

54. Snieder H, Sawtel PA, Ross L, Walker J, Spector TD, Leslie RDG. HbA1c levels are genetically determined even in type 1 diabetes: evidence from healthy and diabetic twins. *Diabetes* 2008;50;2058-2863

55. United Kingdom prospective diabetes study (UKPDS) group. Intensive blood glucose control with sulphonyureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes(UKPDS 33*). Lancet*, 1998:352;837-853.

56. Klein R, Klein BE, Moss BE, Davis MD, DeMets DL. Is blood pressure a predictor of the incidence or progression of diabetic retinopathy? Arch Intern Med. 1989 Nov;149:2427-32

57. 'Glycated haemoglobin in uremic patients as measured by affinity and iron exchange chromatography'. *Clinchem.com retrieved*2011-08-31.

58. Njikam J.Kollmann KHM, Kariuki MM. The prevalence and pattern of diabetic retinopathy in Central Hospital of Yaoundé Cameroon. 2010 *M Med dissertation. Department of ophthalmology.*

APPENDIX 1

QUESTIONNNAIRE

Serial no

Date……

Age…….sex……...

Duration of Diabetes …….

Type of Diabetes: I ……. BP mmHg……

11 ……

Mode of treatment: Duration:

Insulin……. ……

O.H.A……. ……

Diet…….. ……

Ocular complaints…….. Duration……

Previous fundus examination: Yes…… No……

Visual acuity: R.E…… L.E……

Grading of diabetic retinopathy: **R.E.** **L.E.**

---

1. Normal. No DR
2. Minimal NPDR …….. ……
3. NPDR with Macular Oedema …….. ……..
4. NPDR with Macular Oedema that is not Clinically Significant …….. ……..
5. NPDR with CSME …….. ……..
6. Severe NPDR (pre-proliferation) …….. ……..
7. NHRPDR …….. ……..
8. NHRPDR with CSME ……... ……..
9. HRPDR …… ……..
10. HRPDR not amenable to photocoagulation …… ……..

HbA_1c ……Fasting blood sugar …… mmol/l

Plan:

APPENDIX 2

WHO GRADING OF VISUAL ACUITY

Visual acuity	Vision
>6/6 – 6/18	Normal vision
<6/18 – 6/60	Visual impairment
<6/60 – 3/60	Severe visual impairment
<3/60	Blind
<6/18	Visual loss

APPENDIX 3

THE MANAGEMENT RECOMMENDATIONS FOR DIABETIC RETINOPATHY

GRADE	FOLLOW-UP (in months)	LASER	FLA
0	12	No	No
1	12	No	No
2	6-12	No	No
3	4-6	No	Occasionally
4	2-4	Yes	Yes
5	3-4	?	Occasionally
6	2-3*	?	Occasionally
7	2-3*	Yes	Yes
8	3-4	Yes	Occasionally
9	1-6	Not possible (Vitrectomy indicated In some cases)	No

*= if photocoagulation is deferred. If treated, follow up in 3-4 months

? = the value in treatment for non-proliferative diabetic retinopathy is uncertain

APPENDIX 4

GRADING OF DIABETIC RETINOPATHY (ETDRS)

0 Normal. No DR.

1 minimal non-proliferative diabetic retinopathy i.e. with rare micro-aneurysms.

2 Non-proliferative diabetic retinopathy without macula oedema.

3 Non-proliferative diabetic retinopathy with macular oedema that is not clinically significant.

4 Non proliferative diabetic retinopathy with CSME

CSME is defined by the ETDRS as the following:

- Thickening of the retina at or within 500 microns of the centre of the fovea.

Or

- Hard exudates at or within 500 microns from the fovea, if associated with thickening of the adjacent retina.

Or

- A zone or zones of retinal thickening one disc area or larger, any point of which is within a disc diameter of the macula.

5 Severe non-proliferative retinopathy (pre-proliferative).

6 Non high-risk proliferative diabetic retinopathy without CSME (NHRPDR without CSME).

7 Non high-risk proliferative diabetic retinopathy with clinically significant macula oedema (NHRPDR with CSME).

8 High-risk proliferative diabetic retinopathy (HRPDR). The high risk characteristics for severe visual loss are:

Neovascularisation at the disc (NVD) greater than 1/4 to 1/3 disc area or vitreous and/or pre-retinal haemorrhage accompanied by new vessels, either NVD or NVE , which is > 1/4 disc area.

9 High-risk proliferative diabetic retinopathy not amenable to photocoagulation.

APPENDIX 5

LIST OF INSTRUMENTS/MEDICATION

1. Tropicamide 1% eye – drops for pupillary dilatation.
2. Snellen's chart for testing visual acuity.
3. Slit lamp bio-microscope (Haag-Streit 900).
4. Indirect ophthalmoscope.
5. Retinoscope – objective refraction.
6. Trial lenses and trial frames.
7. Fundus camera and fluorescein dye.

APPENDIX 6

CONSENT FORMS IN ENGLISH AND KISWAHILI, COVERING LETTER.

My name is Dr. Wambugu Mariangela. I am a postgraduate student at the University of Nairobi. Department of Ophthalmology, in my third year of study.

I am conducting a study on the prevalence of diabetic retinopathy among patients attending the medical diabetes clinic at Kenyatta National Hospital. This study has been approved by Kenyatta National Hospital and University of Nairobi Ethics and Research committee (KNH/UON – ERC).

The information obtained from this study will be of benefit to all health care providers as it will help in improving management of patients with Diabetes and hence at risk of getting blind From Diabetic Retinopathy. It is of benefit to you since it offers you a chance of having a timely full ocular examination. If diagnosis of diabetic eye disease is made, you will be given appropriate treatment and follow-up. You will be booked for follow-up at the eye clinic also, if you have a normal eye examination.

I am kindly requesting you to participate in a brief interview, ocular examination and appropriate laboratory test, to enable me to make a diagnosis. This will be followed by appropriate treatment and will also enable me to fill the questionnaire accurately.

The examination will include testing your vision, examination of the front part of the eye, and installation of drops into the eyes, which will enable the back of the eye to be examined. This will take about 30 minutes. The eye drops will cause blurring of vision, but this is not permanent, it will go away after 4 hours. I will also take a blood sample to test the level of blood sugar control.

Participation in this study is voluntary and can be stopped at any time without any disadvantage to you as participant. All information will be treated with strict confidentiality at all times. Thank you.

I do hereby give consent to participate in this study. I have understood the nature and details of the study as explained to me by .....

Date ..... Sign.....

I confirm that I have explained the nature and details of my study to the above named participant. I guarantee strict confidentiality of all the information provided in the study.

Dated ..... Sign .....

Jina langu ni Dr.Wambugu Mariangela, mimi ni mwanafunzi katika Chuo Kikuu cha Nairobi ambako ninajifunza upasuaji na matibabu ya macho, niko katika mwaka wangu wa tatu.

Ninafanya utafiti kuchunguza upana wa ugonjwa wa Diabetic Retinopathy(Uharibifu wa macho kutokana na ugonjwa wa sukari) katika Hospitali Kuu Ya Kenyatta. Uchunguzi huu umepitishwa na tume ya uchunguzi ya Hospitali Kuu ya Kenyatta na Chuo Kikuu cha Nairobi. (KNH/UON ERC).

Matokeo ya uchunguzi huu yatakuwa ya manufaa kwa wale wote wanaochangia katika kutoa matibabu. Yatasaidia katika kuinua jinsi watu wenye ugonjwa wa sukari na ugonjwa wa macho wanavyotibiwa. Itakuwa ya manufaa kwako kwani utaweza kupimiwa macho yako vyema. Itakupa nafasi yakuweza kupimwa macho na kupewa matibabu unayoyahitaji. Utapata pia kufuatiliwa katika kliniki ya macho.

Ninakuomba ujiunge katika kujibu maswali mafupi, na pia kupimwa macho napia kipimo cha damu, ili kuniwezesha kuukagua ugonjwa wowote wa macho na pia kukupa matibabu. Umbali ambao macho yako yanaweza kuona utapimwa, kisha yatatiwa dawa ili kuweza kupimwa ndani. Hii itachukua muda wa dakika 30. Dawa hii itayafanya macho yako yawe hayaoni vizuri kwa muda mfupi lakini yatarejea katika hali njema baada ya masaa 4.

Utajitolea kwa hiari yako na unaweza kujiondoa kutoka zoezi hili bila madhara yoyote kwako. Ujumbe wote utakaotoa utawekwa kwa siri ya hali ya juu wakati wote.

Asante.

Ninakubali kuwa mhusika katika utafiti huu. Nimepewa maelezo kamili na .....Na kwamba nimeyaelewa vizuri.

Tarehe..... Sahihi.....

Ninahakikisha kwamba nimemtaarifu mhusika maelezo kamili ya utafiti wangu. Ninamhakikishia siri ya maelezo yote atakayoyatoa.

Tarehe..... Sahihi .....

MMED THESIS PROPOSED BUDGET

ITEMS	Unit Cost ((Ksh)	Quantity	Total (Ksh)
Proposal presentation Typing & printing draft	40	30	1,200
Copies to supervisor	2	30 x 2	120
Revision/ correction of drafts	2	30 x 2	120
Copies to ethical committee Photocopies	2	30	60
Binding	100	3	300
Ethical committee fees	1500	1	1,500
Subtotal			**3300**
Data collection Questionnaire	10	2	20
Flash disc	1500	1	1,500
Photocopy (questionnaire)	2	200	400
Investigations and consumables			
Fluoresceine angiography			
HbA1c	1500	75	112500

Contracted services e.g. statistician	20000	1	20,000
Subtotal			
Data management & reporting			
Typing & printing of preliminary results	10	50	500
Copies to supervisors	2	80 x 2	360
Revision of results	2	80 x 2	360
Printing black & white Photocopies black & white Coloured copies	10 3x40 20x20	40 8 8	400 960 3200
Binding of books	300	8	1600
Subtotal **GRAND TOTAL**			**5480** **143200**

Approval: Supervisors

Dr K. H. M. Kollmann

Sign..... Date .....

Dr. Dunera Ilako

Sign..... Date .....