PREVALENCE AND PATTERN OF DIABETIC RETINOPATHY AMONG DIABETIC PATIENTS WITH CHRONIC KIDNEY DISEASE ATTENDING THE RENAL OUTPATIENT CLINIC IN KENYATTA NATIONAL HOSPITAL

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THE UNIVERSITY OF NAIROBI

DECLARATION

This dissertation is my work and has never been submitted for a degree or award at any other university.

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ABBREVIATIONS

CKD	Chronic Kidney Disease
DM	Diabetic Mellitus
DME	Diabetic Macula Edema
DR	Diabetic Retinopathy
DN	Diabetic nephropathy
ESDR	End Stage Renal Disease
ETDRS	Early Treatment Diabetic Retinopathy study
GFR	Glomerular Filtration rate
eGFR	estimated Glomerular Filtration Rate
HBA1c	Glycated Hemoglobin
IDF	International Federation of Diabetes
IRMA	intra-retinal microaneurysms
KD: IGO	Kidney Disease: Improving Global Outcomes
KNH	Kenyatta National Hospital
NPDR	Non-Proliferative Diabetic Retinopathy
NVD	New Vessels at Disk
NVE	New Vessels Elsewhere
OCT	Optical Coherence Tomography
PDR	Proliferative Diabetic Retinopathy
PGH	Provincial General Hospital
ROPC	Renal Outpatient Clinic
USA	United States of America
USD	United States Dollar
WEDR	Wisconsin Epidemiologic study of Diabetes Retinopathy
WHO	World Health Organization

OPERATIONAL DEFINITION OF TERMS

1) Acute kidney disease (as per KD:IGO) – Increased serum creatinine to 1.5 times baseline or more. Urine output less than 0.5ml/kg/hr for the past 6 hours or increased serum creatine by 0.3mg/dL or more within 48 hours.

2) Chronic kidney disease- (as per KD:IGO) – Kidney damage for more than three months. There should be one or more of the following
    i) Urine sediment abnormalities
    ii) Tubular dysfunction evidenced by electrolyte imbalance
    iii) Structural abnormalities detected by imaging
    iv) GFR <60ml/min per 1.73m^2 (calculated using creatine)

ABSTRACT

Study Background

Over the last several decades, there has been a global increase in the prevalence of diabetes mellitus. As the number of people living with diabetes is increasing, so is the number of people suffering from the complications of uncontrolled diabetes, which include macro-angiopathies and micro-angiopathies such as nephropathy, retinopathy and neuropathy. Whereas retinopathy is almost universal in patients with DM, only about 40% of diabetic patients have chronic kidney disease (CKD).

Study Objective

This study sought to determine the prevalence and pattern of diabetic retinopathy among patients with chronic renal disease attending the Kenyatta National Hospital renal outpatient clinic.

Materials and methods

This was a cross-sectional hospital-based study carried out among adult patients with diabetes and chronic kidney disease at the renal outpatient clinic. It was conducted between March and April 2023. Each participant gave informed consent, and a pre-designed data collection tool was filled. We recruited 102 participants; 47 were females, and 55 were male (F:M 1:1.2). The participants underwent a single-shot macula-centered non-mydriatic retina photo of each eye. The photos were graded using the ETDRS score for DR in their original form. The worse eye was taken as the diagnosis of the participant. The data was analysed using SPSS Version 26 in descriptive and inferential statistics and presented in tables and figures.

Results

The prevalence of DR among known DM-CKD patients at KNH ROPC was 56.7% (95 % CI, 49.7%-62.4%). DR was more prevalent among participants who had DM for more than ten years and HBA1c of more than 6%. Among the study participants, we found that mild NPDR was 22%, moderate NPDR 8%, severe NPDR 9% and PDR 18%. We did not find a statistically significant association between increasing severity of CKD and worsening ETDRS DR stage. Only 21.6% of diabetic patients with CKD at ROPC had undergone a retina exam within one year preceding the study.

Recommendations

There is a need to increase screening of diabetic patients at the ROPC.

CHAPTER ONE: INTRODUCTION

1.1 Background Information

Diabetes is a chronic metabolic group of illnesses caused by decreased insulin production, cell resistance to insulin action, or a combination of both mechanisms(1). Diabetes results in elevated blood glucose levels that lead to complications that affect multiple organ systems and may eventually lead to decreased quality of life and death(1).

Complications that result from diabetes are classified as either macrovascular or microvascular(1,2). Macrovascular complications primarily affect large blood vessels and include myocardial infarctions, cerebral vascular accidents and peripheral vascular diseases. Microvascular complications, on the other hand, affect smaller calibre blood vessels, causing retinopathy, nephropathy and neuropathy(1,2).

Diabetic retinopathy and nephropathy are subtle, possibly even asymptomatic complications in the early stages, but are characterised by significant changes in quality of life in the later stages of the disease. A study carried out in India showed that quality of life was significantly lower in diabetic patients with DR compared with those without DR, primarily as a result of the effects on vision and general mental well-being (3).

The visual effects noted in the later stages of DR include distortion in the depth perception, visual acuity, colour sensitivity and visual field loss(4). DR is the fifth most common cause of preventable blindness in the working age group, resulting in a significant socioeconomic impact in the community(5,6).

The annual cost of treating DR is mounting with every passing year as the number of diabetic patients increases. Total global expenditure for the treatment of DR in 2017 was estimated at 727 billion USD(7).

The direct cost has been estimated at 11.6% of the health budget in Western countries(8).

In the United States of America, the annual direct cost of treating DR was 490 million USD in 2004(8). In Sweden, it costs about 334.1 USD per patient in the same year(8).

In Indonesia, the estimated annual cost for the management of DR was 2.4 billion US dollars in 2017(9).

Similarly, chronic kidney disease (CKD) is also a debilitating disease whose treatment including dialysis and renal transplants, require specialised expertise and are expensive(10,11)

Diabetic nephropathy (DN) is among the leading causes of chronic kidney disease and has been seen in both type 1 and type 2 diabetes(12). In the USA, it accounts for 30% to 50% of patients with end-stage renal disease(12). In a meta-analysis of studies published between January 1980 and October 2019 in China, DN's overall prevalence was 21.8%(13).

As with DN, regular monitoring and screening for retinopathy prevents severe forms of retinal damage(14). In both diseases, primary prevention is both cost-effective and more accessible than tertiary prevention and management(14,15)

Diabetes and its complications create a significant strain on the socioeconomic status of the patient, their families and the community. Few studies have been done to establish the cost of diabetes care in Sub–Saharan Africa. In Tanzania, for example, between 1989-1990, it is estimated that about 138 USD was required to take care of a diabetic patient representing 8.1% of the budgeted health expenditure(16). In Cameroon, the cost of treating a diabetic patient in 2001 was 489 USD, representing 3.5% of that year's budgeted health expenditure(16).

The kidney and the retina are low-resistance organs supplied by small blood vessels. These small vessels are very susceptible to the ischemic changes brought about by hyperglycemia. The pathology in DR and DN has been hypothesised to occur in tandem(17).

Nephropathy is critical especially when associated with worsening of DR, and nephropathy treatment such as hemodialysis has been associated with improved retinopathy and better response to laser photocoagulation(17–19).

Studies over the years have shown that a pre-present microvascular difficulty can also contribute to the development of another and should pre-empt investigation for the others(20).

The relationship between diabetic microvascular complications has not been studied, and whether the patient's environment, genetics or geographic location plays any role is unclear. Although co-relation has been established in many studies(17,20–22), some studies have reported that these complications can occur in isolation(23).

Retinopathy is almost universal in patients with DM, but only about 40% of diabetic persons have CKD(6,12). Furthermore, DR is common in patients with nephropathy but patients with Retinopathy do not necessarily have DN(22).

Diabetic patients with microalbuminuria without clinically detectable DR in Turkey were subjected to retinal optical coherence tomography (OCT), and the study showed that microalbuminuria is associated with early retinal microcirculation alterations(24).

Multiple studies have shown that the presence of CKD may be a prognosticating factor for DR, and similarities in their pathogenesis have been discussed(25–27). However, specific associations, such as the stage or severity of CKD, that might predict the progression of DR have not been studied(25).

CHAPTER TWO: LITERATURE REVIEW

2.1 Diabetes Mellitus

Diabetes is primarily classified into two major groups: Type 1 and Type 2 diabetes. Other classifications, such as gestational diabetes and diabetes secondary to infections, drugs and pancreatic anomalies also exist. This study shall focus on type 1 and 2 diabetes.

Type 1 diabetes also known as Insulin-dependent diabetes mellitus, accounts for about 10% of the diabetic population(1). The pathophysiology of the disease may be attributed to the destruction of beta cells in the pancreas, leading to a decrease in the amount of insulin secreted in the body. The beta cell destruction may be due to an immune-mediated process or idiopathic. Idiopathic form of type 1 diabetes is commonly seen in people of African and Asian lineage(28).

Type 2 diabetes is also known as non-insulin-dependent diabetes mellitus. It is the most common type of diabetes, accounting for up to 90% of DM in the USA(1). It is characterised initially by increased insulin resistance to the insulin secreted by the body and, consequently, a relative decrease in insulin production (1).

Clinical symptoms of DM include polydipsia, polyuria, polyphagia and unexplained weight loss. One must meet one of the following criteria to diagnose DM, according to the American Diabetes Association[24].

1. Symptoms of DM plus random blood sugar more significant or equal to 11.1mmol/l
2. Fasting plasma glucose of equal or greater than 7 mmol/l
3. Two-hour plasma glucose of greater or equal to 11.1 mmol/l during an oral glucose tolerance test.

Diabetes treatment should follow a multi-disciplinary course involving the physician, nephrologist, ophthalmologist, and foot podiatrist, among others(1).
Glycemic control depends on nutrition, weight loss, and appropriate use of insulin and oral hypoglycemic agents(1,2,7,29,30).

2.1.1 Epidemiology of diabetes

Over the years, there has been a rise in the number of people living with diabetes, with factors such as obesity, genetics and longer life expectancy primarily being responsible(7)(31).

In sub–Saharan Africa, it is estimated that 19.4 million people are living with DM in 2019, and the number is expected to rise to 47.1 million by 2015(32). All diabetic patients are at risk of DR, so as the number of patients with DM rises, the number of patients with DR is also expected to rise.

The World Health Organization estimated the prevalence of diabetes in Kenya to be 3.3% in 2015 and predicts a rise to 4.5% by 2025(33).

2.2 Diabetic Retinopathy

DR is a microvascular diabetic complication affecting the retina, resulting from prolonged hyperglycemic states. It occurs in almost all persons with DM type 1 and up to 90% of type 2 with uncontrolled hyperglycemia (HBA1c more than 6%) and after 10-15 years of living with diabetes(3,4,8,32,34)

2.2.1. Classification of DR

The Diabetic Retinopathy Study (DRS) and the Early treatment of Diabetic Retinopathy Study (ETDRS) classify DR into No detectable Diabetic Retinopathy, Non-proliferative Diabetic Retinopathy (NPDR), further grouped into mild, moderate and severe and Proliferative diabetic Retinopathy (PDR)(35). The ETDRS classification of DR is shown in Appendix C.

The lesions are within the retina and include microaneurysms, small dot and blot haemorrhages, flame-shaped haemorrhages, intraretinal microvascular abnormalities (IRMA) and cotton wool spots. The presence of some or all of these lesions enables classification into mild, moderate or severe NPDR(35).

The presence of new vessels on the disc (NVD) or elsewhere (NVE) on the retina enables the classification of PDR(35).

Diabetic maculopathy is DR around the macula, a disease entity classified independently, which can lead to significant visual impairment(35).

2.2.2 Epidemiology of DR

Diabetic retinopathy is a devastating complication of diabetes affecting the working adult population(6). The IDF estimated that 25.7% of diabetic patients between 2015 and 2019 had DR and DME(36). Currently, IDF estimates that about 56.3 million people within the working age group have vision-threatening DR and estimates that 1 in every 3 persons living with diabetes will have DR by 2030, which is approximately 191 million people(36).

The global burden of DR is estimated to remain disproportionately high in sub–Saharan Africa and other third-world nations due to scarcity of resources, personnel, equipment and medicine(30). These challenges facing the health systems make it hard to manage DM and its complications in these emerging nations. As a result, the age-standardised prevalence of DR is disproportionally high in sub-Saharan Africa and South Asia compared to the Western countries. 1 out of 39 people is blind as a result of DR in sub-Saharan Africa, and 1 out of 52 has severe visual impairment as a result of DR(6).

A study in KNH in 1999 by Kariuki(37) et al. showed the prevalence of DR to be 49.8%. Ten years later, a follow-up study by Wambugu(38) et al. showed that the prevalence of DR was less at 31.9%, attributed to improvement in treatment with better glycemic control over the years(38). Among the patients recruited into the study by Wambugu et al., 68.5% had no DR, 23.2% had mild and moderate NPDR, 1.9% had severe NPDR, and 6.6% had PDR.

A population-based cross-sectional study done between 2007-2008 by Mathenge et al. in Nakuru found the prevalence of DR to be 35.9%(39). The distribution of patients was 22.1% had mild and moderate NPDR, and 13.9% had severe NPDR and PDR. In this study, 64.1% of the patients had no DR.

Njambi et al., in 2012, in a cross-sectional hospital-based study in Embu Provincial General Hospital, found the prevalence of DR was 41% among diabetic patients with a mean age of 59.9 years(40). 10.3% of these patients had mild NPDR, 20.2% had moderate NPDR, 2.4% had severe NPDR, and 4.0% had PDR. 59% of the patients had no DR.

2.3 Diabetic Nephropathy (DN)

Diabetic Nephropathy (DN) is another microvascular complication of prolonged hyperglycemia affecting the kidneys.

As with DR, DN is seen in uncontrolled hyperglycemia. It is also seen in type 1 DM, having the disease for over 10 years and approximately 2% of newly diagnosed type 2(12,41). DN results in chronic kidney disease (CKD), which is a clinical syndrome characterised by

1. Persistent albiminuria >300mg/d
2. Progressive decline in the estimated glomerular filtration rate (eGFR)
3. Elevated blood pressure

2.3.1 Classification of CKD

CKD is defined by Kidney Disease: Improving Global Outcomes (KD:IGO) based on estimated glomerular filtration rate eGFR and albuminuria and is classified as Stage 1-5 based on the severity of the disease(42).

This is illustrated in Appendix D(42).

The eGFR is calculated by the CKD epi equation, and creatinine is measured using the kidney function test(42).

2.3.2 Epidemiology of DN

In the USA, DN is the leading cause of CKD and is reported to cause 30-40% of all End Stage Renal Disease (ESDR)(12).

Noubiap et al. examined the prevalence and incidence of CKD in Africa in a meta-analysis. They reviewed 32 articles over the last 20 years from across 16 countries, with 90.5% of the studies having been carried out in urban centre health facilities. They found the prevalence of CKD to range from 11% in Tunisia to 83.7% in Tanzania. They also found DM among the main risk factors for developing ESRD. Other risk factors noted were duration of DM, hypertension, advancing age and obesity(43)

Ngassa et al. 2015 studied the prevalence of micro- or macroalbuminuria in type 1 and type 2 diabetic patients in a tertiary care Centre in South Africa. The study also examined the relationship with diabetes control parameters such as glycated haemoglobin (HBA1C), blood pressure and lipids. HbA1C of more than 7% was recorded in 88.9% of the patients, and the

study found a prevalence of micro- or macroalbuminuria was 33.6% and poorly controlled DM was the ultimate risk factor for progression to ESRD(41).

Mumbi et al., in a cross-sectional hospital-based study in 2006, investigated ocular changes seen in black African renal patients at KNH. They found the prevalence of diabetic nephropathy in patients with CKD to be 11.9%(44).

Otieno et al. 2015 conducted a hospital-based study where they recruited 385 diabetic patients seeking to establish the burden of unrecognised CKD in these patients. They found the prevalence of CKD 3-5 (asymptomatic stages) adults aged above 30 years with type 2 DM to be 39.0%, with the unrecognised patients totalling 30% of the population(45)

2.3.3 Diabetic Retinopathy and Diabetic Nephropathy

Studies conducted across various population groups in the world have shown that the pathophysiology of diabetic retinopathy and nephropathy are closely associated. For instance, Ha et al. have noted that diabetic retinopathy, especially at the proliferative stage, could be a valuable tool for diagnosing and screening diabetic nephropathy(19).

A study in Taiwan in 2019 by Park et al. seeking to find out whether diabetic retinopathy is a prognostic factor for the progression of chronic kidney disease in diabetic patients concluded that DR severity is a prognosticating factor for future CKD progression in type 2 diabetic patients. They conducted a hospital-based study recruiting 2,197 patients with type 2 DM who visited the ophthalmologist between August 2006 and February 2014. They compared the annual decline rate of eGFR among subjects with different severity of DR. The group with CKD progression showed higher progression of DR progression at 25.5% vvs16.2%(46)

Hsing et al., in 2020, conducted a hospital-based study in Taiwan. They included 1329 patients and divided the cohort into two endpoints. The first was to trace the incidence of ESRD in all enrolled participants, and the second was for DM patients without CKD to follow their progression to CKD. In patients without CKD initially, they found that the progression

of CKD was in a stepwise manner as the DR worsened. They concluded that DR severity is an independent factor related to the decline in renal function in diabetic patients(47).
In the USA, Hong et al. suggested that similar mechanisms may underline the development of the adverse effects of DM. The presence of DR among their study participants was associated with an increased risk of kidney disease(48).

Ahmed et al. in Sudan reported that almost a third of patients with diabetes developed nephropathy. They also found a significant association between nephropathy and the development of retinopathy, with 35.6% of the participants having retinopathy (p=0.01)(49).

Mumbi et al. 2006 conducted a cross-sectional hospital-based study to investigate ocular changes seen in black African renal patients at KNH. They found the prevalence of DR among patients with CKD to be 48.5%. Of these patients, 12.1% had mild and moderate NPDR, 3% had severe NPDR, and 33.3% had DR(44).

2.4 Study rationale

Whereas studies have established that up to 90% of patients with poorly controlled diabetes have DR, only 40% of them have CKD; however, to the best of our knowledge, no study in Kenya has demonstrated the association between the pattern of diabetic retinopathy and diabetic nephropathy resulting in chronic kidney disease.
This study, therefore, sought to establish gaps, if any, in the care of diabetic patients with CKD and may guide national policies in the comprehensive management of DR-CKD in Kenya.

2.5 Study Objectives

2.5.1 Broad Objective

To determine the prevalence and pattern of diabetic retinopathy among known diabetic patients with chronic kidney disease attending the renal outpatient clinic at KNH

2.5.2 Specific Objectives

1. To determine the prevalence of diabetic retinopathy among known diabetic patients with chronic kidney disease attending the renal outpatient clinic at KNH

2. To determine the pattern of diabetic retinopathy among known diabetic patients with chronic kidney disease attending the renal outpatient clinic at KNH (by age, sex, duration of DM and HBA1c)
3. To determine the severity of diabetic retinopathy (using ETDRS- Early Treatment Diabetic Retinopathy Study) by severity of chronic kidney disease (using KD:IGO – Kidney Disease: Improving Global Outcome)
4. To determine the proportion of patients with diabetic retinopathy at the Renal outpatient clinic who have had a retinal exam in the past year

CHAPTER THREE: RESEARCH METHODS

3.1 Study design

This was a cross-sectional hospital study. It was a prospective study involving diabetic patients with chronic kidney disease seen in the renal unit.

3.2 Study setting

The study was conducted at the Kenyatta National Hospital renal outpatient hospital, a national teaching and referral hospital about four kilometres from Nairobi city centre. It facilitates research and medical education at the University of Nairobi, Kenya. (KNH Strategic Plan, 2019-2023).

The KNH renal outpatient clinic has two arms. One clinic runs on Monday at the dialysis centre and sees, on average 20 patients each day. The other takes place on Friday in clinic 23 and, on average, sees about 40 patients each day. These clinics provide comprehensive care to patients with kidney diseases of varying aetiology.

3.3 Study population

The study population included diabetic patients with CKD attending the renal outpatient clinic at Kenyatta National Hospital

3.4 Inclusion and exclusion criteria

3.4.1 Inclusion criteria

- All adult diabetic patients with chronic kidney disease attending the renal outpatient clinic at KNH during the study.
- Written consent

3.4.2 Exclusion criteria

- Opaque media*
- Moribund patient unable to sit up for a fundus picture.
- No recent HBA1C (>3months)
- Patients under 18 years of age

* Opaque media refers to any corneal or lenticular opacity noted in the patient's eye. Visualization of the retina in fundus photography is obscured in the setting media opacity

3.5 Sample size determination

Schaeffer's formula for calculating sample size for frequency in a population was used(50). The assumptions used in the formula are an alpha level of 0.05, a design effect of 1, an approximate finite population size of 119 and a comparable prevalence of Diabetic Retinopathy in CKD patients of 48.5%(44). The result was a sample size of 83 with finite population correction. The formula used is as detailed below-

$$Sample\ size\ (n) = DEFF\ \times \frac{Np(1-p)]}{\{\frac{d^2}{Z^2_{1-\frac{\alpha}{2}}} * (N-1)\} + p(1-p)}$$

$$Sample\ size\ (n) = 1\ \times \frac{119 * 0.485(1-0.485)]}{\{\frac{0.05^2}{1.96} * (119-1)\} + 0.485(1-0.485)}$$

$Sample\ size(n) =$ **91 (Corrected for 10% attrition rate)**

DEFF- (Design effect)- 1

N- (Population size for finite population correction)- 119 (Mumbi et al.)(44)

Z- (Z score at 95% confidence levels) – 1.96

d – (Desired absolute precision) -0.05%

p- Hypothesised frequency of outcome factor in the population (Diabetic retinopathy in CKD patients with Diabetes Type 2)- 48.5%(44)

α- Alpha level- 0.05

3.6 Sampling and recruitment

The study targeted all adult patients diagnosed with DM and CKD by the physician seen in KNH-ROPC for the duration of the study. Non-random (convenient) sampling of the 91 patients was done based on arrival time to the renal outpatient clinic. The researcher relied on the medical records to identify the sample patients with diabetes and chronic kidney disease at the renal outpatient clinic. When patients who fit the inclusion criteria were identified, they were issued with unique identification numbers. The researcher then sought

their consent after explaining the purpose of the study to them. The recruitment continued until the sample size was achieved.

3.7 Study materials

For repeatability and reproducibility of the results, the investigator used a digital fundus camera and the images captured were stored in a database.

Fundus camera specifications:

- Model- cannon CR-2AF non-mydriatic digital retinal camera

There was training between the researcher and a vitreoretinal specialist to minimise inter-observer variation.

As in Appendix E, inter-observer variation results showed an 85% agreement with a kappa of 0.8, which is substantial agreement between the two(51).

3.8 Data collection procedure

Participants recruited for the study were then escorted to the eye clinic in KNH (clinic 35) after being attended to in the renal clinic.

The principal investigator/research assistant used the questionnaire to record the patient's details, i.e. age, duration of DM, the current HBA1C status (from the last three months) and the severity of the renal disease based on KD:IGO. The principal investigator/research assistant then took a single-shot macula-centered retina photograph of each eye. All collected information relevant to the study was recorded in a pre-designed file abstraction tool (illustrated in Appendix B).

The photos were taken while the participants were sitting, and the worse eye was used for staging.

The researcher and research assistant ensured the privacy and comfort of the study participants before, during and after the data collection processes.

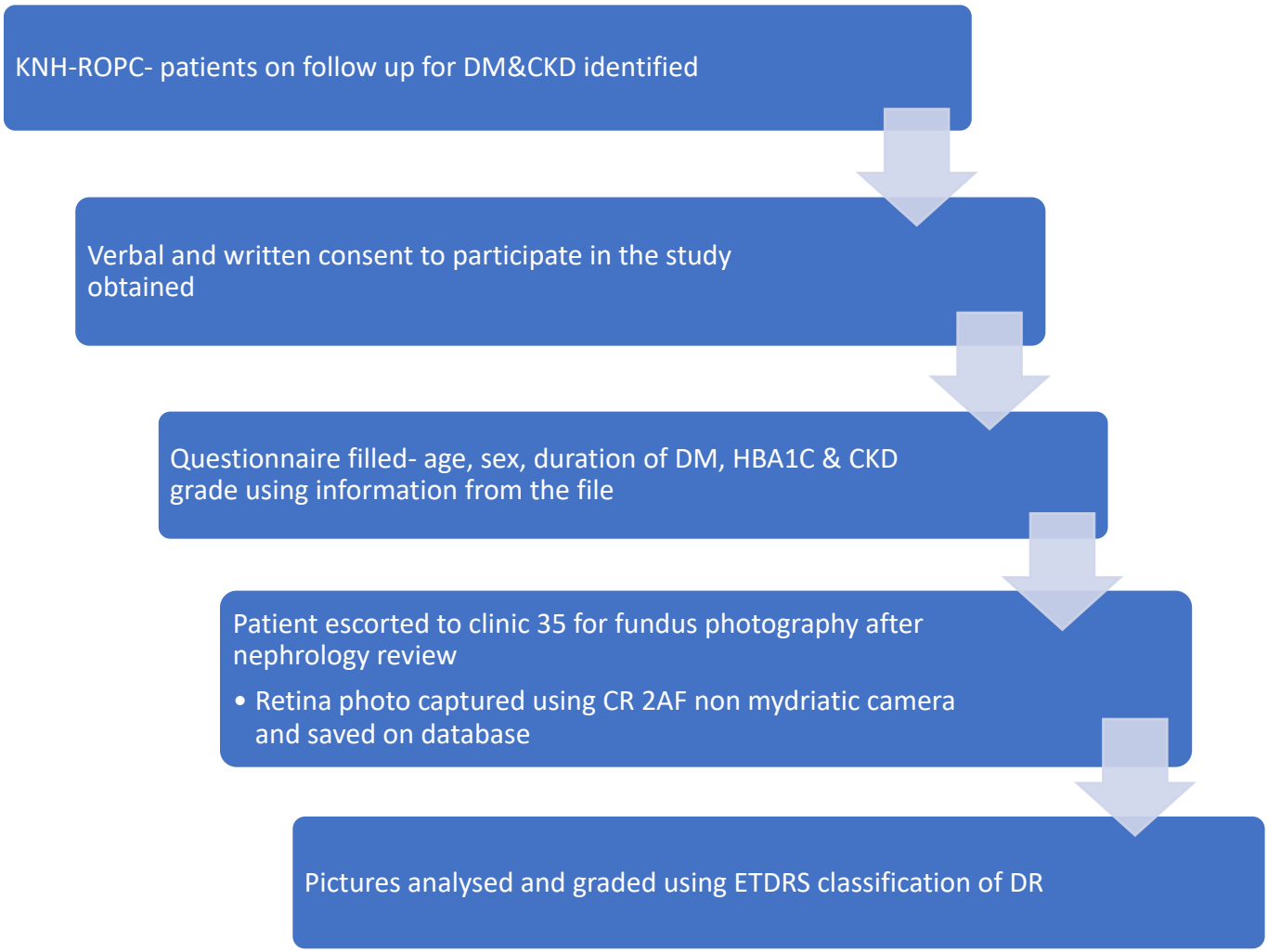

Figure 1: Participant recruitment process

3.9 Data management and analysis

3.9.1 Data recording

The data was recorded into a spreadsheet software Excel 2019©. The researcher ensured the correctness and accuracy of the data.

3.9.2 Data Analysis

Data recorded in questionnaires was collated. Before data entry, a data quality check was done on the photos and scripts, looking for inappropriate duplicates, outliers and missing values. Data analysis was done using SPSS version 26.

Descriptive analysis was done as appropriate. Categorical variables were analysed using proportions and presented in tables and charts where applicable. Continuous variables were tested for normality visually using the QQ plot. The mean and standard deviation were used to measure centrality and dispersion in normally distributed data, while the median and interquartile range were employed in non-normal data.

The prevalence of DR among CKD patients was calculated using the formula below-

Prevalence of DR among CKD patients at the ROPC $= \frac{patients\ with\ DR+CKD}{patients\ with\ CKD}$

Inferential analysis will be done to assess the contributing factors to the severity of DR. The methods used will include odds ratio and chi-square test as appropriate

3.9.3 Data management and storage

The researcher did not allow access to the data by unauthorised persons. The information was stored as hard copies in the form of filled questionnaires and soft copies in a hard drive. This data will be kept safely for five years from the date of successful publication of the results.

3.9.4 Quality assurance

The primary investigator did the recruitment of participants. A pre-designed questionnaire was used to collect data. Each participant underwent a single-shot non-mydriatic high-resolution coloured photo. The photos were saved and examined in their original resolution without conversion.

The principal investigator verified the information on each questionnaire to ensure that there was no missing data. Before data analysis, we audited the camera database to ensure that there was no duplicate photo of the same eye. The data was entered into a Microsoft Office Excel sheet and then analysed using SPSS version 26.

3.10 Ethics Consideration

The Kenyatta National Hospital-University of Nairobi Ethics and Research Committee was approached for approval to conduct the study. The Deputy Director of Clinical Services and Deputy Director of Health Information, KNH, sought permission to use the patients' files. Participants' file identities and details were anonymously kept using coded questionnaires. Data was stored in one computer and password-protected to facilitate confidentiality. Participants found to have media opacities, diabetic retinopathy and any other eye conditions were counselled and referred to the appropriate KNH ophthalmology clinic for management and follow-up.

3.11 Study utility

The knowledge gained from this study will give insight into the prevalence and patterns of diabetic retinopathy among diabetic patients with chronic kidney disease. That information will be helpful in planning and executing a more cohesive relationship between nephrologists and ophthalmologists in the care and management of a diabetic patient.

3.12 Study results and dissemination plan

The results were presented to the ophthalmology department and might be published in ophthalmology journals. A copy of the research findings will be handed over to the KNH research office.

3.13 Limitations of the study

Below are some of the limitations that the study encountered:

I. Media opacities such as cataract, which may be complications of diabetes, resulted in ungradable fundus pictures.
II. Our fundus camera may have missed peripheral lesions, resulting in misclassification of DR. The camera was new, first-time use, and it would have been desirable to undergo subsequent quality assurance.
III. Our study assumed CKD only resulted from DM. A renal biopsy, the gold standard for accurate diagnosis, was not a prerequisite for this study.

CHAPTER FOUR: RESULTS

4.1: Participants flow diagram

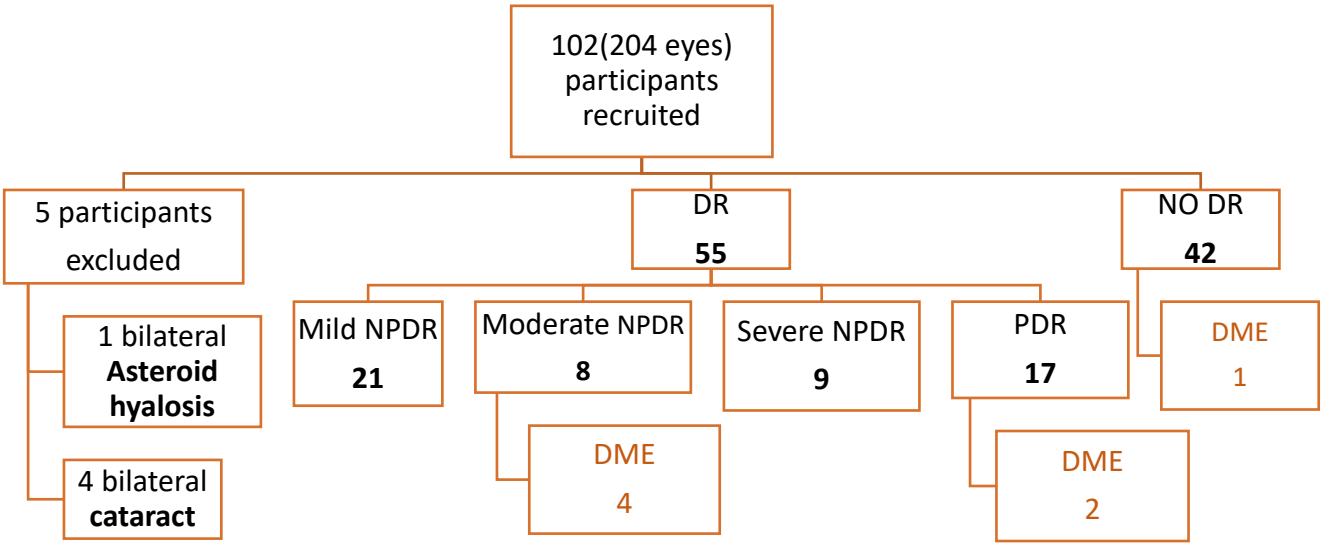

Figure 2: Participants' flow chart

One hundred two known DM and CKD patients (204 eyes) attending the renal outpatient clinic of KNH were eligible. We excluded 5 (4.9%) participants with ungradable photos in both eyes. Of these, 4 (3.9%) had bilateral dense cataract, and 1 (1.0%) had bilateral dense vitreous opacities due to asteroid hyalinosis that precluded a clear photograph.

4.2 Results

4.2.1 Demographic information among study participants

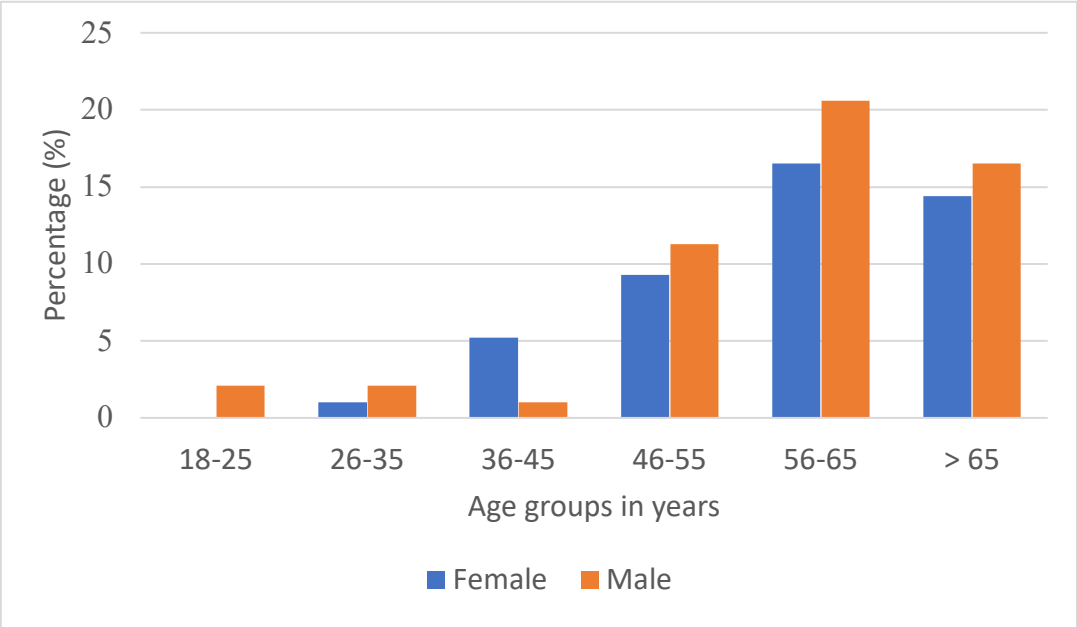

Figure 3: Age-sex distribution among the study participants (n=97)

Most (n= 85, 88.6%) participants were older than 45 years. The mean age was 59.11 years (range 19-85) with a standard deviation of 12.609 (median= 59, mode = 59).

The male respondents (n= 52, 53.6%) were slightly more than the female respondents (n= 45, 46.4 %). The female-to-male ratio was 1:1.2

The male participants were more in every age category except in the age group 36-45 years, where females were more than males.

4.2.2 Information regarding DM among study participants at ROPC KNH

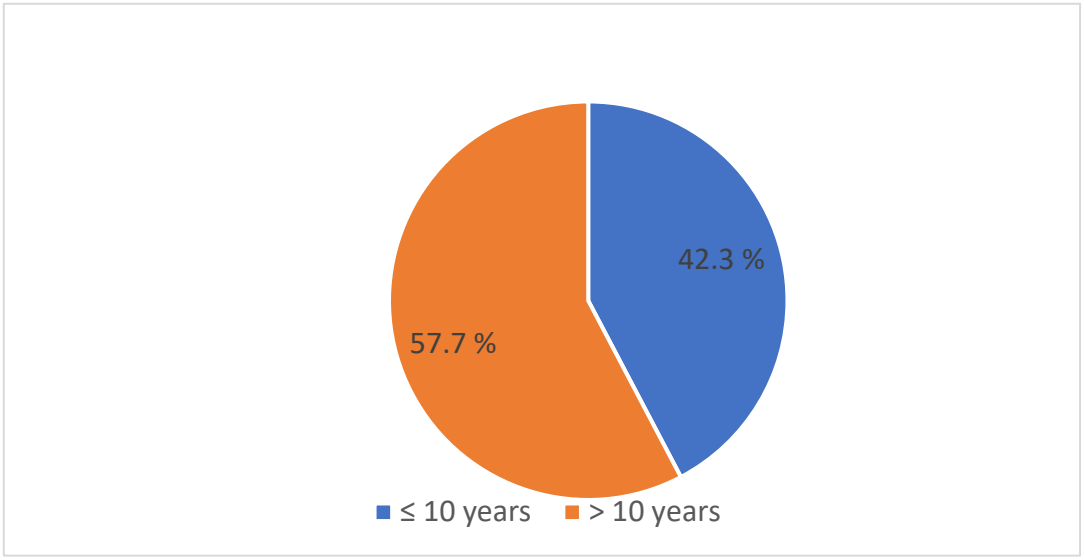

Figure 4: Proportion of participants with DM >10 years (n=97)

Most participants (56) had suffered from DM for more than 10 years from diagnosis.

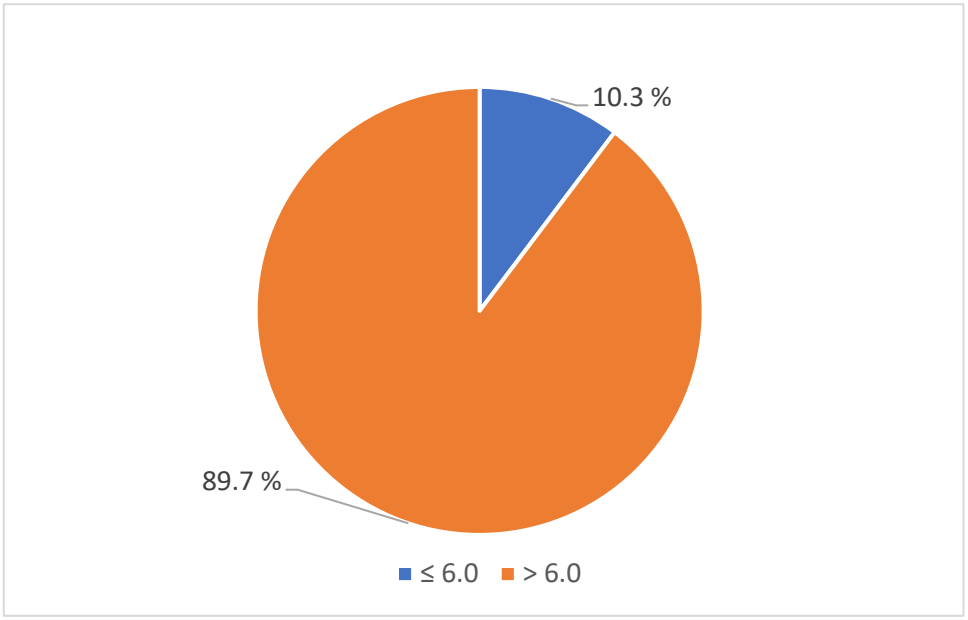

Figure 5: Participants' HBA1c level in the last 3 months (n=97)

Most participants (87) had poorly controlled DM (HBA1c >6% within 3 months preceding the study)

Table 1: Information on DM among the participants (n=97)

Variable		Number of patients (%)
Type of DM	Type 1	15(15.5)
	Type 2	82(84.5)
Total		97(100.0)
DM clinic	KNH	69(71.1)
	Other	28(28.9)
Total		97(100.0)
Prior DR screening	Yes	57(58.8)
	No	40(41.2)
Total		97(100.0)
When last screened for DR	< 2016	3(3.1)
	2016-2018	6(6.2)
	2018-2020	19(19.6)
	2020-2023	33(24.0)
	Never	36(37.1)
Total		97(100.0)
Current DM treatment	OHA	43(44.3)
	Insulin	31(32.0)
	OHA+ Insulin	23(23.7)
Total		97(100.0)

The majority of the patients had type 2 DM (84.5 %) and attended the diabetic clinic in KNH (71.1%). While 59.7% of the participants had screening for DR since the diagnosis of DM, only 21.6% had had their retinal exam in the past year.

Participants on oral hypoglycaemic agents (OHA) as the treatment modality for diabetes were 44.3%, 32.0% were on insulin, and 23.7% were on a combination of insulin and OHA.

4.2.3 Information regarding CKD among study participants at ROPC KNH

Table 2: Participants' severity of CKD (n=97)

Variable	Stage	Number of patients (%)
Severity of CKD	Stage 1	2(2.1)
	Stage 2	12(12.4)
	Stage 3a	14(14.4)
	Stage 3b	5(5.2)
	Stage 4	15(15.5)
	Stage 5	49(50.5)
Total		97(100.0)

Half of the respondents, 50.5%, had stage 5 CKD

Table 3: Information on CKD among the participants (n=97)

Variable		Number of patients (%)
Duration of having CKD (Years)	≤ 5	83(85.6)
	6-10	12(12.4)
	11-15	2(2.1)
	>15	0(0.0)
Total		97(100.0)
Currently on dialysis	Yes	36(37.1)
	No	61(62.9)
Total		97(100.0)
Have had a kidney transplant	Yes	7(7.2)
	No	90(92.8)
Total		97(100.0)

A majority (85.6%) of the participants had lived with CKD for less than 5 years; among them, 37.1% were on dialysis, and 7.2% had had a kidney transplant.

4.2.4 Prevalence of DR among DM-CKD patients at ROPC KNH

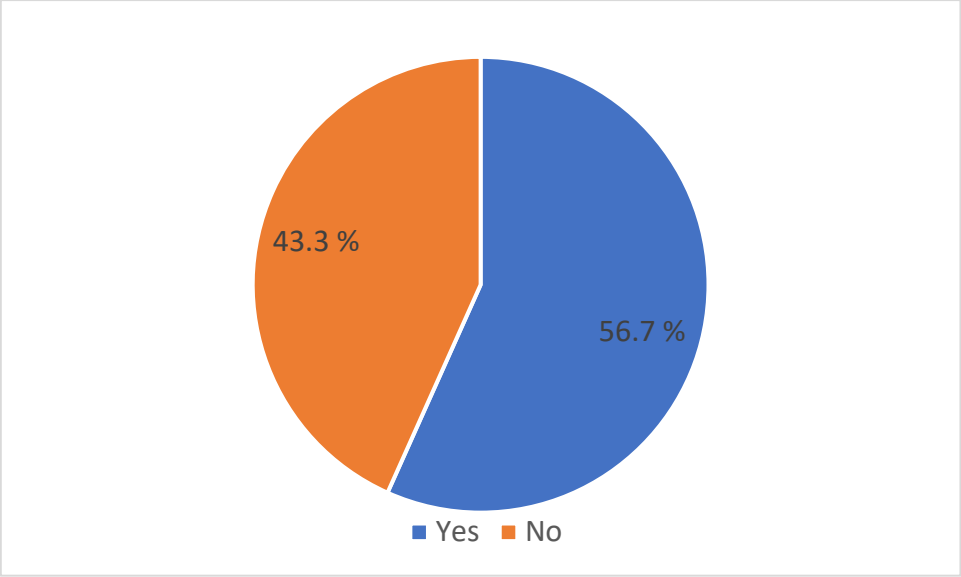

Figure 6: Prevalence of DR(n=97)

The prevalence of DR was 56.7% (95 % CI, 49.701 %-62.406 %)

Table 4: Prevalence DR by sex (n=97)

Sex	Number of patients (%)		
	With DR	Without DR	Total
Male	31 (32)	21 (21.6)	52 (53.6)
Female	24 (24.7)	21 (21.6)	45 (46.4)
Total	55 (56.7)	42 (43.3)	97(100)

DR was more prevalent in male participants (32%) compared to females (24%); however, this difference was not statistically significant (p=0.533).

4.2.5 Prevalence of DME among DM-CKD patients at ROPC KNH

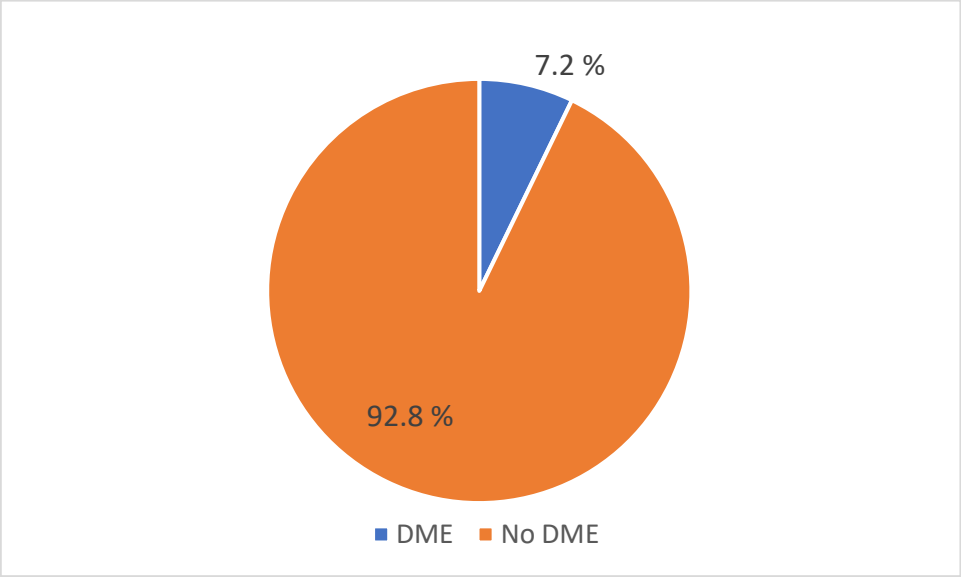

Figure 7: Prevalence of DME n=97

The prevalence of DME was 7.2 % (95 % CI, 6.701%-8.707%).

Table 5: Distribution of DME in DR (n=97)

Patient has DME	Number of patients (%)					
	No DR	Mild NPDR	Moderate NPDR	Severe NPDR	PDR	Total
Yes	1 (1.0)	0(0.0)	4 (4.1)	0 (0.0)	2 (2.1)	7 (7.2)
No	41 (42.3)	21(21.6)	4 (4.1)	9 (9.3)	15 (15.5)	90 (92.8)
Total	42 (43.3)	21(21.6)	8 (8.2)	9 (9.3)	17(17.5)	97 (100)

Most of the participants with DME (85.7 %) also had DR; 4.1% of the participants had moderate NPDR, while 2.1% had PDR. DR was present in all but 1 of the seven patients with DME.

4.2.6 Pattern of DR among DM-CKD patients at ROPC KNH

Table 6: Stages of DR (n=97)

	Frequency (n)	Percentage (%)
No DR	42	41.2
Mild NPDR	21	20.6
Moderate NPDR	8	7.8
Severe NPDR	9	8.8
PDR	17	16.7
Total	97	100.0

Among the patients with DR, those with mild NPDR and PDR represented the largest proportions at 20.6% and 16.7%, respectively.

Table 7: Pattern of DR by sex (n=97)

Sex	Number of patients (%)					
	No DR	Mild NPDR	Moderate NPDR	Severe NPDR	PDR	Total
Male	21 (21.6)	15(15.5)	6 (6.2)	4 (4.1)	6 (6.2)	52 (53.6)
Female	21 (21.6)	6(6.2)	2 (2.1)	5 (5.2)	11 (11.3)	45 (46.4)
Total	42 (43.3)	21(21.6)	8 (8.2)	9 (9.3)	17(17.5)	97 (100)

More males had mild forms of DR (mild and moderate NPDR) compared to female participants. More females had severe forms of DR (severe NPDR and PDR) compared to males.

Table 8: Pattern of DR by age (n=97)

Age group in years	Number of patients (%)					
	No DR	Mild NPDR	Moderate NPDR	Severe NPDR	PDR	Total
18-25	0(0.0)	1(1.0)	1(1.0)	0(0.0)	0(0.0)	2(2.1)
26-35	3(3.1)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	3(3.1)
36-45	4(4.1)	1(1.0)	0(0.0)	1(1.0)	0(0.0)	6(6.2)
46-55	9(9.3)	6(6.2)	2(2.1)	0(0.0)	3(3.1)	20(20.6)
56-65	14(14.4)	8(8.2)	2(2.1)	3(3.1)	9(9.3)	36(37.1)
>65	12(12.4)	5(5.2)	3(3.1)	5(5.2)	5(5.2)	30(30.9)
Total	42(43.3)	21(21.6)	8(8.2)	9(9.3)	17(17.5)	97(100)

The participants aged 56-65 had the highest number of patients overall. It was also the group with the most participants with DR (n=22) and the most significant number with PDR (9.3%).

The pattern of DR by age-sex distribution is illustrated in Appendix F.

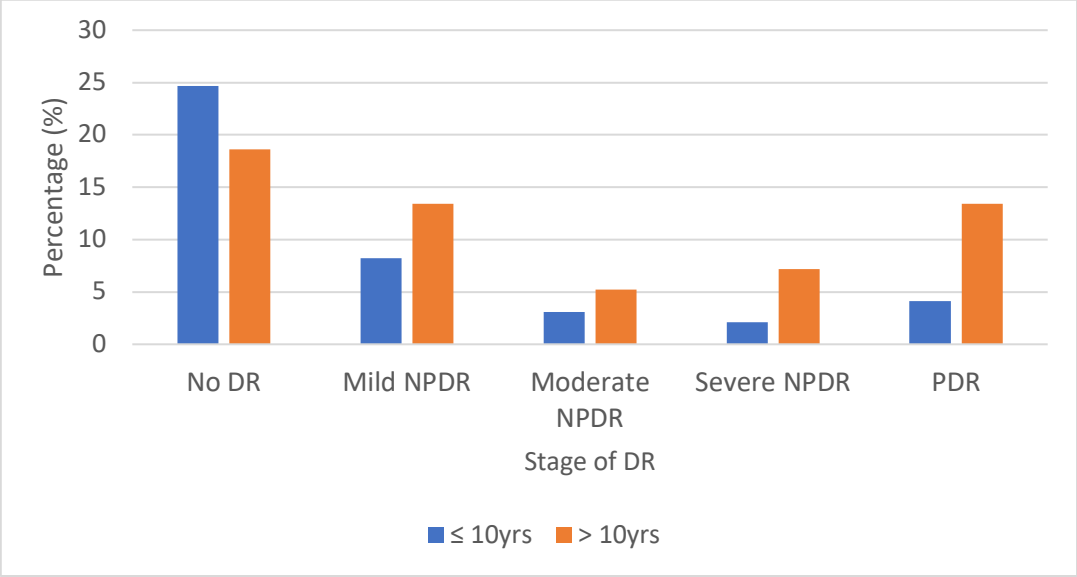

Figure 8: Pattern of DR by duration of DM (n=97)

DR was more prevalent in the participants who had DM for more than 10 years.

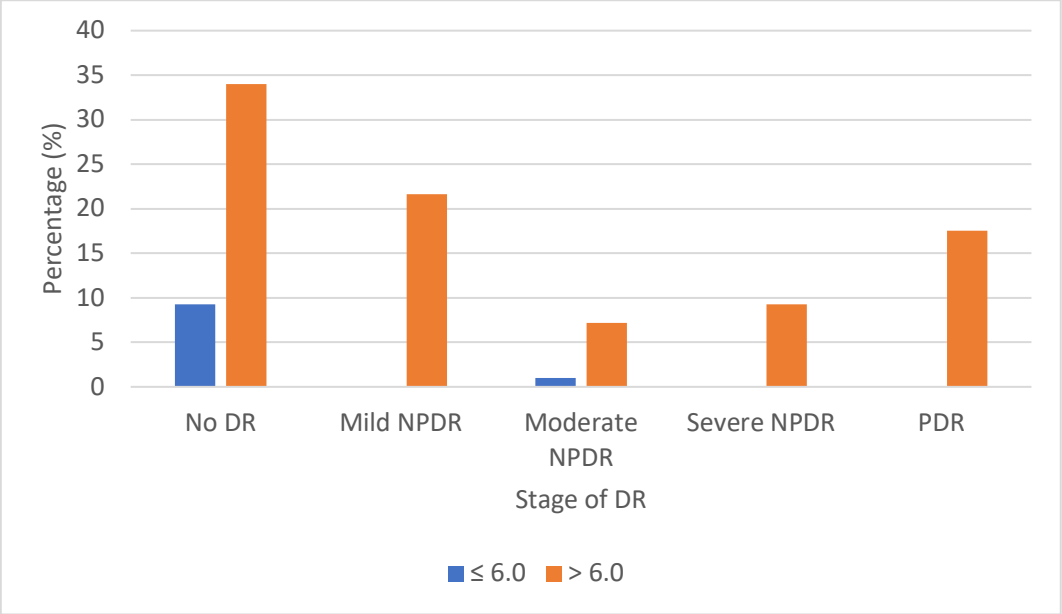

Figure 9: Pattern of DR by HBA1c levels(n=97)

DR was more prevalent in patients who had an HBA1c level of more than 6.0 %. (p= 0.026).

4.2.7 Proportion of study participants at ROPC KNH with DM-CKD who have had a retina exam in the past year

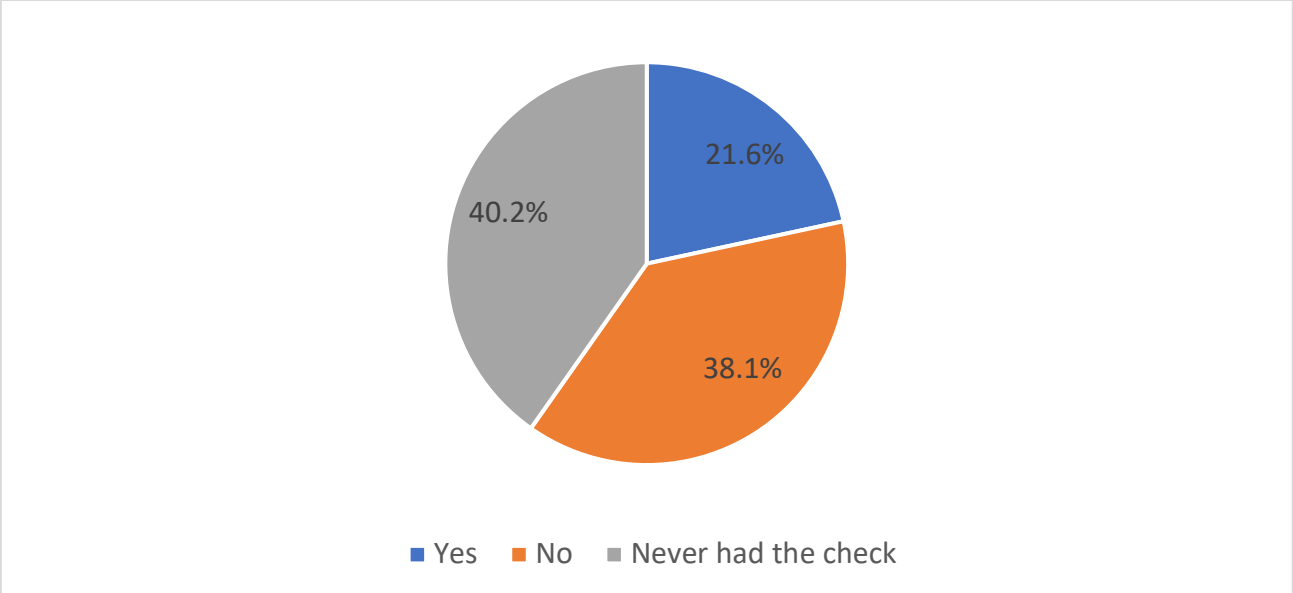

Figure 10: Retina exam in the past one year (n=97)

While 58 participants had their eyes screened for diabetes complications before this study, only 21 had a retinal exam in the past year.

4.2.8 Number of eyes with DR that had received treatment after assessment before this study

Table 9: DR treatment after assessment (n=45 eyes)

Treatment	Number of eyes (%)
Surgery (PPV)	3 (6.6%)
Anti-VEGF intravitreal injection	7 (15.6%)
Pan-retinal photocoagulation	35 (77.8%)
Total	45 (100%)

Of the participants who had previous retina examinations, 45 eyes had received DR treatment. Laser was the most commonly (n=35, 77.8%) employed treatment modality. All 3 eyes that had undergone pars plana vitrectomy also received endo-laser and anti-VEGF intravitreal injections.

4.2.9 Severity of DR compared to severity of CKD among DM-CKD at ROPC-KNH (n=55)

Table 10: Severity of DR by severity of CKD (n=97)

Severity of CKD	Number of patients n (%)		Total	Odds Ratio	p-value
	Severe NPDR & PDR	Mild and moderate NPDR			
Stage 3b-5 (Severe)	19 (34.5)	23(41.8)	43(76.4)	0.708 (0.20-2.47)	0.601
Stage 1-3a (mild)	7(12.7)	6(10.9)	13(23.6)		
Total	26(43.6)	29(52.7)	55(100.0)		

Among participants with severe forms of DR (severe NPDR and PDR), 34.5% had severe stages of CKD (stage 3b-5), while 12.7% had mild CKD (stage 1-3a). Among those with mild and moderate NPDR, 41.8% had severe CKD, while 10.9% had mild CKD.

Using an odds ratio of 0.708 (95% CI 0.20-2.47) and p=0.601, we did not find a statistically significant association between increasing severity of CKD and worsening ETDRS DR stage.

CHAPTER FIVE: DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.1 Discussion

We used a cannon CR-2AF non-mydriatic digital retinal camera. Each participant underwent a single-shot macula-centred high-resolution coloured photo. The photos were saved and examined in their original resolution without conversion. The ETDRS severity of DR in the worse eye was considered as the participants' diagnosis. We recruited 102 participants for this study but excluded 5 (4.9%) due to ungradable photos resulting from opaque ocular media. Despite this well-known shortcoming, retina photography has been reported as a valuable tool in the diagnosis of DR and has a high sensitivity for the diagnosis of both advanced disease and mild disease(52,53). Mathenge et al. also reported that slit lamp bio-microscopy significantly underdiagnosed DR compared to retina photography(39).

Our study involved patients with both insulin-dependent and non-insulin-dependent diabetes mellitus between 19 and 85 years. Most were above 45 years old, which was comparable to Ayah et al., who found a significant relationship between age and diagnosis of DM(54).
Our study participants had lived with DM for between 1 year and 54 years and with CKD for between 1 month and 15 years. Of the participants, 36 were on dialysis, and 7 had received kidney transplants.

The prevalence of DR in patients with CKD at KNH was found to be 56.7 %. This is aligned with 48.5% found by Mumbi et al. in 2006 among patients with renal disease at KNH(44). However, this was significantly higher than other KNH studies; Wambugu et al. 31% in 2011 and Ndegwa et al. 22.4% in 2020 as well as that in Embu by Njambi et al. 41% in 2009(38,40,55). Our high prevalence can be explained by the fact that all participants in this study had chronic kidney disease. Therefore, the presence of DR should increase the threshold for renal evaluation.

Our pattern of DR among DM-CKD patients was: majority with mild NPDR followed by PDR, then severe NPDR and moderate NPDR, respectively. Our findings for the pattern are also

closely aligned to those found by Mumbi et al. as follows: 30% versus Mumbi's 12.1% for mild and moderate NPDR and 27% versus Mumbi's 36% for severe NPDR and PDR(44)

In our study, the majority of the participants (71.2%) had severe CKD (stage 3b-,5) CKD, with half of the participants having stage 5 CKD.
We found that among participants with severe NPDR and PDR, 34.5% had severe CKD (stage 3b-5), while 12.7% had mild CKD (stage 1-3a). Among those with mild and moderate NPDR, 41.8% had severe CKD, while 10.9% had mild CKD. We did not find a statistically significant association between increasing severity of CKD and worsening ETDRS DR stage, which is contrary to what El-Asrar et al. found in Saudi Arabia(18). Similarly, Lee et al. and Park et al. in Korea found that patients with DR requiring PRP invariably ended up with DN(17,46).
It is important to note that Mott et al. concluded that the relationship between microvascular diabetic complications of the eye and the kidney may vary according to ethnicity, obesity and use of renin-angiotensin-aldosterone antagonists(56).

Among our sample population, 37% of the patients were undergoing dialysis, while 7.2% had undergone a kidney transplant. Studies have shown that severe DR may be an indicator of renal disease requiring renal replacement therapy or even a transplant. Moreover, these studies have shown that severe renal disease and its treatment can affect the progression of DR. This concurs with our findings, where the majority of the patients fell in the category of No DR and mild DR(57,58).

In our study, there was an increase in the prevalence and severity of DR with an increase in the level of HBA1c and the duration of living with DM. A majority (89.7%) of the participants had an HBA1c of more than 6%, and half of those who had DM for more than 10 years had DR.
We did not find a statistical association between the age, sex, type of DM and the type of diabetic treatment the participants were on and DR. These findings concur with those found by Wambugu, Mathenge and Njambi(38–40)

While 59.7% of the study participants had their retina screened for DR after their diagnosis of DM, only 21.6 % had a retina exam in the past year. The Kenya national guidelines for

screening and management of patients with DR recommend annual retina exams for DM patients or individuals with any other risk factor, including those aged 60 years(34). Our study found that there was a low uptake of DR screening services at the ROPC KNH. There could be several factors explaining this, the main one being that the renal outpatient clinic is independent of the diabetes unit in KNH.

5.2 Conclusion

The following conclusions were made from the findings of the study:

1. The prevalence of DR among known DM patients with chronic kidney disease at KNH ROPC was 56.7%.
2. This study did not find a statistically significant association between increasing severity of CKD and worsening ETDRS DR stage.
3. We also found that only 21.6% of diabetic patients at ROPC had a retinal exam within the past year before the study.

5.3 Recommendations

We recommend heightened screening of DR at ROPC due to the increased prevalence and severity of DR in CKD patients compared to the general population. This is evidenced by the significant number of diabetic patients with CKD at the ROPC who had never undergone a retina exam since the diagnosis of DM.

We also recommend that all patients with rapidly progressive DR undergo prompt renal evaluation.

TIMEFRAME

Phase	Description	Months																							
		2022												2023											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Topic proposal																								
2	Writing proposal																								
3	Proposal defense																								
4	Ethics approval																								
5	Collection of data																								
6	Analysis of data																								
7	Dissemination of results																								

WORK BUDGET

Item	Unit price	Quantity		Total cost (Ksh)
Proposal/Ethical approval				
Proposal printing	10	68 pages (3 copies)		2,040
Binding of proposal	100	3 copies		300
Ethics proposal cost				2,000
Internet	4200	5 months		21,000
			Subtotal	**25,340**
Collection of data				
Questionnaire printing	10	4 pages (110)		4,400
Stationery (Pens)	10	20		400
Box file for questionnaires	400	5		2,000
Flash disc (16GB)	2000	1		2,000
			Subtotal	**8,400**
Contracted services				
Statistician				20,000
Research Assistant				20,000
			Subtotal	**40,000**
Dissemination				
Printing of the final book	10	(Approximately 120 pages) 4 copies		4,800
Binding of the finished book	500	4 copies		2,000
			Subtotal	**6,800**
KNH research permission letter NASCOSTI certification			**Subtotal** **Subtotal**	**2,000** **1,000**
Miscellaneous			**Subtotal**	**5,000**
			Total	**88,540**

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Appendix A: Informed Consent

TITLE: PREVALENCE AND PATTERN OF DIABETIC RETINOPATHY AMONG PATIENTS WITH CHRONIC RENAL DISEASE ATTENDING THE RENAL OUTPATIENT CLINIC IN KENYATTA NATIONAL HOSPITAL

Patient study identification number----------Date ----------
I am Dr Jackline Rigii, a postgraduate student at the Department of Ophthalmology, University of Nairobi.

I am conducting a study on diabetic patients with chronic kidney disease attending the renal outpatient clinic in KNH. The study is for academic purposes, and any information you provide will be treated with confidentiality. Your name and personal information will not appear anywhere in the final write-up. Your decision to enrol on the study or refrain from doing so will not affect your treatment at the hospital.

Diabetes, if uncontrolled, leads to chronic kidney disease (nephropathy) and retinopathy. This study seeks to establish whether diabetic complications occur in tandem and possibly compare the severity of one against the other in a patient. The study will help foster a more cohesive relationship between nephrologists and ophthalmologists in the holistic management of diabetic patients.

Should I find any eye problem, such as the need for spectacles, etc., I will either write you a prescription for the appropriate medication or write you a referral to the relevant consultant for further management.

Approval for this Study has been given by the Kenyatta National Hospital/University of Nairobi ethics committee {KNH/UON-ERC}.

I will be available to answer any questions that will help you understand the nature of the study. If you want clarification, kindly contact me on 0729-314809.

Procedure

A questionnaire will be provided. It should take approximately 10-15 minutes to complete. We researchers will be available to guide you through the question. If you agree to participate in the study, you will be requested to fill in a questionnaire with the assistance of the researcher. This study will involve answering questions, some of which are personal, others medical, followed by a quick eye examination. Then, a retinal photograph will be taken using a fundus camera. The retina is a part of the eye affected by diabetes. The questionnaire in which this information will be filled will have no personal identifiers to protect your confidentiality.

Risks/Discomfort

There is no risk associated with participating in this study. There will be no invasive procedures that will be carried out in this study that may cause harm to you. Refusal to participate will not change any treatment you will receive at the clinic.

Benefits

There will be no direct benefit in participating in the study. Participation in the study is voluntary, but the interviewer will readily assist you if you have any questions. You will not be denied any service if you choose not to participate. You will be free to withdraw from the study at any time, yet your health services are provided completely.

Should I find any eye problems, such as the need for spectacles, medication, etc., I will write you a prescription for the appropriate medication or write you a referral to the relevant consultant for further management.

Confidentiality

Strict confidentiality will be maintained at all times. There shall be no mention of names or identifiers in the report or publications which may arise from the study. Each participant in the study will be identified using codes to link them with their results, and the data collected will only be accessible to the investigators.

Persons to contact

If you have any questions regarding the study, you may contact Dr Jackline Rigii on mobile number 0729 314809 or write an email to rigii.jackie@students.uonbi.ac.ke

If you have any questions about your rights as a research participant, you can contact the Kenyatta National Hospital Ethics and Research Committee by calling 2726300 Ext 44355.

Your participation in the study will be highly appreciated.

Consent form

I ----------having received information on the study, benefits and risks: with this AGREE/DISAGREE (cross out as appropriate) to participate in the study. I understand that participation is voluntary, and I can withdraw anytime.

Participant's signature----------date----------

I ----------declare that I have adequately explained information to the participant/ parent (guardian) on the study, benefits and risks and given her time to ask questions and seek clarification regarding the study. I have answered all the questions to the best of my ability.

Investigator's signature----------date----------

FOMU YA IDHINI

TITLE: PREVALENCE AND PATTERN OF DIABETIC RETINOPATHY AMONG PATIENTS WITH CHRONIC RENAL DISEASE ATTENDING THE RENAL OUTPATIENT CLINIC IN KENYATTA NATIONAL HOSPITAL

Nambari ya mgonjwa----------Tarehe ----------
Jina langu ni Daktari Jackline Rigii, mwanafunzi katika Idara ya Masomo ya Macho katika

Chuo Kikuu cha Nairobi.

Ninafanya utafiti kuhusu ugonjwa wa kisukari katika wagonjwa walio na ugonjwa wa figo katika hospitali kuu ya Kenyatta. Utafiti huu ni kwa mujibu wa kuongeza ujuzi wetu kuhusu magonjwa haya. Ninakuhakikishia kwamba mambo ambayo utaniambia kukuhusu kwa mfano jina lako nitayaweka siri na hautatambulika binafsi kama mojawapo ya watu waliofanyiwa utafiti huu. Matibabu yako hapa hospitalini hayata badilika ama kuadhiriwa kwa vyovyote ukichagua kujiunga na utafiti huu au la.

Ugonjwa huu wa kisukari hadhiri macho na figo. Utafitii huu utatuwezesha kuelewa kama magonjwa haya mawili huanza pamoja au moja baada ya nyingine. Majibu tutakayo yapata katika utafiti huu yatawezesha madaktari wataalamu wa macho na wale wa figo kuweza kutibu wagonjwa wa kisukari kwa upamoja.

Iwapo nitapata shida yoyote kwenye macho yako kama kuhitaji miwani, nitakuandikia dawa za kununua au nikutume kwa wataalamu wa shida hiyo ili waweze kukusaidia.

Idhini ya kufanya utafiti umepewa na Kenyatta National Hospital/University of Nairobi ethics committee {KNH/UON-ERC}.

Nitakuwa wakati wote ili niweze kujibu maswalii yoyote amabyo yatakuwezesha kuelewa utafiti huu zaidi. Kwa swali lolote wasiliana nami kwa nambari ya simu: 0729314809.

Utaratibu

Tutapeana karatasi ya kujibu maswali. Itachukuwa kama dakika 10-15 kujaza maswali. Wanaofanya utafiti watakuwa ili wakusaidie kujaza karatasi ya kujibu maswali. Ukikubali kujumuika na utafiti huu, utahitajika kujibu maswali ya utafiti na utasaidiwa na wanaofanya utafiti. Utafiti huu utakuwa na maswali kuhusu wewe binafsi na mengine kuhusu magonjwa ya kisukari na ya figo. Macho yako yataangaliwa kwenye mashine halafu picha ya pazia ya jicho inayoitwa retina kupigwa picha. Mbinu nitakazotumia hazina madhara kwa macho yako. Majibu ya utafiti wako yatabaki kuwa siri.

Madhara.

Utafiti huu hauna madhara yeyote. Hautadungwa dawa yeyote au kutolewa kitu chochote kwa mwili kwa sababu ya utafiti. Iwapo utakataa kushiriki, hili halitabadilisha matibabu yako wakati unapokaa kwa hospitali.

Manufaa.

Matokea ya utafiti yatakuwa ya manufaa kwa washikadau na wafanyikazi katika Kitengo cha afya haswa kwa kuimarisha matibabu ya wagonjwa wengine. Kujihusisha na utafitii huu ni kwa hiari na mswali yoyte yatajibiwa na yule anaye kuuliza maswali. Iwapo utaamuwa kutojihusisha na utafitii huu basi hutakatazwa kuendelea na kupokea matibabu katika kliniki. Unaweza kujiondoa katika utafitii huu wakati wowote na bado utaendelea kupokea huduma katika hospitali hii.

Iwapo nitapata shida yoyote kwenye macho yako kama kuhitaji miwani, nitakuandikia dawa za kununua au nikutume kwa wataalamu wa shida hiyo ili waweze kukusaidia

Ya siri.

Wewe kama mhusika, utajulikana kwa nambari tu na sio kwa jina lako. Majibu ya utafiti yatabaki kuwa siri na hayataruhusiwa kuonekana na mtu mwingine bila ruhusa yako. Matokeo ya utafiti kwa jumla yatapewa washikadau ambao wanahusika na mipango na matibabu ya macho ya wagonjwa wa ukimwi.

Kama una swali lolote, wasiliana na mtafiti mkuu; Daktari Jackline Rigii, nambari ya simu 0729314809 ama kupitia barua pepe rigii.jackie@students.uonbi.ac.ke

Kama una swali kuhusu haki yako kama mshiriki, unaweza kuwasiliana na Kamiti ya haki na utafiti katika hospitali kuu ya Kenyatta nambari ya simu 2726300 Ugani 44355.

FORMU YA KURUHUSU KUFANYIWA UTAFITI

Mimi ----------nimeelewa maana na jinsi utafiti huu utakavyofanyika, na nimepeana idhini baada ya kuelezwa kuhusu madhara na manufaa yake. NIMEKUBALI/NIMEKATAA (futa moja ya haya mawili) kushiriki katika utafiti huu na ninafahamu kuwa ni wa kujitolea na nina uhuru wa kujiondoa.

Sahihi ----------Tarehe ----------

Mimi ----------natangaza kuwa nimepeana habari ya utafiti huu kwa mhusika huyu haswa kuhusu madhara na manufaa na nimekubali kuulizwa maswali na nimeyajibu kwa uwezo wangu wote.
Sahihi ya mtafiti----------Tarehe----------

Appendix B: Data collection form

1. Biodata
    - Identification number……
    - Age ……
    - Sex ……

2. Type of diabetes (tick one)
    - Type 1
    - Type 2

3. Duration of DM

    ……

4. Current diabetic treatment (tick one)
    - Oral hypoglycemic agent (OHA)
    - Insulin
    - Combination of OHA + Insulin

5. Where do you attend the diabetes clinic?
    - KNH
    - Others (specify)……

6. HBA1C (in the last 3 months)

    …….

7. Severity of CKD as diagnosed and staged by the physician

    ……

8. How long have you had kidney disease?

    …….

9. Are you on dialysis? (tick one)
    - Yes
    - No

10. Have your eyes been checked for diabetes complications before? (tick one)
    - Yes
    - No

11. If yes, when was the last screening

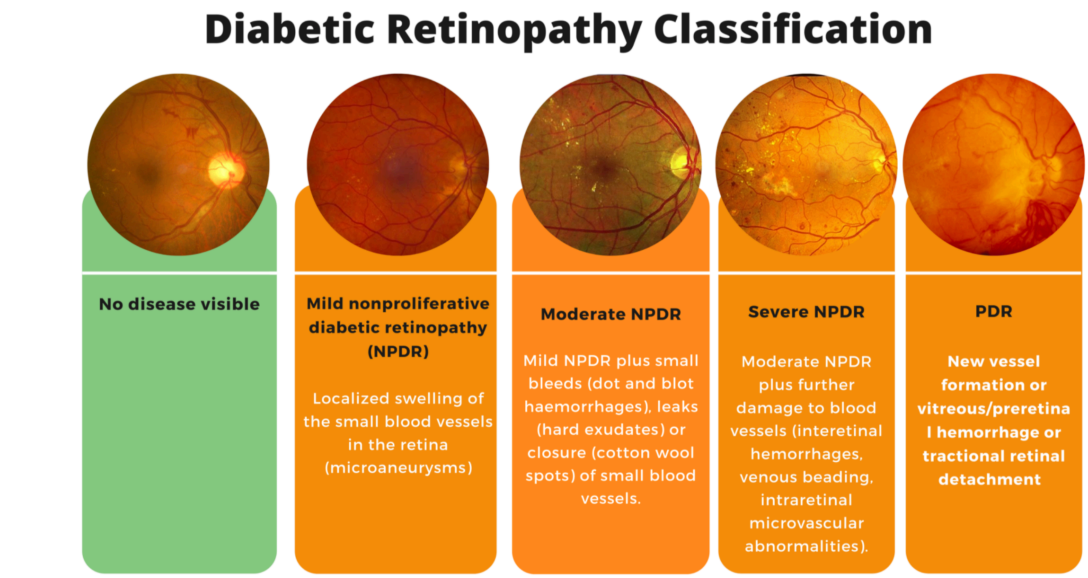
……

12. Have the patients with DR received any retina treatment before the study?
    - Yes
    - No

13. ETDRS staging of the DR (in the worse eye)

……..

Appendix C: Early Treatment Diabetic Retinopathy Study (ETDRS)



Appendix D: Kidney Disease Improving Global Outcomes KD:IGO

Prognosis of CKD by GFR and albuminuria categories: KDIGO 2012				Persistent albuminuria categories Description and range		
				A1	A2	A3
				Normal to mildly increased	Moderately increased	Severely increased
				< 30 mg/g < 3 mg/mmol	30–300 mg/g 3–30 mg/mmol	> 300 mg/g > 30 mg/mmol
GFR categories (ml/min/1.73 m²) Description and range	G1	Normal or high	≥ 90			
	G2	Mildly decreased	60–89			
	G3a	Mildly to moderately decreased	45–59			
	G3b	Moderately to severely decreased	30–44			
	G4	Severely decreased	15–29			
	G5	Kidney failure	< 15			

Green: low risk (if no other markers of kidney disease, no CKD); Yellow: moderately increased risk; Orange: high risk; Red: very high risk.

Appendix E: Inter-observer variation results

Codebook

DR grading

DR grade	**code**
No DR	0
Mild NPDR	1
Moderate NPDR	2
Severe NPDR	3
PDR+PRP	4
asteroid	5

Examiners

Examiner	**code**
JNM (Nyamori)	Rater_1
JWR (Rigii)	Rater_2

Grading Agreement

Agreed	**code**
Yes	1
No	0

Output

Agreement=85%

Kappa statistic=77.6% (substantial agreement)

```
. kap rater_1 rater_2

             Expected
Agreement    Agreement      Kappa    Std. Err.          Z       Prob>Z
------------------------------------------------------------------------
  85.00%       33.00%     0.7761      0.1225        6.34       0.0000
```

Kappa score grading (Landis & Koch)(51)

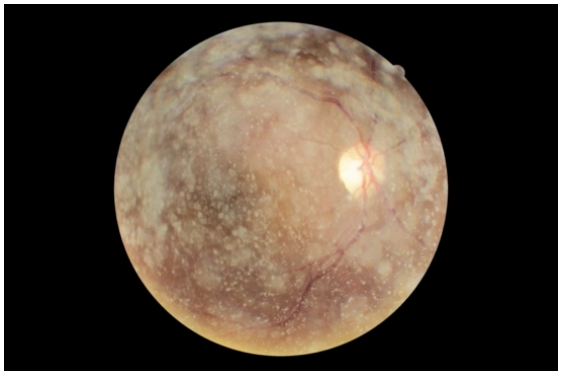
Kappa score	Grade
<0	No agreement
0-0.20	Slight agreement
0.21-0.40	Fair agreement
0.41-0.60	Moderate agreement
0.61-0.80	Substantial agreement
0.81-1	Almost perfect agreement

Appendix F: Pattern of DR by Age-sex distribution

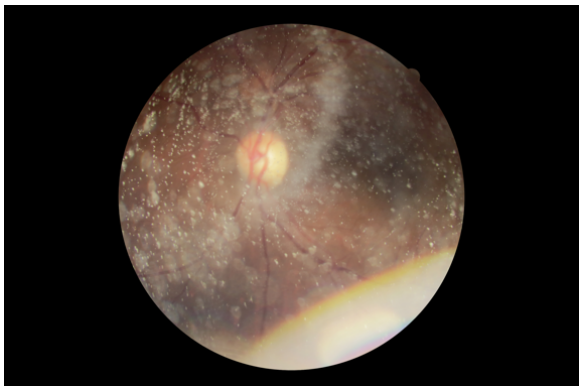
Pattern of DR				Gender		Total
				Female	Male	
No DR	Age (Years)	26-35	Count	1	2	3
			% of Total	2.4%	4.8%	7.1%
		36-45	Count	3	1	4
			% of total	7.1%	2.4%	9.5%
		46-55	Count	6	3	9
			% of Total	14.3%	7.1%	21.4%
		56-65	Count	6	8	14
			% of Total	14.3%	19.0%	33.3%
		>65	Count	5	7	12
			% of Total	11.9%	16.7%	28.6%
	Total		Count	21	21	42
			% of Total	50.0%	50.0%	100.0%
Mild NPDR	Age (Years)	18-25	Count	0	1	1
			% of Total	0%	4.8%	4.8%
		36-45	Count	1	0	1
			% of Total	4.8%	0%	4.8%
		46-55	Count	1	5	6
			% of Total	4.8%	23.8%	28.6%
		56-65	Count	3	5	8
			% of Total	14.3%	23.8%	38.1%
		>65	Count	1	4	5
			% of Total	4.8%	19.0%	23.8%
	Total		Count	6	15	21
			% of Total	28.6%	71.4%	100.0%
Moderate NPDR	Age (Years)	18-25	Count	0	1	1
			% of Total	0%	12.5%	12.5%
		46-55	Count	0	2	2
			% of Total	0%	25.0%	25.0%
		56-65	Count	0	2	2
			% of Total	0%	25.0%	25.0%

		>65	Count	2	1	3
			% of Total	25.0%	12.5%	37.5%
	Total		Count	2	6	8
			% of Total	25.0%	75.0%	100.0%
Severe NPDR	Age (Years)	36-45	Count	1	0	1
			% of Total	11.1%	0%	11.1%
		56-65	Count	2	1	3
			% of Total	22.2%	11.1%	33.3%
		>65	Count	2	3	5
			% of Total	22.2%	33.3%	55.6%
	Total		Count	5	4	9
			% of Total	55.6%	44.4%	100.0%
PDR	Age (Years)	46-55	Count	2	1	3
			% of Total	11.8%	5.9%	17.6%
		56-65	Count	5	4	9
			% of Total	29.4%	23.5%	52.9%
		>65	Count	4	1	5
			% of Total	23.5%	5.9%	29.4%
	Total		Count	11	6	17
			% of Total	64.7%	35.3%	100.0%

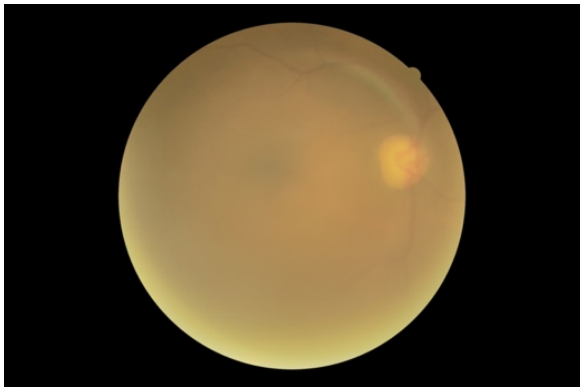
Appendix G: Excluded photos (ungradable)



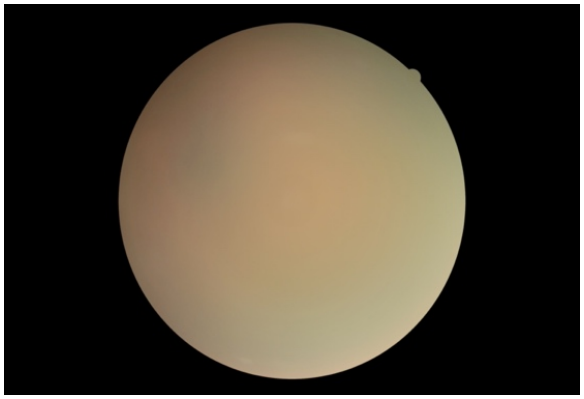
picture 1: asteroid hyalosis



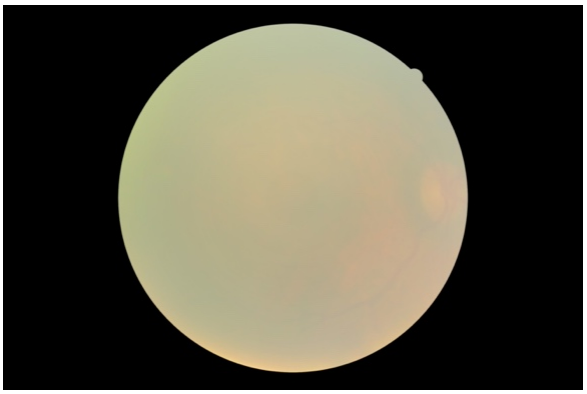
picture 2: asteroid hyalosis



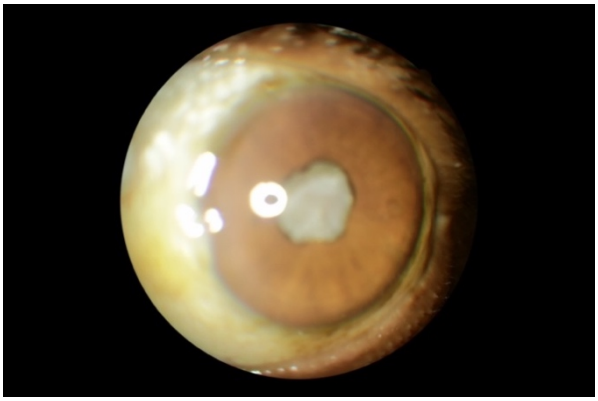
picture 3: dense cataract



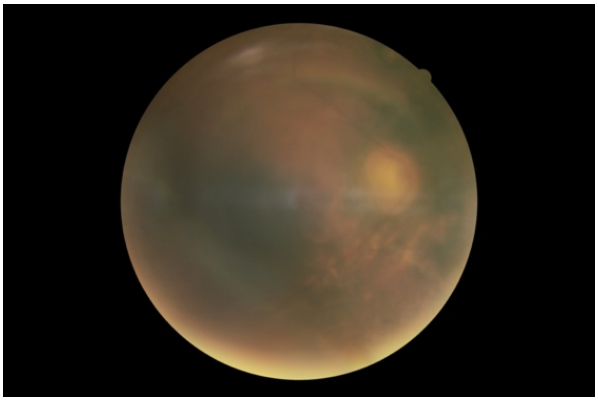
picture 4: dense cataract



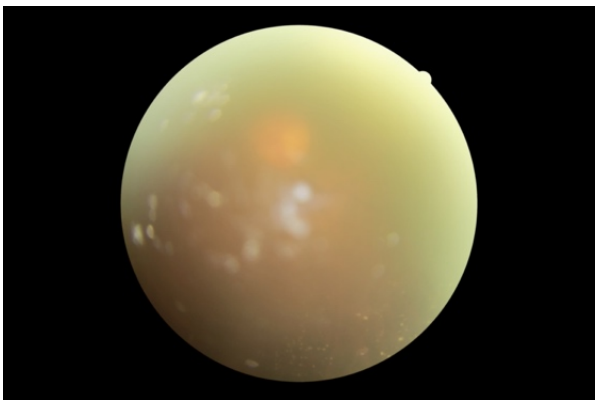
picture 5: dense cataract



picture 6: complicated cataract



picture 7: dense cataract



picture 8: dense cataract