Prevalence and Predictors of Diabetic Kidney Disease among Diabetes Patients in Diabetic Clinic of Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia: A Cross Sectional Study

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A thesis submitted in partial fulfillment of the requirements for the specialty certificate in Internal Medicine.

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This thesis is submitted in partial fulfilment of the requirements for the Specialty certificate in Internal Medicine.

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Summary

Background: Diabetes is the leading cause of CKD and ESRD in the worldwide. Diabetic kidney disease, one of which is Diabetic Nephropathy, is one of the common and significant complications in Diabetes Patients next only to cardiovascular complications. Many factors are thought to be associated with the development of DKD including older age, longer duration of DM, Poor Glycemic Control, Obesity. Dyslipidemia and HTN among others.

Objective: The objective of this study is to assess the prevalence and predictors of Diabetic Kidney Disease in patients with Diabetes Mellitus in Tikur Anbessa Specialized Hospital.

Methods: This cross-sectional study was done on 308 randomly selected Diabetic patients on follow up at Diabetic Clinic at Tikur Anbessa Specialized Hospital from July to November 2021. Structured questionnaire was employed to collect data on the sociodemographic, clinical and laboratory data of the study subjects. Trained physician data clerks collected data from the chart, interview and electronic medical records. Data was entered into EpiInfo 3.1 and was exported to SPSS version 25 for analysis. Descriptive analysis was done for all the cases. Ethical clearance was sought from the Institutional Review Board of the department of Internal Medicine, College of Health Sciences, Addis Ababa University.

Results: One hundred nighty seven (64%) of the study participants are female. The mean age is 51.6 (95% CI= 41.0-62.0) years. Most (91.6%) of the study participants are from Addis and most of the patients have Type 2 DM (80.8%) and the remaining have Type 1 DM. Most of the patients have duration of Diabetes greater than 05 years (78.8%) and only 16 patients (5.1%) have duration of diabetes less than 01 year. Most (55%) of the study participants have a BMI in the overweight or obese category with mean BMI of 25.9 (95% CI, 22.7-28.9). Most of the patients have hypertension (57.5%) as a comorbidity. The prevalence of dyslipidemia in the study population is 77.6%. Our study found the prevalence of DKD in DM patients following at Diabetes Clinic of TASH to be **23.05%.** Hypertension is the only significantly associated risk factor in this study.

Conclusion: The results of our study show a high prevalence of DKD in Diabetes patients in Diabetes clinic of TASH. Our study also confirmed the high prevalence of other CVS risk factors including Hypertension, Overweight/Obesity and Dyslipidemia. Hypertension is associated with significantly higher risk of developing DKD in patients with DM.

Key Words: Diabetic kidney Disease, Chronic Kidney Disease, Cardiovascular risk factors.

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Declaration

I, **Amanuel Berhanu,** declare that this thesis is my original work and it has not been presented for a similar or other degree at any other university.

I also declare that a complete list of references is provided indicating all the sources of information quoted or cited

Signature……..

This thesis has been submitted with the approval of my advisor.

Advisor- **Abel Zemenfes (MD, Consultant Internist and Nephrologist, Assistant Professor of Medicine.)**

Signature……..

Acknowledgement

I would like to thank the department of Internal Medicine for giving me the chance to do this study and get a valuable experience. I would like foremost to express my thanks to my advisor, Dr. Abel Zemenfes, for his motivation, patience, understanding and guidance through all stages of development of this research. I also want to forward my thanks to the renal and endocrine unit of the department of Internal medicine. Last but not least I want to thank the diabetes Clinic staff for their cooperation in data collection.

Acronyms

DM Diabetes Mellitus

DKD Diabetic Kidney Disease

DN Diabetic Nephropathy

CKD Chronic Kidney Disease

ESRD End Stage Renal Disease

BMI Body Mass Index

CKD-EPI Chronic kidney disease epidemiology collaboration

GFR Glomerular Filtration Rate

eGFR Estimated glomerular filtration rate

HgbA1C Hemoglobin A1C

AKI Acute Kidney Injury

KDIGO Kidney Disease Improving Global Outcomes

IDF International Diabetes Federation

ADA American Diabetes Association

FBS Fasting Blood Sugar

RBS Random Blood Sugar

TASH Tikur Anbessa Specialized Hospital

CDC Center for Disease Control

1. Introduction

1.1. Background

DM, as a cause of DKD, is the leading cause of CKD and ESRD in the US[1] and in the worldwide[2]. DKD can develop in the case of both type 1 and type 2 Diabetes. Type 1 Diabetes is an autoimmune disease characterized by antibody-mediated and cell-mediated destruction of pancreatic islets. Type 1 Diabetes may occur at any age but usually presents before the age of 30 years. Type 2 Diabetes is characterized by a combination of Insulin resistance and Insulin deficiency. The metabolic syndrome (Insulin Resistance, Visceral Obesity, Hypertension, Hyperuricemia and dyslipidemia) is often followed by Type 2 Diabetes. For a long period, Insulin resistance is compensated by increased insulin secretion, but a gradual decline in Pancreatic function finally culminates in hyperglycemia, and patients with Type 2 Diabetes may require treatment with Insulin. Type 2 Diabetes was typically a disease of elderly adults, but recently it is increasingly seen in younger adults, adolescents and even children. Diabetic Nephropathy remain a major cause of morbidity and death of persons with either Type 1 DM or Type 2 DM.

Globally most patients with Diabetes are in developing countries.[3] There is a more rapid increase in the prevalence of Type 2 Diabetes in the developing world compared with the developed world.[4] Indeed, 4 out of 5 people with Diabetes live in low- and middle-income countries, and it has been projected that these countries will experience the greatest surge in diabetes over the next two decades. For example, the prevalence of Diabetes is predicted to increase by 110% in Africa, 70% in Southeast Asia, and 60% in South and Central America by 2035, versus 37% in North America and 22% in Europe.

In western countries, Diabetes is the leading single cause of ESRD.[5] According to the U.S Renal Data System, in 2016, DKD was the most frequent primary diagnosis, with over 150 cases per 1 million population per year. Indeed, in many countries including the USA, more than 50% of patients in renal replacement programs have Diabetes as the major cause of their renal failure.[6] In China, a large-scale hospital-based survey found that DKD exceeded Glomerulonephritis as the most prevalent cause of ESRD since 2011.[7] In developed countries, for every 20 patients with Diabetes and Chronic Kidney Disease (CKD) less than one will survive to ESRD, succumbing instead to Cardiovascular disease, Heart Failure or Infection, to which the presence and severity of Diabetic Kidney Disease significantly contributes. Cardiovascular deaths and events more frequently precede the need for RRT, particularly in patients with albumin excretion <1000mg/g of creatinine or GFR <45.

The risk for the development of DKD is equal in Type 1 and Type 2 diabetes, and only 30-40% of patients with Type 1 or Type 2 Diabetes will ultimately develop Nephropathy. It is estimated that

25-40% of patients with Type 1 DM and 5-40% of patients with Type 2 DM ultimately develop DKD.[8,9] Up to 20% of patients with Type 2 DM already have DKD when they are diagnosed with DM[10], and on future 30-40% develop Diabetic Nephropathy mostly within 10 years of diagnosis.[11] Although Diabetic Nephropathy appears to be more common in Type 1 DM[12], because of large and increasing number of persons with type 2 DM, more than 80% of Diabetic patients in RRT programs have Type 2 DM. Prevalence of persistently raised moderately or severely decreased albuminuria in DM patients decreased from approximately 21% to 16%. Prevalence of persistently decreased GFR increased from 9 to 14%.

Diabetic Nephropathy is characterized clinically as a triad of Hypertension, Proteinuria and ultimately renal impairment. It historically was defined by the presence of albuminuria accompanied by retinopathy in patients with Type 1 DM.[13] Presence of albuminuria is thought to be an early sign of Diabetic glomerulopathy which is characterized by glomerular thickening, endothelial damage, mesangial expansion and nodules and podocyte loss. DN can manifest as overt nephropathy with macroalbuminuria or as incipient nephropathy with microalbuminuria. The classic five stages of nephropathy (Hyperfiltration, Silent, Microalbuminuria, Macroalbuminuria, Renal Impairment) as described by Mogenesen and colleagues, although not totally reliable remains the best way of describing this condition, particularly in Type 1 DM patients. DN is one of the causes of DKD but DKD can also be caused by other non-classical glomerular lesions and tubulointerstitial disease.

DKD is a clinical diagnosis based on the presence of albuminuria, decreased GFR, or both in DM. Although the gold standard for diagnosis is histology of the kidney, majority of patients do not undergo kidney biopsy as they are presumed to have DKD based upon history and lab evaluation. Renal biopsy is rather performed when an alternate diagnosis like Glomerulonephritis or Primary Nephrotic Syndrome is suspected. DKD does not indicate a specific pathologic phenotype. Albuminuria can be estimated by spot/random urine measurements of albumin and creatinine and albumin to creatinine ratio or it can be measured using 24-hour urine protein collection. Moderately increased albuminuria previously microalbuminuria is defined by albumin to creatinine ratio of 30-300mg/g or 24-hour urine protein of 30-300mg/day. Any detectable albuminuria forecasts a higher risk for future kidney and cardiovascular disease in diabetic patients. Severely increased albuminuria previously macroalbuminuria is defined by albumin to creatinine ratio of >300mg/g or 24-hour urine protein >300mg/day. Decreased GFR is defined by GFR <60ml/min/1.73m2. Annual rate of decline in GFR due to age related senescence of the kidney is 0.5-1ml/min/1.73m2[14] but in Diabetic patients it is usually >3ml/min/1.73m2. In some patients the DKD can be non-albuminuric which is defined by reduced GFR in the absence of albuminuria.[15] In Type 1 DM with GFR <60, 7 to 24% are non-albuminuric while in Type 2 DM with GFR <60, 39-52% are non albuminuric. Prevalence of Diabetic retinopathy is lower in individuals

with non-albuminuric CKD compared with albuminuric DKD. By contrast prevalence of macrovascular disease is similar between albuminuric and non-albuminuric DKD.
Clinical diagnosis of DKD is based on the fulfillment of the following sets of criteria:

- Persistently increased albuminuria and/or persistently decreased GFR.
- Long duration of DM (5 years for Type 1 DM and at the time of diagnosis in Type 2 DM) and established Diabetic Retinopathy. Retinopathy can be especially absent in Type 2 DM.
- A judgement that alternates etiologies are unlikely.
- Presumptive diagnosis is unlikely if: Severely increased albuminuria within 05 years of onset of Type 1 DM or for many years prior to the onset of Type 2 DM, Presence of RBC casts, WBC casts or dysmorphic RBCs in urine sediment, Presence of another systemic disease like SLE that is commonly associated with kidney disease, Sudden increase in albuminuria or a rapid decline in GFR, In particular a sustained increase in albuminuria of greater than 5 to 10 fold that occurs over a period of less than 1 to 2 years and GFR decline greater than 5ml/min/1.73m2/year.

The associated risk factors/predictors for development of DKD in patients with Diabetes include increasing age, female sex, Hyperglycemia with poor glycemic Control, absence of RAS inhibition, Hypertension with poor Blood Pressure Control, Dyslipidemia, Diabetic Retinopathy, Family history of DM/DN, Longer Duration of Diabetes, Low socioeconomic status, Obesity and Smoking. Recent studies also demonstrate important roles for sleep apnea, overall calorie intake, and the degree of exercise, although quantitative relations have not been established.

In a person with Type 1 Diabetes who has a first degree relative with diabetes and nephropathy, the risk for development of DKD is 83%. The frequency is only 17% if there is a first degree relative with Diabetes but without nephropathy. Environmental factors, especially diet, may be involved in the pathogenesis of Diabetes and DKD. Smoking is a strong environmental risk factor for progression of DKD and may be related to hypoxia in the kidney. Studies of smoking and diabetic kidney disease have yielded conflicting results, likely due to different study designs and specific definitions of smoking and diabetic kidney disease, although the majority report a higher risk of kidney disease among smokers.[16,17] The proportion of patients with Type 1 and Type 2 Diabetes who develop proteinuria and elevated serum creatinine concentration is related to the duration of diabetes.

Only few studies compared prevalence of DKD in Type 1 and Type 2 DM patients. In general rates of albuminuria seem to be similar but decreased GFR is more common in patients with Type 2 DM. Increasing age is directly related to the prevalence of DKD with decreased GFR rising from 8% in the 5th decade to 19% in the 6th decade and 35% in the 7th decade of life.[18] Although age related senescence of the kidney is possible explanation for this finding, the primary explanation

is the typical indolent course of diabetic kidney disease requiring decades of exposure to diabetes for progressive kidney disease to manifest.

In the US, African American, Latino, American Indians are more affected than whites.[19] Both DKD and CKD in general are more prevalent in women compared to men,[20] but men have higher risk of progression from late-stage CKD to ESRD.[19] After controlling for race, the incidence rate of ESRD in one study was 4.5-fold higher among populations in which more than 25 percent lived below the poverty level as compared with populations in which fewer than 5 percent lived below the poverty level.[21] Obesity results in activation of the renin-angiotensin-aldosterone system (RAAS), causing increased sodium retention, activation of the sympathetic nervous system, and increased intraglomerular capillary pressure, exacerbating the same processes caused by diabetes and also resulting in glomerulosclerosis.[22]

There is overwhelming evidence that glycemic control impacts the risk for incident and progressive diabetic kidney disease.[23,24] Hyperglycemia is one of the independent risk factors associated with increased prevalence of CKD as lower HgbA1C levels are associated with reversal of hyperfiltration, increased albuminuria, rapid GFR decline and the development of Stage 3 CKD. In patients with Type 1 Diabetes, strict glycemic control decreases the risk of albuminuria and impaired glomerular filtration rate (GFR). The Diabetes Control and Complications Trial (DCCT) compared the effects of intensive glucose control with conventional treatment on the long-term complications of Type 1 Diabetes. During a 9-year period, patients with mean HgbA1C of 7% who received intensive therapy had a 35% to 45% lower risk for development of moderately increased albuminuria compared with the control group (mean HgbA1C 9%).

Hypertension with poor BP control and AKI are also contributing factors for the development of CKD. Blood pressure control is important to the pathogenesis and progression of diabetic kidney disease. Similar to the effect of hyperglycemia, there is a linear relationship between blood pressure and the risk for adverse kidney outcomes.[25,26] A systolic blood pressure greater than 140 mmHg has consistently been found to increase the risk for the development of severely increased albuminuria and stage 3 CKD.[25]

According to ADA/KDIGO guidelines patient should undergo annual testing for kidney complications using serum Creatinine based estimated GFR and urine tests for abnormal levels of albumin excretion.[27,28] Abnormal results should be confirmed by repeat testing over a period of 3 to 6 months. Testing should start 5 years after diagnosis and at the time of diagnosis in patients with Type 1 and Type 2 DM respectively.

1.2 Statement of the Problem

DKD is one of the most important complications in Diabetic patients. Diabetic Kidney Disease is the 2nd most common cause of morbidity and mortality following Cardiovascular diseases. Most of the studies done on the prevalence of DKD in Patients with Type 2 Diabetes are done in the developed countries with little data available in developing countries including Ethiopia. Furthermore, the possible predictors of Diabetic Kidney Disease in patients with Diabetes are not well described in Ethiopia. This cross-sectional study will try to fill this gap by evaluating the prevalence and predictors of Diabetic Nephropathy in Diabetes patients following at Diabetic Clinic of Tikur Anbessa Hospital.

2. Literature Review

Diabetic kidney disease (DKD) is a complication that occurs in 20–40% of all diabetic patients. In the Western world, diabetic nephropathy is the primary single cause of end-stage renal disease (ESRD)[29]. Both type 1 and type 2 diabetes can lead to nephropathy, but, in type 2 diabetes, a smaller proportion of patients progress to ESRD. Because of the higher prevalence of type 2 diabetes, these patients represent more than half of diabetic patients on dialysis[30].

The prevalence of diabetes around the world has reached epidemic proportions. Although diabetes is already estimated to affect more than 8% of the global population (nearly more than 350 million people), this is predictable to grow to over 550 million people by the year 2035[31]. It has been estimated that more than 40% of people with diabetes will develop chronic kidney disease[32], including a significant number who will develop ESRD requiring renal replacement therapies (dialysis and or transplantation).

Diabetic nephropathy is uncommon if diabetes is less than one decade's duration. The highest incidence rates of 3% per year are on average seen 10–20 years after diabetes onset, after which the rate of nephropathy tapers off. It is worthy of mention that a diabetic patient for 20–25 years without clinical signs of DKD has low chances of developing such complication (only 1% per year)[33].

Diabetic nephropathy is a chronic complication of both type 1 and type 2 DM[34]. There are five stages in the development of diabetic nephropathy. In Stage I GFR is either normal or increased, and it lasts around 5 years from the onset of the diabetes. The size of the kidneys is increased by nearly 20% and renal plasma flow is increased by 10–15%, but without albuminuria or hypertension. Stage II starts more or less 2 years after the onset of the disease, with thickening of the basement membrane and mesangial proliferation with normalization of GFR but without clinical signs of the disease. Many patients continue in this stage for life. However, stage III represents the first clinically detectable sign of glomerular damage and microalbuminuria (albumin 30–300 mg/day). It usually occurs 5–10 years after the onset of the disease with or without hypertension. Approximately 40% of patients reach this stage. Stage IV is the stage of chronic kidney disease with irreversible proteinuria (>300 mg/day), decreased GFR below 60 ml/min/1.73 m^2, and sustained hypertension. Stage V is defined when ESRD with GFR less than 15 ml/min/1.73 m^2 is detected. Nearly 50% of patients will need renal replacement therapy in the form of peritoneal dialysis, hemodialysis, or kidney transplantation[35]. In the early stages of diabetic nephropathy, nephromegaly and changed Doppler indicators may be the early morphological signs of renal damage; however, proteinuria and GFR are the best indicators of the degree of the damage[36].

The predictive value of microalbuminuria for the progression of kidney damage in patients with type 1 or 2 DM was confirmed in the early 1980s[37]. Almost 20–30% of the patients progress to microalbuminuria after 15 years of disease duration and less than half develop real nephropathy[38]. The European Diabetes (EURODIAB) Prospective Complications Study Group[39] and 18-year Danish study[40] reported an overall occurrence of microalbuminuria (after 7.3 years) in patients with type 1 and 2 DM of 12.6 and 33%, respectively. Conferring to the United Kingdom Prospective Diabetes Study (UKPDS), the incidence of microalbuminuria in patients with type 2 DM in Great Britain is 2% per year and the prevalence is 25% 10 years after the diagnosis[41]. Proteinuria develops more frequently in patients with type 1 diabetes (15–40%), usually after 15–20 years of DM duration[42], but in patients with type 2 DM the prevalence varies between 5 and 20%[31].

Hyperglycemia is a well-known risk factor for DKD and it is recognized that intensive glucose control reduces the risk for DKD[31]. Specifically, during the Diabetes Control and Complications Study (DCCT), near normalization of blood sugar decreased the risks for incident microalbuminuria and macroalbuminuria by 39% and 54% respectively, compared with conventional therapy. Even with long-term follow-up in observational Epidemiology of Diabetes Interventions and Complications (EDIC) study, formerly assigned patients to DCCT intensive therapy study continued to experience lower rates of incident microalbuminuria and macroalbuminuria with risk reductions of 45% and 61% respectively[43]. Beneficial effects of intensive therapy on the worsening of GFR have become evident during long-term combined DCCT/EDIC follow-up, with a risk reduction of 50%. Other risk factors for DKD in diabetic patients include male sex, obesity, hypertension, inflammation, resistance to insulin, hypovitaminosis D, and dyslipidemia[31,41,44]. Moreover, a hereditary component to DKD has long been recognized as some genetic loci, and polymorphisms in specific genes have been associated with DKD.

The incidence of DKD and rates of DKD progression are less clear in type 2 compared with type 1 diabetes, mainly due to the highly variable age of onset, complexity of defining the exact time of diabetes onset, and the relative scarcity of long-term type 2 diabetes cohorts. Therefore, two of the best characterized type 2 diabetes cohorts are the UKPDS and the Pima Indian population. The UKPDS enrolled more than 5000 participants with new-onset type 2 diabetes, and, after a median of 15 years of follow-up, they found that microalbuminuria (defined as persistent urine albumin concentration ≥50 mg/l) occurred in 38% of participants and reduced GFR (defined as persistent estimated creatinine clearance ≤60 ml/min/1.73 m^2) occurred in 29% of participants[45]. Among Pima Indians, for whom the onset and duration of diabetes are more precisely determined due to systematic diabetes screening, the cumulative incidence of heavy proteinuria (≥1 g per gram creatinine) was 50% at 20 years' duration, before the widespread use of RAAS inhibitors. The high rate of proteinuria in the Pima population has remained stable

over time, although the incidence of ESRD has declined[46].

In most type 2 diabetic patients, the prevalence of DKD at any point in time is ~30–50%. Among US adults with diabetes (>90% type 2), the prevalence of DKD was ~35% overall, ranging from nearly 25% in patients younger than 65 years to nearly 50% in patients older than 65 years[46]. At younger ages, microalbuminuria predominates, whereas in older age reduced GFR is increasingly prevalent among cases with DKD. This finding could be attributed to the trend in using medications that reduce albuminuria, such as glucose-lowering medications and RAAS inhibitors. However, the phenotype of reduced GFR with normoalbuminuria has been increasingly recognized in type 2 diabetes. In population-based studies of diabetes in the USA and Australia, 36–55% of individuals with reduced GFR did not have concurrent microalbuminuria or macroalbuminuria. Frequently, nonalbuminuric reduced GFR was observed in the absence of diabetic retinopathy, suggesting underlying processes other than diabetic glomerulopathy. In the UKPDS, female sex, increased age, and insulin resistance were risk factors for reduced GFR but not microalbuminuria, whereas male sex, adiposity, hyperglycemia, and dyslipidemia were risk factors for microalbuminuria but not reduced GFR[47]. Higher blood pressure was a risk factor for both reduced GFR and microalbuminuria.

In the USA, 25.6 million adults (11.3%) aged 20 years and older had diabetes in 2011, with the prevalence increasing in older age groups (26.9% of people aged ≥65 years). However, nearly 3% of newly diagnosed patients with type 2 DM have overt nephropathy. Among people with diabetes, the prevalence of DKD remained stable[48]. Approximately 44% of new patients entering dialysis in the USA are diabetic. Early diagnosis of diabetes and early intervention are critical in preventing the normal progression to renal failure seen in many type 1 and a significant percentage of type 2 diabetic patients. The prevalence of diabetes is higher in certain racial and ethnic groups, affecting ~13% of African-Americans, 9.5% of Hispanics, and 15% of Native Americans, primarily with type 2 diabetes[49,50]. Nearly 20–30% of all diabetic patients will develop evidence of nephropathy, although a higher percentage of type 1 patients progress to ESKD.

Epidemiologic differences occur among European countries, mainly Germany. The proportion of patients admitted for renal replacement therapy is higher than that reported from the USA. In Heidelberg (southwest of Germany), nearly 60% of patients admitted for renal replacement therapy in 1995 had diabetes, with the majority (90%) of type 2 DM. An increase in ESRD secondary to type 2 DM has been noted even in countries known to have low incidences of type 2 DM, such as Denmark and Australia. The exact incidence and prevalence from Asia are not readily available[48].

Parving *et al.*[51] reported the prevalence of microalbuminuria/macroalbuminuria in a cross-sectional study among 32,208 type 2 diabetes patients' from 33 countries to be 38.8 and 9.8%, respectively. Asian and Hispanic patients had the highest prevalence of microalbuminuria (43.2 and 43.8%) and macroalbuminuria (12.3 and 10.3%), whereas Caucasians had the lowest microalbuminuria (33.3%) and macroalbuminuria (7.6%). Twenty-two percent of patients had compromised renal function (GFR<60 ml/min/1.73 m^2). Unnikrishnan *et al.*[52] reported that the prevalence of overt nephropathy and microalbuminuria was 2.2 and 26.9%, respectively, among urban Asian Indians with type 2 diabetes. Among 8897 Japanese type 2 diabetic patients from 29 medical clinics or general/university-affiliated hospitals from different areas, the prevalence of microalbuminuria and decreased GFR (<60 ml/min/1.73 m^2) was 31.6 and 10.5%, respectively[53].

In a cross-sectional study from Egypt, 42% of diabetic patients had nephropathy[54]; in Jordan, 33% of diabetic patients at a national diabetes center had nephropathy[55] and at a diabetic clinic in Libya 25% of patients had nephropathy[56].

In Africa there were limited studies examining the prevalence and predictors of Diabetic Nephropathy in Patients with Diabetes. Africa, like the rest of the world, is experiencing an increasing prevalence of diabetes alongside other non-communicable diseases, mainly as a result of urbanization, sedentary lifestyles, obesity and population growth and ageing[57]. Estimates for 2013 by the International Diabetes Federation (IDF) indicate that the number of adults with diabetes in the world will expand by 55%, from 381.8 million in 2013 to 591.9 million in 2035[58]. The largest increase of the population with diabetes will occur in sub-Saharan Africa, with a projected growth of 109.6%, from 19.8 million in 2013 to 41.5 million in 2035[58].

Mortality attributable to diabetes in sub-Saharan Africa was estimated to account for 8.6% of the total death in 2013[59]. Diabetic nephropathy (DN) is one of the most common complications of diabetes. The prevalence of DN is increasing steeply along with the diabetes epidemic[60]. Approximately one third to half of patients with diabetes develops renal manifestations[60,61,62,63]. DN is associated with increased premature mortality, end-stage renal disease and need to renal replacement therapy, cardiovascular diseases, and escalating health-care costs[60].

DN has been suggested to be more frequent among patients with diabetes in Africa as compared to those in the developed world due to delayed diagnosis, limited screening and diagnostic resources, poor control of blood sugar and other risk factors, and inadequate treatment at an early stage[59,64,65]. However, evidence to support the burden of kidney diseases in people with diabetes in Africa remains very patchy.

One systematic review was done on DN in Africa which included 32 studies published over the last 20 years on kidney diseases in people with Diabetes residing in Africa. The 32 studies were performed in 16 countries, with a geographical distribution covering all the African regions. However, more than half the studies, were from South Africa (five), Nigeria (four), DR Congo (three) and Ethiopia (three). The overall prevalence of CKD varied from 11% in Tunisia to 83.7% in Tanzania[66,67]. In studies where proteinuria was used to assess CKD, the prevalence varied from 5.3% in South Africa to 53.1% in Cameroon (study with a small sample size[68,69]. When considering the estimation of the GFR, the prevalence ranged from 4.6% in Tanzania to 43.1% in Nigeria (study with a small sample size)[70,71]. Twenty studies (62.5%) reported factors associated with CKD in diabetic patients. However, in most studies the method to assess this association was imprecise. In cross-sectional studies, correlates of CKD included systolic and diastolic high blood pressure, long duration of diabetes, older age, dyslipidemia and obesity[66,67,71,72,73,74,75,76,77,78,79,80,81,82,83,84,85,86,87].

In Ghana, a study that examined the prevalence and predictors of CKD among Ghanaian patients with hypertension and Type 2 DM, found that the prevalence of CKD was 16.1% among patients with DM and 28.5% among patients with both DM and Hypertension. The predictors identified were increased age, low educational status, duration of Hypertension, and use of herbal medications. Female gender was found to be protective in the study.[88]

A meta-analysis on CKD in Sub-Sharan Africa concluded that CKD is emerging as a significant public health challenge with a reported prevalence of 13.9%. Predictors were found to be Age, Sex, Educational Status, Duration of DM, duration of HTN, regular exercise, BMI, use of ACEIs/ARBs, Use of herbal preparations and HgbA1C.[89]

In Ethiopia, A study that investigated patient awareness, prevalence and risk factors of CKD among DM and Hypertension patients at Jimma Hospital Medical center, found the prevalence of CKD to be 26%. Mean age of patients were 54.81±12.45 years. Factors associated were uncontrolled BP, FBS ≥ 150mg/dl, ACEI non users, poor knowledge of CKD and long duration of Hypertension.[90] Another study which assessed CKD and associated risk factors among DM patients at a tertiary Hospital in northwest Ethiopia (Gonder) found that 3.9% had a renal impairment with GFR < 60 and 20.1% had albuminuria. Older age, systolic BP ≥ 140mmhg, Type 2 DM and longer duration of DM were independent risk factors for CKD.[91]

A systematic review and meta-analysis of 12 studies about CKD among diabetes patients in Ethiopia found an estimated prevalence of CKD of 35.52% for Stages 1 to 5 with 14.5% for Stages 3 to 5. Age > 60 years, female sex, duration of Diabetes > 10 years, BMI >30kg/m2, Type 2 DM, poor glycemic control, FBS >150, HDL >40mg/dl, Systolic BP >140mmhg and diabetic retinopathy were the associated factors.[92]

3. Significance of the Study

Despite being a significant public health problem in Ethiopia, data regarding prevalence and risk factors for Diabetic Kidney Disease are scarce. This study will try to assess the prevalence and possible associated predictors of DKD in Diabetes Patients. As a tertiary hospital, Diabetes patients having follow up at Tikur Anbessa Specialized Hospital (TASH) frequently have comorbidities including DKD and its predictors. Identifying the prevalence of DKD and its predictors in Diabetic patients with large detail will help characterize the patterns and possible associations. The results of this study can be used as an input for the policy makers to increase the awareness and practice for early identification of the development of this complication (DKD) and its associated predictors to improve the overall Diabetes and Renal care.

4. Objectives

4.1 General Objective

General objective of this study is to assess the prevalence and predictors for diabetic kidney disease in patients with Diabetes in Tikur Anbessa Specialized Hospital.

4.2 Specific Objectives

Specific objectives of this study are:

To identify baseline characteristics of Diabetic patients

To assess prevalence of DKD in Diabetes patients

To describe specific groups of DKD in Diabetes patients

To identify possible predictors of Diabetic Kidney Disease in Diabetes patients.

5. Methodology

5.1 Study Area and Study Period

This study was conducted at Diabetes Clinic of Tikur Anbessa Specialized hospital, one of the tertiary leveled referral hospitals in Addis Ababa, Ethiopia. The study area is located at the center of capital city of Ethiopia, Addis Ababa. Tikur Anbessa Specialized Hospital (TASH) is the country's largest teaching and the tertiary hospital with more than 400,000 patients seen at an outpatient follow up clinic annually. TASH is referral center for many referral hospitals as well and a hospital under which very vast clinical service is given, including some specialty services only found in TASH. It is one of the biggest and pioneer teaching centers under the administration of Addis Ababa University. The college runs multiple postgraduate and fellowship programs, not to mention it has been the earliest center for undergraduate medicine program for more than 50 years. The center has a diabetes center with approximately 4000 patients on follow-up. There are seven endocrinologists and the services provided include timely follow-ups, foot care, retinopathy screening, Diabetic counseling and medication dispensing among others.

5.2 Study Design

A retrospective cross sectional study design was used. This is a retrospective study and it was conducted on patients who are on follow-up at Diabetes Clinic of Tikur Anbessa Specialized Hospital. The study was conducted over five months period from July to November of 2021.

5.3 Population

5.3.1 Source Population

All DM patients on follow up at Diabetic Clinic at TASH.

5.3.2 Study Population

All randomly selected Diabetic patients on follow-up at Diabetes Clinic of TASH.

5.4. Eligibility Criteria

5.4.1Inclusion Criteria

All Diabetic patients on follow up at Diabetic clinic at TASH who fulfill the following eligibility criteria:

- Men or women aged between above 18 yrs of age.

- Had follow up at TASH for > 3 months.

5.4.2 Exclusion Criteria

- Individuals who are very ill and unable to consent

5.5 Sampling

5.5.1 Sample Size Determination

The sample size was calculated using the single proportion formula.

$$\frac{\boldsymbol{n = Z^2_{\alpha/2} pq}}{\boldsymbol{d^2}}$$

Z α/2 = is standard normal variant (at 5% type 1 Error (P <0.05) it is 1.96

d = margin of error was taken as 0.05.

p = expected proportion of the population with the event of outcome (prevalence) –the prevalence of Diabetic Kidney Disease in Diabetic patients in a similar set up is 30-40%. (30% used for the calculation)

q =1-p: the probability of non-occurrence of the event of interest.

The calculated sample size is 307.4666 approximated to 308.

5.5.2 Sampling Technique

Sampling was done by systematic random sampling. The total number of Diabetes patients having follow up at TASH was retrieved from HMIS data and systematic random sampling was done.

5.6 Data Collection Method

Sociodemographic data was collected by interview, chart review and electronic record review. Diabetes and DKD related facts, possible risk factors, medications and some of the associated conditions was retrieved by interview, and chart and electronic record review. Those data were collected by trained general practitioners.

5.7 Variables

5.7.1 Outcome Variables

- Prevalence of DKD in Diabetes Patients

- Predictors associated with DKD in diabetes Patients.

5.7.2 Explanatory Variables

- Specific DKD (Albuminuric VS Nonalbuminuric)

- Contribution of the predictors to the development of DKD

5.8 Operational Definitions

DM- FBS ≥ 126mg/dl or HgbA1C ≥ 6.5% or 2 hr plasma glucose level ≥ 200mg/dl during 75gm OGTT or RBS ≥ 200 with classic symptoms of hyperglycemia.

DKD- Presence of persistent albuminuria by 24-hr urine protein determination confirmed by repeat testing over a period of 3 to 6 months or persistently decreased eGFR to <60 ml/min/1.73m2 of BSA confirmed by repeat estimation over a period of 3 to 6 months or both in a patient with Diabetes plus at least 5 yrs of duration or later of Type 1 DM or at the time of dx or later of Type 2 DM in the absence of any alternative diagnosis that explains the findings better.

CKD: decreased eGFR to <60 ml/min/1.73m^2 of BSA

eGFR: calculated based on serum creatinine with CKD-EPI equation.

Albuminuria- 24-hour urine protein > 30mg/24 hrs.

Moderately increased albuminuria- 24-hour urine protein- 30-300mg/24hrs

Severely increased albuminuria- 24-hour urine protein- >300mg/24hrs

Non- Albuminuric DKD- Reduced GFR < 60ml/min/1.73m2 in the absence of albuminuria

CKD Staging: based on eGFR

5.9 Data Quality Control

Regular checkups of data collection methods and study protocol adherence was undertaken by the team. Regular checkup for completeness and consistency of the collected data was done. A

general practitioner was trained on the objectives of the study, interview technique, and data collection process.

5.10 Data Processing and Analysis

Data was checked for completeness, edited, coded and entered into Epi data version 3.1 and exported to SPSS version 25.0 statistical software for cleaning and analysis. Frequencies and proportion were used to describe study subjects and socio-demographic characteristics. Continuous variables were expressed as means ± standard deviation. Differences between group means were tested using two-tailed Student's t-test. Proportions were reported as percentages and compared between groups with Chi-square. Tables and graphs were used to present results. A p value of less 0.05 was considered statistically significant.

5.11 Ethical Approval

Data collection was carried out after approval of the research proposal by institutional review board of college of health Sciences, Addis Ababa University. Appropriate measures were taken to protect confidentiality of the collected information. All collected data did not contain patient identifications like names and residence addresses. Written informed consent was taken from eligible patients. Patients were provided with information on the objectives of the study and confidentiality issues. At the end of the session, patients were given the opportunity to enroll in the study at that time and continue the appropriate DM care per Ethiopian federal ministry of health standard of care guidelines. Those who want to discuss their participation in the study with family members were given an opportunity to do so and were enrolled at their next scheduled clinic visit.

6. Results

6.1 Sociodemographic characteristics

A total of 308 participants were included in this study with response rate of 95%. Forty-two were excluded from the study for various reasons (Figure 1). Almost two-thirds (67.3%) of the participants were ≥50 years old with a mean age of 51.6 (95% CI= 41.0-62.0) years. One hundred nighty seven (64%) of participants were female. Thirty-eight participants (12.3%) have no formal education while sixty-two (20.1%), hundred-six (34.6%), fifty (16.2%) and fifty-two (16.8%) have primary education, high school, diploma and degree respectively. Table 1 summarizes the sociodemographic characteristics of our participants.

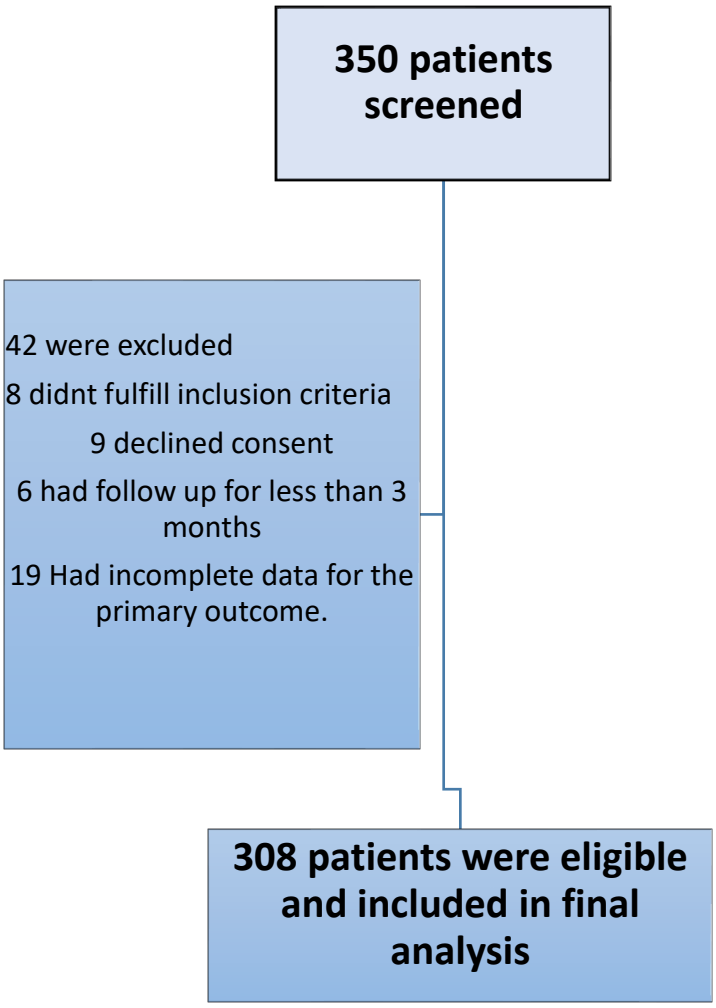

Figure 1. Participant flow chart showing number of patients screened, excluded and recruited in the study

Table 5. The sociodemographic characteristics of DM patients at TASH diabetes clinic, Addis Ababa, Ethiopia, 2021

Characteristics	Frequency (n=308)	Percentage (%)
Age(years)		
<=29	31	10.06
30-39	31	10.06
40-49	54	17.53
50-59	91	29.54
>=60	101	32.79
Gender		
Female	197	64.0
Educational status		
No formal education	38	12.3
Primary School	62	20.1
High school	106	34.6
Diploma	50	16.2
Degree and above	52	16.8
Residency area		
Urban	283	91.9
Rural	7	2.3
Semi-urban	18	5.8
Monthly Income (Ethiopian Birr)		
<1000	108	35.2
1000-2000	57	18.5
2000-3000	45	14.6
3000-4000	42	13.6
>5000	56	18.1
Occupation		
Student	15	4.9
Government employee	49	15.9
Private job	53	16.9
Housewife	76	24.7
Farmer	2	0.6
Other	26	8.4
None	87	28.2
Any First degree relative with DM		
Yes	176	57.1
Any First degree relative with DKD		
Yes	36	11.7

6.2 Clinical and Laboratory parameter characteristics.

Most (80.8%) of the patients have Type 2 DM and the remaining have Type 1 DM. Most (78.8%) of the patients have duration of Diabetes greater than 05 years and only sixteen (5.1%) patients have duration of diabetes less than 01 year. 65.3% of our study participants were on Insulin and 67.8 % were on oral hypoglycemic agents. Hundred-four (33.76%) of the patients are on both oral hypoglycemic agents and Insulin. Metformin (67.5%) is the most used agent followed by glyburide (20.8%) and 6 patients are on SGLT2 inhibitors. The mean HgbA1C in the study participants is 8.8% (95% CI, 7.2-9.9) and the mean average of the last 03 FBS determinations documented is 163mg/dl (95% CI, 132-180.5).

Hypertension is the leading comorbidity with Hundred Seventy-Seven (57.5%) of the study participants having documented hypertension. Of the participants with hypertension, 42.3% have duration of hypertension for greater than 10 years. Majority (95.4%) of the hypertensive patients are on medications plus life style modifications, with the most used class of medication being ACEIs (73.37%) followed by Ca channel blockers (55.02%), Diuretics (24.26%), B blockers (16.56%) and ARBs (1.77%). The mean SBP measurement is 129.6mmhg (95% CI, 120-140) and mean DBP measurement is 76.7mmhg (95% CI, 70-80).

Two hundred thirty-nine (77.6%) of the study participants have dyslipidemia as a documented diagnosis. Two hundred sixteen (70%) of the study participants are on statins. Mean LDL, HDL, TG and Cholesterol are 104.4mg/dl (95% CI, 75.1-127.8), 42.3mg/dl (95%CI, 35-49), 143.7mg/dl (95% CI, 129-169), 155.8mg/dl (95%CI, 123-186) respectively. Mean estimated 10-year ASCVD risk, which was calculated for only 222 of the study participants because of missing data, is 6.1% (95% CI, 1.7-7.5).

Documented microvascular complications include neuropathy in sixty-five (21.1%) and retinopathy in twenty-four (7.79%). Documented macrovascular complications include ischemic heart disease in twenty-two (7.14%), peripheral Arterial Disease in fourteen (4.54%) and cerebrovascular Disease in one (0.32%) of the study participants. 42.85% and 11.68% of the patients have 1st degree relative history of DM and 1st degree relative history of DKD respectively.

Table 6. Characteristics of DM patients at TASH diabetic clinic, Addis Ababa, Ethiopia, 2021

Characteristics	Frequency (n=308)	Percentage (%)
Type of DM		
Type 1	59	19.2
Type 2	249	80.8
Duration of DM		
<1 year	16	5.19
1-5 years	49	15.9
5-10 years	74	24.02
>10 years	169	54.87
Medications		
Insulin	201	65.3
Oral Hypoglycemic Agents	209	67.8
Either Insulin or Oral hypoglycemic agents	202	65.58
Both Insulin and Oral Hypoglycemic agents	106	34.41
HgbA1C(%)		
< 7	34	14.78
7-8	65	28.26
8-9	36	15.65
>=9	95	41.3

6.3 Physical measures and behavioral risk factors

Two Hundred Eighty-Four (91.88%) of the participants have never smoked a cigarette while twenty (6.49 %) and four (1.2%) of them were previous and current smokers respectively. Only five (1.62%) and only seven (2.27%) of the participants chew chat and drink alcohol respectively. Eighty-Nine (28.89%) of the participants claimed that they have a moderate exercise for at least 90 minutes per week. Fourteen (4.54%) of the participants were seropositive for retroviral infection and all were on ART, eighty-seven of the participants have unknown status. The mean BMI of the study participants is 25.9kg/m2 (95% CI, 22.7-28.9).

Table 7. Physical measures and behavioral risk factors of Diabetic Kidney Disease in DM patients at TASH diabetes clinic, Addis Ababa, Ethiopia, 2021

Characteristics	Frequency (n=308)	Percentage (%)
Smoking status		
Current smoker	4	1.2
Previous smoker	20	6.49
Never smoker	284	91.88
Active Chat Chewing	5	1.62
Active Alcohol drinker	7	2.27
Moderate Physical Exercise at least 30 minutes, at least 3 times/week	89	28.89
Serostatus for RVI		
Positive	14	4.54
Negative	207	67.2
Unknown	87	28.24
BMI(kg/m2)		
<18.5	9	2.92
18.5-24.9	125	40.58
25-29.9	126	40.90
>=30	48	15.58

6.4 Diabetic Kidney Disease Characteristics.

Seventy- One (23.05%) of our study participants have Diabetic Kidney Disease. Eight (11.26%) of them are with Type 1 DM and Sixty-Three (88.73%) of them are with Type 2 DM. The prevalence of DKD among Type 1 and Type 2 DM is 13.55% and 25.3% respectively. Seventy (98.59%) of them have DKD by proteinuria criteria and nineteen (26.76%) have DKD by the GFR criteria. Eighteen (25.35%) of them have DKD by both proteinuria and GFR criteria. Only one Patient has DKD exclusively by GFR criteria- Nonproteinuric DKD. Of the patients with DKD with proteinuria criteria, 33 (47.14%) patients have 24-hour urine protein of 30-300mg/24 hours and 37 (52.85%) patients have 24-hour urine protein of >300mg/24 hours. Fifteen (78.94%) patients have GFR in the 30-59ml/min/1.73m2 range and 3 (15.78%) patients have GFR in the 15-29ml/min/1.73m2 range. Only 1 patient has GFR <15ml/min/1.73m2- ESKD. All the above results are confirmed to last more than 03 months. Urinalysis from these 71 patients documented were evaluated for obvious signs that can point to other causes of the deranged RFTs and 24-hour urine protein. Twenty-eight (9.09%) of patients have proteinuria by dipstick but no documented 24-hour urine protein so were not considered as DKD.

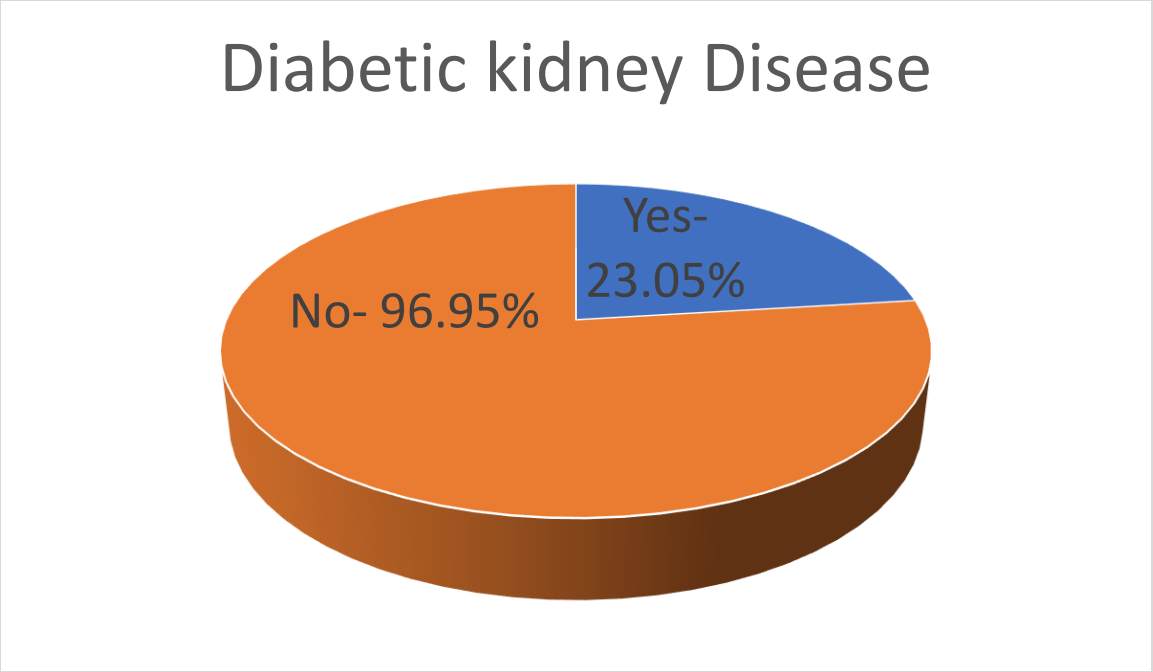

Figure 2. The prevalence of Diabetic Kidney Disease in DM patients at TASH diabetes clinic, Addis Ababa, Ethiopia, 2021

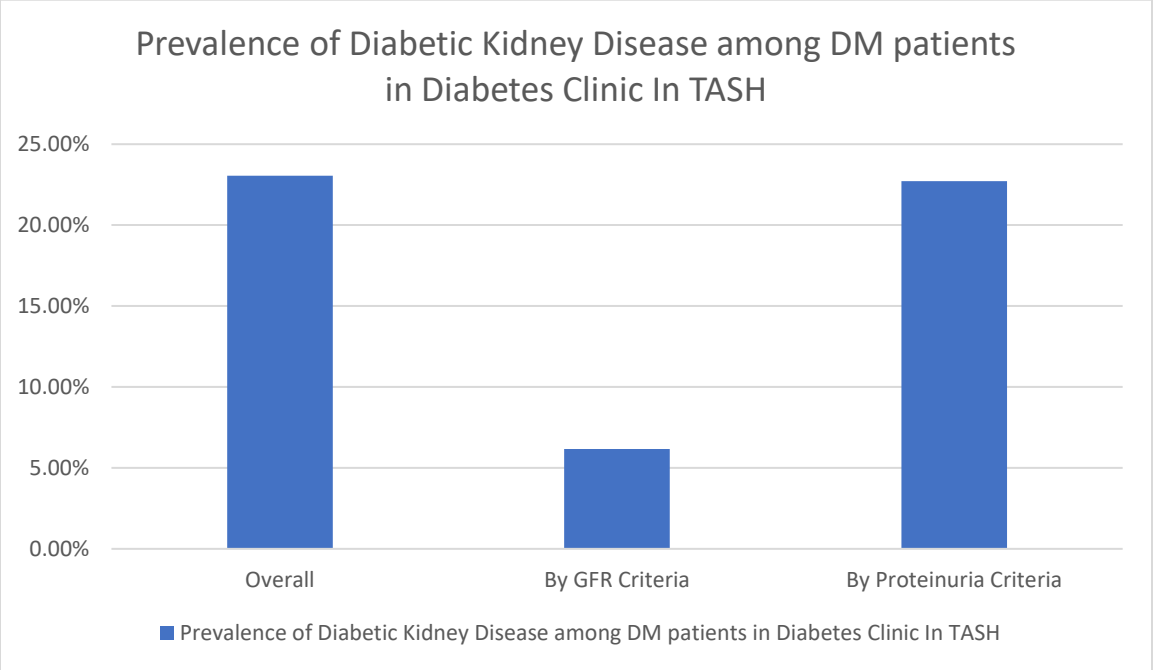

Figure 3. The prevalence of specific group of Diabetic Kidney Disease in DM patients at TASH diabetic clinic, Addis Ababa, Ethiopia, 2021.

Table 8. Diabetic Kidney Disease characteristics of DM patients at TASH Diabetes clinic, Addis Ababa, Ethiopia, 2021

Characteristics	Frequency (n=308)	Percentage (%)
Proteinuric DKD (24-hour urine protein)	70	22.72
30-300mg/24 hours	33	10.71
>300 mg/24 hours	37	12.01
Proteinuric DKD (Both GFR and 24-hour urine Protein)	18	5.84
Non-Proteinuric DKD (Only GFR Criteria)	1	0.32
GFR (ml/min/1.73m2)		
30-59	15	4.87
15-29	3	
<15	1	

6.5 Determinant of diabetic kidney disease

The strength of association between the independent variables and diabetic kidney disease was assessed using bivariate and multivariate logistic regression (Table 5). Based on the p-value of the bivariable analysis, eight variables were identified as candidate variables for the multivariable analysis. These are sex, occupation, educational status, Type of DM, neuropathy, retinopathy, hypertension, and physical exercise. The result of multivariable analysis however identified only hypertension and occupation as independent risk factors associated with DKD.

It was found that participants who had hypertension had 5.53 times higher odds for developing DKD compared to the counterparts [AOR= 5.53; 95% CI: 2.51 - 12.21]. Similarly, it was found that housewives had 65% lower odds of developing DKD compared to participants with no occupation [AOR= 0.35; 95% CI: 0.14 – 0.87]. (Table 5)

Table 5. Bivariable and multivariable binary logistic regression analyses results of factors associated with DKD among DM patients on follow-up at TASH.

Variable	DKD		COR	AOR	P-value
	Yes No. (%)	No No. (%)			
Sex					
Male	33 (29.7)	78 (70.3)	1	1	
Female	38 (19.3)	159 (80.7)	0.55 (0.32, 0.95)	0.86 (0.44, 1.68)	0.666
Occupation					
Student	2 (13.3)	13 (86.7)	0.31 (0.07, 1.46)	1.73 (0.24,12.46)	0.588
Government employee	11 (22.4)	38 (77.6)	0.58 (0.26, 1.3)	0.67 (0.26, 1.76)	0.421
Private business	10 (19.2)	43 (80.8)	0.48 (0.21, 1.08)	0.59 (0.23, 1.56)	0.29
Housewife	11 (14.5)	65 (85.5)	0.34 (0.16, 0.74)	0.35 (0.14, 0.87)	0.024*
Farmer	1 (50)	1 (50)	2 (0.12, 33.13)	3.97 (0.17,91.16)	0.389
Other	8 (30.8)	18 (69.2)	1	1	
None	28 (32.2)	59 (67.8)	0.89 (0.35, 2.29)	0.58 (0.2, 1.66)	0.309
Educational status					
No formal education	5 (13.5)	32 (86.5)	1	1	
Primary school	18 (29)	44 (71)	2.62 (0.88, 7.79)	2.91 (0.87, 9.79)	0.084
High school	22 (20.8)	84 (79.2)	1.68 (0.58, 4.8)	1.72 (0.52, 5.73)	0.377
Diploma	16 (31.3)	35 (68.7)	3.3 (1.09, 10)	2.88 (0.79, 10.51)	0.11
Degree & above	10 (19.2)	42 (80.8)	1.52 (0.47, 4.9)	2.32 (0.55, 9.67)	0.249
Type of DM					
Type1	8 (13.5)	51 (86.5)	1	1	
Type2	63 (25.3)	186 (74.7)	2.21 (0.99, 4.9)	1.12 (0.37, 3.35)	0.84
Neuropathy					
No	50 (20.5)	193 (79.5)	1	1	
Yes	21 (32.3)	44 (67.7)	1.8 (0.98, 3.29)	1.42 (0.72, 2.82)	0.311
Retinopathy					
No	61 (21.5)	223 (78.5)	1	1	
Yes	10 (41.7)	14 (58.3)	2.56 (1.08, 6.04)	2.19 (0.84, 5.68)	0.107
Hypertension					
No	11 (8.4)	120 (91.6)	1	1	
Yes	60 (33.9)	117 (66.1)	5.09 (2.6, 9.94)	5.53 (2.51, 12.21)	<0.001*
Physical exercise					
Yes	12 (13.5)	77 (86.5)	1	1	
No	59 (26.9)	160 (73.1)	2.16 (1.09, 4.27)	2.06 (0.92, 4.59)	0.079

7. Discussion

The major finding in our study is the high prevalence of Diabetic Kidney Disease in DM patients following at Diabetes Clinic at TASH.

Diabetic kidney disease (DKD) is a complication that occurs in 20–40% of all diabetic patients. In the Western world, diabetic nephropathy is the primary single cause of end-stage renal disease (ESRD)[29]. Both type 1 and type 2 diabetes can lead to nephropathy, but, in type 2 diabetes, a smaller proportion of patients progress to ESRD. Because of the higher prevalence of type 2 diabetes, these patients represent more than half of diabetic patients on dialysis[30].

Almost two-thirds of our study participants are females which is consistent with the reported proportion of female patients visiting the diabetic clinic of TASH monthly in the monthly clinical audits. There are different reports on the predictor role of gender on prevalence of diabetic kidney disease with some putting female gender as a predictor for DKD and few others putting it as protective. The well-known UKPDS puts female sex as a risk factor for a decreased GFR and male sex as a risk factor for microalbuminuria.[47] In our study there is no significant correlation between gender and DKD.

Although there is a slightly more proportion of Type 1 DM patients in our study, most (80.8%) of our study participants are Type 2, which is consistent with the predominance of Type 2 DM among patients with DM. Most of our study participants are older than 50 years of age which is consistent with the relatively old population of DM. The other striking finding in our study is that 57.02% of Type 2 DM Study participants are on Insulin which is significantly higher than the result reported by different studies. The fact that most (54.8%) of our study participants have duration of diabetes greater than 10 years may explain this finding as most patients with Type 2 DM will ultimately require Insulin.

The prevalence of hypertension among diabetic patients in our study is 57.5% which is significantly higher than the estimated prevalence (15.7%) in the general population in the most recent national survey. Compared to the US data from the Statistics from the Centers for Disease Control and Prevention (CDC) and National Health and Nutritional Examination Survey[93] (NHANES) database which reports prevalence of 73.6%, our result is significantly lower. But the result is consistent with a study which was done in 2018 in a referral hospital, in Hosanna, Ethiopia which reported a prevalence of 55%.[94] The high prevalence of Hypertension among our patients underlines the need for vigilant screening and management to prevent associated complications. The RAAS blockers are the recommended 1st line anti-hypertensive agents in patients with DM because of added benefits. With this regard, 75.14% of our study participants with HTN are on RAAS blockers which may signify a room for improvement in the management of our patients, although the mean systolic BP and mean diastolic BP in our study participants

are 129.6mmhg and 76.7mmhg respectively which may show a relatively target BP Control according to the international guidelines.

The prevalence of dyslipidemia among diabetic patients in our study is 77.6% which is comparable to a study done in 2018 in Jimma University (68.1%) in Type 2 DM patients and which has a lower mean age of 49.6 compared to our study.[95] Mean values for LDL (104.4mg/dl), HDL (42.3mg/dl), total cholesterol (155.8mg/dl) and Triglyceride (143.7mg/dl) are comparable to other studies and also to the study mentioned above.

The prevalence of HIV infection in our study, 4.5%, is much higher compared to the current national prevalence of 0.9%. The prevalence of overweight or obesity in our study participants, 56.48%, is comparable to the reported prevalence of 54.8% by CDC.[93] Only 40.58% of our study participants have a normal BMI which underscores the importance of interventions for the control of obesity which has implications in predicting complications and healthy life style in patients with DM.

The prevalence of DKD is high in our study which is 23.05% but relatively lower compared to studies by EURODIAB[39], UKPDS[47], CDC[93] which reported prevalence of 33%, 25% and 35% respectively. But the aforementioned studies have significantly higher sample size than our study. A meta-analysis of 27 studies done on prevalence of Diabetic Kidney Disease in Sub Saharan Africa found the prevalence to be 35.3% with a prevalence of 29.7% in eastern Africa.[96] A previous study done in Jimma University found the prevalence of CKD to be 26% in patients with either Type 2 DM or Hypertension.[90] A systematic review and meta-analysis of 12 studies about CKD among diabetes patients in Ethiopia found an estimated prevalence of CKD of 35.52%.[92] Both of the above studies were done in different sample populations.

One possible explanation for the relatively lower prevalence of DKD in our study is the fact that the study is done in Diabetes Clinic in which most patients are appointed every 06 months, which makes the probability of picking patients with DKD lower. Another explanation is DKD patients prefer visiting renal clinics where they are followed every 03 months to the maximum, with even a more frequent appointment, which is evidenced by a pilot observation which showed out of 67 patients with DKD attending renal clinic over two weeks, only thirty-four (50.74%) visited the Diabetes clinic in the previous 06 months.

Regarding pattern of DKD, the prevalence of DKD by GFR definition in our study is only 6.16% which is significantly lower than the UKPDS data which states a prevalence of 29%.[47] The same study reported prevalence of proteinuria of 38% compared to our study prevalence of 22.7%. But the duration of diabetes in the above study which was at least 15 years and a sample size of 5000 patients, is significantly higher than our study.

The relatively higher prevalence of Diabetic Kidney Disease in our study underscores the importance of screening and early recognition of DKD and the institution of the proven preventions/treatments including glycemic control, BP control, Initiation of ACEI/ARBS and management of dyslipidemia.

Our study showed a correlation of sex, occupation, educational status, Type of DM, Presence of Neuropathy and/or retinopathy, HTN and Physical Exercise with Diabetic Kidney disease. The finding is expected for sex, Type of DM, Presence of retinopathy, HTN and Physical exercise as demonstrated by most of the aforementioned studies. Our study failed to show any correlation of DKD with the other associated risk factors including presence of dyslipidemia, behavioral risk factors, BMI status, medication history and the pattern of glycemic control.

Only the presence of HTN is associated as an independent risk factor associated with CKD in our study which is the most mentioned risk factor in all the literatures reviewed. Therefore, adhering to guidelines on targets and managements for prevention and treatment of hypertension in Diabetic patents is of paramount importance.

8. Strength and limitations

The strength of this study includes being the first of its kind in our hospital.

The limitations of this study include the fact that most of our patients didn't have a renal biopsy for which to ascertain etiology will be difficult. Other limitations include the relatively small sample size, which makes the extrapolation of the study difficult and the retrospective nature of the study making it difficult to pick for associations.

9. Conclusion

The results of our study show a high prevalence of DKD in Diabetes patients in Diabetes clinic of TASH. Our study also confirmed the high prevalence of other CVS risk factors including Hypertension, Overweight/Obesity and Dyslipidemia. Hypertension is associated with significantly higher risk of developing DKD in patients with DM.

10. Recommendations

Based on the findings of our study, we recommend all Diabetic patients to follow healthy life style and particularly give emphasis on salt restriction and adherence to treatment of Hypertension in addition to Diabetes with an aim of preventing/controlling DKD.

We also suggest for physicians caring for Diabetes patients to screen patients according to the international guidelines and institute appropriate guideline-based prevention and treatment.

We recommend further research with a relatively larger sample size with prospective design for further understanding of prevalence and pattern of DKD and associated risk factors.

11. References

1. United States Renal Data System. USRDS 2018 Annual Data Report: Atlas of Chronic Kidn ey Disease and End-Stage Renal Disease in the United States. National Institutes of Healt h, editor, National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases, Bethesda, MD 2017.
2. International Diabetes Federation. IDF Diabetes Atlas. International Diabetes Federation , editor, Brussels, Belgium 2017.
3. Atkins RC. The epidemiology of chronic kidney disease. *Kidney Int Suppl*. 2005;94:S14-S18.
4. Guariguata L, Whiting DR, Hambleton I, et al. Global estimates of diabetes prevalence for 2013 and projections for 2035. *Diabetes Res Clin Pract*. 2014;103(2):137–149.
5. Gilbertson DT, Liu J, Xue JL, et al. Projecting the number of patients with end-stage renal disease in the United States to the year 2015. *J Am Soc Nephrol*. 2005;16:3736-3741.
6. U.S. Renal Data System. *USRDS 2006 Annual Data Report: Atlas of End-Stage Renal Disease in the United States*. Bethesda, MD: National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases; 2006.
7. Zhang L, Long J, Jiang W, et al. Trends in Chronic Kidney Disease in China. *N Engl J Med*. 2016;375(9):905–906.
8. Ismail N, Becker B, Strzelczyk P, et al. Renal disease and hypertension in non–insulin-dependent diabetes mellitus. *Kidney Int*. 1999;55: 1-28.
9. Parving HH, Hommel E, Mathiesen E, et al. Prevalence of microalbuminuria, arterial hypertension, retinopathy and neuropathy in patients with insulin dependent diabetes. *Br Med J (Clin Res Ed)*. 1988;296:156-160.
10. Standl E, Stiegler H. Microalbuminuria in a random cohort of recently diagnosed type 2 (non–insulin-dependent) diabetic patients living in the greater Munich area. *Diabetologia*. 1993;36:1017-1020.
11. Schmitz A, Vaeth M, Mogensen CE. Systolic blood pressure relates to the rate of progression of albuminuria in NIDDM. *Diabetologia*. 1994;37:1251-1258.
12. Zimmet P, Alberti KG, Shaw J. Global and societal implications of the diabetes epidemic. *Nature*. 2001;414:782-787.
13. Olivarius Nde F, Andreasen AH, Keiding N, Mogensen CE. Epidemiology of renal involvement in newly-diagnosed middle-aged and elderly diabetic patients. Cross-sectional data from the population-based study "Diabetes Care in General Practice", Denmark. Diabetologia 1993; 36:1007.
14. Denic A, Glassock RJ, Rule AD. Structural and Functional Changes With the Aging Kidney. Adv Chronic Kidney Dis 2016; 23:19.
15. Kramer HJ, Nguyen QD, Curhan G, Hsu CY. Renal insufficiency in the absence of albuminuria and retinopathy among adults with type 2 diabetes mellitus. JAMA 2003; 289:3273.

16. Liao D, Ma L, Liu J, Fu P. Cigarette smoking as a risk factor for diabetic nephropathy: A systematic review and meta-analysis of prospective cohort studies. PLoS One 2019; 14:e0210213.
17. Feodoroff M, Harjutsalo V, Forsblom C, et al. Smoking and progression of diabetic nephropathy in patients with type 1 diabetes. Acta Diabetol 2016; 53:525.
18. Centers for Disease Control and Prevention. Chronic Kidney Disease Surveillance System - United States 2018 [June 19, 2019]. Available from: http://www.cdc.gov/ckd.
19. United States Renal Data System. USRDS 2018 Annual Data Report: Atlas of Chronic Kidney Disease and End-Stage Renal Disease in the United States. National Institutes of Health, editor, National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases, Bethesda, MD 2017.
20. Tsai WC, Wu HY, Peng YS, et al. Risk Factors for Development and Progression of Chronic Kidney Disease: A Systematic Review and Exploratory Meta-Analysis. Medicine (Baltimore) 2016; 95:e3013.
21. Volkova N, McClellan W, Klein M, et al. Neighborhood poverty and racial differences in ESRD incidence. J Am Soc Nephrol 2008; 19:356.
22. Hostetter TH. Hyperfiltration and glomerulosclerosis. Semin Nephrol 2003; 23:194.
23. Diabetes Control and Complications Trial Research Group, Nathan DM, Genuth S, et al. The effect of intensive treatment of diabetes on the development and progression of long-term complications in insulin-dependent diabetes mellitus. N Engl J Med 1993; 329:977.
24. Stratton IM, Adler AI, Neil HA, et al. Association of glycaemia with macrovascular and microvascular complications of type 2 diabetes (UKPDS 35): prospective observational study. BMJ 2000; 321:405.
25. Ku E, McCulloch CE, Mauer M, et al. Association Between Blood Pressure and Adverse Renal Events in Type 1 Diabetes. Diabetes Care 2016; 39:2218.
26. Rossing K, Christensen PK, Hovind P, et al. Progression of nephropathy in type 2 diabetic patients. Kidney Int 2004; 66:1596.
27. American Diabetes Association. 11. Microvascular Complications and Foot Care: Standards of Medical Care in Diabetes-2019. Diabetes Care 2019; 42:S124.
28. Levey AS, Atkins R, Coresh J, et al. Chronic kidney disease as a global public health problem: approaches and initiatives - a position statement from Kidney Disease Improving Global Outcomes. Kidney Int 2007; 72:247.
29. Rabkin R. Diabetic nephropathy. Clin Cornerstone 2003; 5:1–11.
30. American Diabetes Association. Nephropathy in diabetes. Diabetes Care 2004; 27(Suppl 1):S79–S83.
31. Andersen AR, Christiansen JS, Andersen JK, Kreiner S, Deckert T. Diabetic nephropathy in type 1 (insulin-dependent) diabetes: an epidemiological study. Diabetologia 1983; 25:496–501.
32. American Diabetes Association. Standards of medical care in diabetes. Diabetes Care 2014; 37(Suppl 1):S14–S80.

33. Soman SS, Soman AS, Rao TKS. Diabetic nephropathy.
34. Vrhovac B, Jakšić B, Reiner Ž, Vucelić B. Internamedicina. Zagreb: NakladaLjevak; 2008. 1258–1259
35. Mogensen CE. Microalbuminuria, blood pressure and diabetic renal disease: origin and development of ideas. Diabetologia 1999; 42:263–285.
36. Buchan IE. ArcusQuickStat biomedical version. Cambridge: Addison Wesley Longman Ltd; 1997.
37. Viberti GC, Hill RD, Jarrett RJ, Argyropoulos A, Mahmud U, Keen H. Microalbuminuria as a predictor of clinical nephropathy in insulin-dependent diabetes mellitus. Lancet 1982; 1:1430–1432.
38. Mogensen CE. Microalbuminuria predicts clinical proteinuria and early mortality in maturity-onset diabetes. New Eng J Med 1984; 310:356–360.
39. Orchard TJ, Dorman JS, Maser RE, Becker DJ, Drash AL, Ellis D *et al.* Prevalence of complications in IDDM by sex and duration. Pittsburgh Epidemiology of Diabetes Complications Study II. Diabetes 1990; 39:1116–1124.
40. Chaturvedi N, Bandinelli S, Mangili R, Penno G, Rottiers RE, Fuller JH. Microalbuminuria in type 1 diabetes: rates, risk factors and glycemic threshold. Kidney Int 2001; 60:219–227.
41. de Boer IH, Afkarian M, Rue TC, Cleary PA, Lachin JM, Molitch ME *et al.* Renal outcomes in patients with type 1 diabetes and macroalbuminuria. J Am Soc Nephrol 2014; 25:2342–2350. doi: 10.1681/ASN.2013091004. Epub 2014 Jun 12.
42. Hovind P, Tarnow L, Rossing P, Jensen BR, Graae M, Torp I *et al.* Predictors of the development of microalbuminuria and macroalbuminuria in patients with type 1 diabetes: inception cohort study. Br Med J 2004; 328:1105–1108.
43. De Boer IH, Sun W, Gao X *et al.* DCCT/EDIC research group. Effect of intensive diabetes treatment on albuminuria in type 1 diabetes: long-term follow-up of the Diabetes Control and Complications Trial and Epidemiology of Diabetes Interventions and Complications study. Lancet Diabetes Endocrinol 2014; 2:793–800. doi: 10.1016/S2213-8587(14)70155-X. Epub 2014 Jul 17.
44. Hovind P, Tarnow L, Rossing P, Jensen BR, Graae M, Torp I *et al.* Predictors for the development of microalbuminuria and macroalbuminuria in patients with type 1 diabetes: inception cohort study. BMJ 2004; 328:1105. Epub 2004 Apr 19.
45. Retnakaran R, Cull CA, Thorne KI, Adler AI, Holman RR. Risk factors for renal dysfunction in type 2 diabetes: UK prospective diabetes study 74. Diabetes 2006; 55:1832–1839.
46. Pavkov ME, Knowler WC, Bennett PH, Looker HC, Krakoff J, Nelson RG. Increasing incidence of proteinuria and declining incidence of end-stage renal disease in diabetic Pima Indians.
47. Fioretto P, Steffes MW, Sutherland DE, Goetz FC, Mauer M. Reversal of lesions of diabetic nephropathy after pancreas transplantation. New Engl J Med 1998; 339:69–75.

48. De Boer IH, Rue TC, Hall YN, Heagerty PJ, Weiss NS, Himmelfarb J. Temporal trends in the prevalence of diabetic kidney disease in the United States. JAMA 2011; 305:2532–2539.
49. United States Renal Data System. Incidence of reported end-stage renal disease. Available at: United States Renal Data System Incidence of reported end-stage renal disease.
50. American Diabetes Association. Total prevalence American Diabetes Association. Total prevalence of diabetes and prediabetes.
51. Parving HH, Lewis JB, Ravid M, Remuzzi G, Hunsicker LG; DEMAND investigators. Prevalence and risk factors for microalbuminuria in a referred cohort of type II diabetic patients: a global perspective. Kidney Int 2006; 69:2057–2063.
52. Unnikrishnan R, Rema M, Pradeepa R *et al.* Prevalence and risk factors of diabetic nephropathy in an urban South Indian population: the Chennai Urban Rural Epidemiology Study (CURES 45). Diabetes Care 2007; 30:2019–2024.
53. Yokoyama H, Sone H, Oishi M, Kawai K, Fukumoto Y, Kobayashi MJapan Diabetes Clinical Data Management Study Group. Prevalence of albuminuria and renal insufficiency and associated clinical factors in type 2 diabetes: the Japan Diabetes Clinical Data Management study (JDDM15). Nephrol Dial Transplant 2009; 24:1212–1219.
54. Herman WH, Aubert RE, Engelgau MM, Thompson TJ, Ali MA, Sous ES *et al.* Diabetes mellitus in Egypt: glycaemic control and microvascular and neuropathic complications. Diab Med 1998; 15:1045–1051.
55. Jbour AS, Jarrah NS, Radaideh AM, Shegem NS, Bader IM, Batieha AM *et al.* Prevalence and predictors of diabetic foot syndrome in type 2 diabetes mellitus in Jordan. Saudi Med J 2003; 24:761–764.
56. Kadiki OA, Roaed RM. Epidemiological and clinical patterns of diabetes mellitus in Benghazi, Libyan Arab Jamahiriya. East Mediterr Health J 1999; 5:6–13.
57. Zimmet P, Alberti KG, Shaw J. Global and societal implications of the diabetes epidemic. Nature. 2001;**414**:782–787.
58. Aguiree F, Brown A, Cho NH, Dahlquist G, Dodd S, Dunning T, Hirst M, Hwang C, Magliano D, Patterson C, et al. IDF Diabetes Atlas: sixth edition. 6th ed. Basel, Switzerland: International Diabetes Federation; 2013.
59. Kengne AP, Echouffo-Tcheugui JB, Sobngwi E, Mbanya JC. New insights on diabetes mellitus and obesity in Africa-part 1: prevalence, pathogenesis and comorbidities. Heart. 2013;**99**:979–983.
60. Harjutsalo V, Groop PH. Epidemiology and risk factors for diabetic kidney disease. Adv Chronic Kidney Dis. 2014;**21**:260–266.
61. Assogba GF, Couchoud C, Roudier C, Pornet C, Fosse S, Romon I, Druet C, Stengel B, Fagot-Campagna A. Prevalence, screening and treatment of chronic kidney disease in people with type 2 diabetes in France: the ENTRED surveys (2001 and 2007) Diabetes Metab. 2012;**38**:558–566.
62. Bakris GL. Recognition, pathogenesis, and treatment of different stages of nephropathy in patients with type 2 diabetes mellitus. Mayo Clin Proc. 2011;**86**:444–456.

63. Thomas MC, Weekes AJ, Broadley OJ, Cooper ME, Mathew TH. The burden of chronic kidney disease in Australian patients with type 2 diabetes (the NEFRON study) Med J Aust. 2006;**185**:140–144.
64. Kengne AP, Sobngwi E, Echouffo-Tcheugui JB, Mbanya JC. New insights on diabetes mellitus and obesity in Africa-Part 2: prevention, screening and economic burden. Heart. 2013;**99**:1072–1077.
65. Mbanya JC, Motala AA, Sobngwi E, Assah FK, Enoru ST. Diabetes in sub-Saharan Africa. Lancet. 2010;**375**:2254–2266.
66. Bouaziz A, Zidi I, Zidi N, Mnif W, Zinelabidine HT. Nephropathy following type 2 diabetes mellitus in Tunisian population. West Indian Med J. 2012;**61**:881–889.
67. Janmohamed MN, Kalluvya SE, Mueller A, Kabangila R, Smart LR, Downs JA, Peck RN. Prevalence of chronic kidney disease in diabetic adult out-patients in Tanzania. BMC Nephrol. 2013;**14**:183.
68. Levitt NS, Bradshaw D, Zwarenstein MF, Bawa AA, Maphumolo S. Audit of public sector primary diabetes care in Cape Town, South Africa: high prevalence of complications, uncontrolled hyperglycaemia, and hypertension. Diabet Med. 1997;**14**:1073–1077.
69. Sobngwi E, Mbanya JC, Moukouri EN, Ngu KB. Microalbuminuria and retinopathy in a diabetic population of Cameroon. Diabetes Res Clin Pract. 1999;**44**:191–196.
70. Ajayi S, Mamven M, Ojji D. eGFR and chronic kidney disease stages among newly diagnosed asymptomatic hypertensives and diabetics seen in a tertiary health center in Nigeria. Ethn Dis. 2014;**24**:220–225.
71. Majaliwa ES, Munubhi E, Ramaiya K, Mpembeni R, Sanyiwa A, Mohn A, Chiarelli F. Survey on acute and chronic complications in children and adolescents with type 1 diabetes at Muhimbili National Hospital in Dar es Salaam, Tanzania. Diabetes Care. 2007;**30**:2187–2192.
72. Alebiosu CO. Clinical diabetic nephropathy in a tropical African population. West Afr J Med. 2003;**22**:152–155.
73. Alebiosu CO, Odusan O, Familoni OB, Jaiyesimi AE. Cardiovascular risk factors in type 2 diabetic Nigerians with clinical diabetic nephropathy. Cardiovasc J S Afr. 2004;**15**:124–128.
74. Alebiosu CO, Odusan O, Jaiyesimi A. Morbidity in relation to stage of diabetic nephropathy in type-2 diabetic patients. J Natl Med Assoc. 2003;**95**:1042–1047.
75. Bentata Y, Haddiya I, Latrech H, Serraj K, Abouqal R. Progression of diabetic nephropathy, risk of end-stage renal disease and mortality in patients with type-1 diabetes. Saudi J Kidney Dis Transpl. 2013;**24**:392–402.
76. Bouzid C, Smida H, Kacem A, Turki Z, Ben Salem L, Ben Rayana C, Slama BC. [Renal failure in Tunisian patients with type 2 diabetes: frequency and related factors] Tunis Med. 2011;**89**:10–15.
77. Choukem SP, Dzudie A, Dehayem M, Halle MP, Doualla MS, Luma H, Kengne AP. Comparison of different blood pressure indices for the prediction of prevalent diabetic

nephropathy in a sub-Saharan African population with type 2 diabetes. Pan Afr Med J. 2012;**11**:67.
78. Eghan BA, Frempong MT, Adjei-Poku M. Prevalence and predictors of microalbuminuria in patients with diabetes mellitus: a cross-sectional observational study in Kumasi, Ghana. Ethn Dis. 2007;**17**:726–730.
79. Elbagir MN, Eltom MA, Mahadi EO, Berne C. Pattern of long-term complications in Sudanese insulin-treated diabetic patients. Diabetes Res Clin Pract. 1995;**30**:59–67.
80. Katchunga P, Hermans MP, Manwa B, Lepira F, Kashongwe Z, M'Buyamba-Kabangu JR. [Hypertension, insulin resistance and chronic kidney disease in type 2 diabetes patients from South Kivu, DR Congo] Nephrol Ther. 2010;**6**:520–525.
81. Keeton GR, Smit Rv, Bryer A. Renal outcome of type 2 diabetes in South Africa--a 12-year follow-up study. S Afr Med J. 2004;**94**:771–775.
82. Marshall SL, Edidin D, Sharma V, Ogle G, Arena VC, Orchard T. Current clinical status, glucose control, and complication rates of children and youth with type 1 diabetes in Rwanda. Pediatr Diabetes. 2013;**14**:217–226.
83. Rahlenbeck SI, Gebre-Yohannes A. Prevalence and epidemiology of micro- and macroalbuminuria in Ethiopian diabetic patients. J Diabetes Complications. 1997;**11**:343–349.
84. Rissassi JR, Nseka M, Jadoul M, Lepira FB, Mvitu M, Mbenza G, Yekoladio D, Aloni M, Nge OO. [Prevalence and determinants of microalbuminuria and macroalbuminuria in children and young adults with type 1 diabetes in Kinshasa] Nephrol Ther. 2010;**6**:40–46.
85. Rotchford AP, Rotchford KM. Diabetes in rural South Africa--an assessment of care and complications. S Afr Med J. 2002;**92**:536–541.
86. Sobngwi E, Mbanya JC, Moukouri EN, Ngu KB. Microalbuminuria and retinopathy in a diabetic population of Cameroon. Diabetes Res Clin Pract. 1999;**44**:191–196.
87. Worku D, Hamza L, Woldemichael K. Patterns of diabetic complications at jimma university specialized hospital, southwest ethiopia. Ethiop J Health Sci. 2010;**20**:33–39.
88. Elliot K Tannor, Fred Stephen Sarfo, Linda M Mobula, Osei Sarfo-Kantanka, Rexford Adu-Gyamfi, Jacob Plange-Rhule, Prevalence and predictors of chronic kidney disease among Ghanaian patients with hypertension and diabetes mellitus: A multicenter cross-sectional study.
89. John W Stanifer, Bocheng Jing, Scott Tolan, Nicole Helmke, Romita Mukerjee, Saraladevi Naicker, Uptal Patel, The epidemiology of chronic kidney disease in sub-Saharan Africa: a systematic review and meta-analysis.
90. Kabaye Kumela Goro, Amare Desalegn Wolide, Fantu Kerga Dibaba, Fanta Gashe Fufa, Aster Wakjira Garedow, Birtukan Edilu Tufa, and Eshetu Mulisa Bobasa, Patient Awareness, Prevalence and Risk factors of CKD among DM and Hypertensive Patients at Jimma University Medical Center, Ethiopia.
91. Shewaneh Damtie , Belete Biadgo , Habtamu Wondifraw Baynes , Sintayehu Ambachew , Tadele Melak , Daniel Asmelash , Molla Abebe, Chronic Kidney Disease and

Associated Risk Factors Assessment among Diabetes Mellitus Patients at A Tertiary Hospital, Northwest Ethiopia.
92. Wondimeneh Shibabaw Shiferaw, Tadesse Yirga Akalu, Yared Asmare Aynalem, Chronic Kidney Disease among Diabetes Patients in Ethiopia: A Systematic Review and Meta-Analysis
93. Centers for Disease Control and Prevention. National Diabetes Statistics Report, 2020. Atlanta, GA: Centers for Disease Control and Prevention, U.S. Dept of Health and Human Services; 2020.
94. Prevalence of Hypertension among Patients with Type 2 Diabetes Mellitus and Its Socio Demographic Factors in Nigist Ellen Mohamed Memorial Hospital Hosanna, Southern Ethiopia
95. Dyslipidemia and its associated risk factors among adult type 2 Diabetic patients at Jimma University Medical center, Jimma, southwest Ethiopia.
96. Wagnew, F., Eshetie, S., Kibret, G.D. *et al.* Diabetic nephropathy and hypertension in diabetes patients of sub-Saharan countries: a systematic review and meta-analysis. *BMC Res Notes* **11,** 565 (2018). https://doi.org/10.1186/s13104-018-3670-5

12. Annex

1. English Version Questionnaire

Prevalence and risk factors of Diabetic Kidney Disease among Diabetes patients in Tikur Anbessa specialized hospital, Addis Ababa, Ethiopia

After taking written informed consent and ethical approval, the following data will be retrieved by reviewing patient's charts and interviewing patients.

A. Sociodemographic factors

1. Card number (I care)
2. Age:
3. Sex:
    a. Male
    b. Female
4. Occupation:
    a. Student
    b. Government employee
    c. Private business
    d. House wife
    e. Farmer
    f. Other …….
5. Marital status
    a. Married
    b. Single
    c. Divorced
    d. Widowed
6. Monthly income
    a. <1000 Birr
    b. 1000-2000 Birr
    c. 2000-3000 Birr
    d. 3000-4000 Birr
    e. >5000 Birr
7. Educational status
    a. No formal education
    b. Primary school
    c. High school
    d. Diploma
    e. Degree and above

8. Living area
    a. Urban
    b. Rural
    c. Semi urban
9. Region
    a. AA
    b. Oromiya
    c. Amhara
    d. SNNRP
    e. Tigray
    f. Others……..
10. Any 1st degree relative with DM ?
    a. Yes
    b. No
11. Any 1st degree relative with DKD?
    a. Yes
    b. No

B. About DM Dx and management
1. DM
    a. Type 1
    b. Type 2
2. Duration of DM
    a. Less than a year
    b. 1year – 5years
    c. 5year- 10years
    d. >10 years
3. Current medications- multiple options can be circled if patient is both on Insulin and oral hypoglycemic agents.
    a. Oral Hypoglycemic agents
    b. Insulin
4. If on oral hypoglycemic agents, types- Multiple options can be circled.
    a. Biguanides
    b. Sulfonylureas
    c. SGLT2 Inhibitors
    d. GLP-2 Antagonists
5. Any microvascular complications other than Diabetic Nephropathy- Multiple options can be circled
    a. Neuropathy
    b. Retinopathy
6. Any macrovascular complications- Multiple options can be circled

a. CAD
b. PAD
c. Cerebrovascular Disease

7. Recent HgbA1C
8. Average of the last 3 FBS determinations

C. Comorbidities

1. Hypertension
   a. Yes
   b. No
2. If yes to question 1, Duration of hypertension.
   a. < 5 years
   b. 5-10 yrs
   c. > 10 yrs
3. If yes to question 1-
   a. On Lifestyle modification
   b. On medications plus lifestyle modifications.
4. If b to question 2, what type of medications. If combination of medications circle multiple options.
   a. ACEIs
   b. ARBs
   c. B Blockers
   d. Diuretics
   e. Ca Channel Blockers
   f. Alpha blockers
5. Recent BP measures on 3 visits.
6. Dyslipidemia
   a. Yes
   b. No
7. Recent Lipid Profile
   a. LDL
   b. HDL
   c. TG
   d. Cholesterol
8. If yes to question 6, management
   a. Life style modifications
   b. Statins plus lifestyle modifications
9. Calculated estimated ASCVD risk- Life time and 10 years.
10. BMI… Put the number and tick the interpretation
    a. Underweight
    b. Normal

c. Overweight
d. Obesity
e. Morbid Obesity

11. Any other comorbidity.

D. Diabetic Kidney Disease
1. Albuminuria
   a. Yes
   b. No
2. If yes to question 1
   a. 24-hour urine protein
   b. Dipstick
3. If a to question 2
   a. 30-300mg/24 hrs
   b. >300mg/24 hrs
4. Recent Creatinine
5. GFR calculated based on CKD- EPI equation
   a. >60 ml/min/1.73m2
   b. 30-59 ml/min/1.73m2
   c. 15-29 ml/min/1.73m2
   d. <15ml/min/1.73m2

E. Behavioral Risk Factors
1. Smoking history
   a. Current
   b. Previous
   c. Never
2. If a or b to question 1, How many pack years?
3. Physical exercise at least 30 minutes 3*/week
   a. Yes
   b. No
4. Chewing chat
   a. Yes
   b. No
5. Alcohol intake
   a. Yes
   b. No
6. If yes to question 5 how much bottles of beer (equivalent) per week:
7. Serostatus for HIV
   a. Positive
   b. Negative
   c. Unknown

2. Information Sheet

Title of Project: Prevalence and Predictors of Diabetic Kidney Disease among Diabetes Patients in Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia: A Cross Sectional Study

Name of the Investigator: Amanuel Berhanu (MD)

My name is Dr._____, and I am working with the Diabetic and Renal team. You are invited to participate in this study. Before you decide to take part, it is important for you to understand why this research is being done and what it involves. Please take time to read/listen to the following information carefully. Raise question if there is anything that is not clear. Thank you for the time you have spent already.

Background to the study.

We would like to see the prevalence of Diabetic Kidney Disease and its predictors in Diabetic Patients in our hospital. DKD is an important complication of Diabetes which significantly contributes to morbidity and mortality. Data is scarce in these regards. You will be interviewed with a prepared questionnaire; your chart will be revised for clinical and laboratory findings.

Possible harms. There is no harm in participating in this study.

Benefits. You will not directly benefit from this study. However, the findings of the study may help plan for care of patients with DM and for strategic prevention of DKD in such patients.

Confidentiality. All information which is collected about you during the course of the research will be strictly confidential.

Autonomy. All the information you give us is highly valuable to the study. It is up to you to decide whether to take part or not. If you decide to participate, you will be given this information sheet to keep and be asked to sign a consent form. Whether you consent or do not consent to be part of the study, your rights for care in the health care facility will not be compromised and you can withdraw from the study any time.

What will happen to the research? The data will be collected over five months period and the result will be available in 8 months time, and we hope to disseminate the result publishing it on national and/or international journals.

Who is organizing and funding the research? Research is funded by Addis Ababa University. The research will be reviewed by the Institutional Review Board of College of health Sciences, Addis Ababa University.

Thank you in advance!

PI address: Amanuel Berhanu, MD

Internal Medicine Resident at Addis Ababa University

Phone number- 0913593156

e-mail: bireamank@gmail.com

3. Informed Consent Form

Diabetic Kidney Disease is a common cause of morbidity and mortality in diabetic patients. Diabetic patients have risk of developing DKD and timely identification and intervention of the possible risk factors improves clinical outcomes. This study tries to assess the prevalence and possible predictors of DKD in diabetes patients. The information obtained will be used by policy makers and managing physicians for better care of individual patient and the strategic control of risk factors.

For this reason, we kindly request you to participate in the study by responding to the interview, and allowing us to review your medical record. We assure you that confidentiality of the information obtained is kept. If you have any questions, we will be so happy to entertain them.

I confirm that I have understood what has been read/what I have read has been clear to me, and I have agreed to participate in the study.

Name_____

Signature_____

4. Investigators Signature Form

I agree to conduct the study in accordance with the relevant, current protocol and will not make changes to the protocol without permission of Department of Internal Medicine, except when necessary to protect the safety, rights, or welfare of study participants. I agree to personally conduct or supervise this study. I will ensure that the requirements relating to obtaining informed consent and Ethics Committee (EC) or Institutional Review Board (IRB) review and are met. I agree to maintain adequate and accurate study records and to make those records available for inspection by the department or unit heads, hospital administrators, and/or other applicable regulatory entities. I also agree to promptly report to the EC/IRB all changes to the study and all unanticipated problems involving risks to human subjects or others. I agree to ensure that all staff members involved in the conduct of this study are informed about their obligations in meeting the above commitments.

Principal Investigator: _____

Signature: _____ Date: _____