Science Development
2025, Vol. 6, No. 4, pp. 240-253
https://doi.org/10.11648/j.scidev.20250604.11

Research Article

Chronic Kidney Disease Among Diabetes Mellitus Patients in Southern Ethiopia: Burden, Awareness and Associated Factors - A Mixed Method Study

Amanuel Arota[1, *], Yimer Seid[2], Wakgari Deressa[2], Feyisa Shasho Bayisa[3]

[1]Department of Epidemiology and Biostatistics, Wolaita Sodo University, Wolaita Sodo, Ethiopia
[2]Department of Preventive Medicine, Addis Ababa University, Addis Ababa, Ethiopia
[3]Department of Epidemiology and Biostatistics, Haramaya University, Harar, Ethiopia

Abstract

Background: Ethiopia is one of the developing countries with a high burden of chronic kidney disease (CKD) among diabetes mellitus (DM) patients. However, little is known about its extent, patient awareness level and contributing factors among patients with diabetes. Therefore, this study was aimed to determine the magnitude, awareness and factors associated with CKD among DM patients in Wolaita Sodo, Southern Ethiopia. *Methods:* An institutional-based cross-sectional study with concurrent qualitative study design was conducted between March 2023 and May 2023 in Wolaita Sodo University Comprehensive Specialized Hospital. A total of 312 patients were selected randomly for quantitative part, and fourteen patients were selected for qualitative study. Data was collected using both medical charts and in-depth interview of patients. Binary logistic regression with odds ratio was used to analyse the association of outcome with predictor variables. P value <0.05 was used to declare statistical significance. Qualitative interview was analysed thematically. *Result:* The majority 206 (66.03%) of participants were male. The mean age (±SD=standard deviation) of participants was 43 (±13.95) years. The proportion of chronic kidney disease among diabetes patients was 20.05% (95% confidence interval [CI]: 18-29). The duration of diabetes greater than ten years (adjusted odds ration [AOR]= 3.42: 95% CI: 1.58-7.38, p = 0.002), Proteinuria (AOR = 5.13: 95% CI: 2.40-10.96, p < 0.001), diabetic retinopathy (AOR = 2.36: 95% CI: 1.07-5.18, p = 0.032), and fasting blood sugar (FBS) levels of 150 mg/dL or higher (AOR = 2.40: 95% CI: 1.10-5.23, p = 0.026) were independently associated with CKD. Low patient awareness of CKD, poor perception of susceptibility and lack of initiative to know their kidney heath status was the main identified themes qualitatively. *Conclusion:* High burden with unacceptably low awareness of chronic kidney disease was found in this study. Prolonged duration of diabetes, proteinuria, diabetic retinopathy, and elevated fasting blood sugar levels were significantly associated with chronic kidney disease. Comprehensive patient education, routine screening, and integrated care strategies that not only promote awareness but also address the significant predictors to enhance early detection and prevention of CKD in diabetes patients should be implemented.

Keywords

Chronic Kidney Disease, Magnitude, Awareness, Diabetes Mellitus, Ethiopia

[*]Corresponding author: arotaamanuel@gmail.com (Amanuel Arota)

Received: 17 June 2025; **Accepted:** 2 July 2025; **Published:** 26 September 2025

1. Introduction

Diabetes presently affects more than one out of every ten persons worldwide, with an estimated current prevalence of 537 million adults aged 20 to 79 years in 2021 [1]. If sufficient action is not taken and the trend continues, this amount is anticipated to be 643 million and, 783 million adults for the same age group in 2030 and 2045, respectively [2, 3]. Moreover, if not managed appropriately it affects major organs like kidney and results in the most dangerous and frequent chronic complication called diabetic kidney disease (DKD) [1]. DKD is manifested by albuminuria and glomerular filtration rate (GFR) <60 Ml/min/1.73 m^2 for at least 3 months regardless of clinical manifestation and associated with high morbidity and mortality among diabetes mellitus (DM) patients [4-6]. Globally an estimated 20-50% of patients with DM will ultimately develop chronic kidney disease (CKD) and it has become the leading cause for end-stage renal disease (ESRD) [7].

The prevalence of CKD among DM patients in Africa varied from 11% to 83.7% [8]. In Ethiopia the pooled prevalence of CKD among DM patients was found to be 35.2% [9] with the incidence ranges from 10.8% to 15.6% [10-13]. Few studies done in Ethiopia found the factors associated with development of CKD among DM were age, sex, hypertension, body mass index, duration of diabetes, haemoglobin A1c, diabetic retinopathy, type of diabetes regimen, poor glycaemic control, level of fasting blood glucose, and type of diabetes [9, 10, 12].

Chronic kidney disease (CKD) is increasingly associated with a range of clinical and public health challenges, including congestive heart failure, end-stage renal disease (ESRD), cardiovascular complications, and elevated healthcare costs [14-16]. Worldwide all-age mortality rate due to CKD increased by 41.5% in the last three decades [16]. As diabetes mellitus (DM) continues to rise globally, its mounting toll is not only making chronic kidney disease (CKD) up to ten times more prevalent among those with diabetes compared to the general population but also driving premature death and disability [1]. In low-income countries, almost 50% of DM attributed deaths are premature - before the age of 70 years. Additionally, people with DM and CKD loses 50% higher health care costs compared to those with DM alone [3]. Moreover, worldwide there are at least 2.284 million people might have died prematurely because of lack of access to renal replacement therapy (RRT) [1, 14]. Between 2010 and 2030, the number of persons undergoing RRT is expected to be greater than double globally [3, 7, 17]. These will place an economic crisis on the both health organization and state economy [1, 2, 14, 15, 18].

In addition, awareness plays a critical role in the management and prevention of chronic kidney disease (CKD) [19]. Studies have demonstrated early recognition of CKD through heightened awareness can slow disease progression, prevent complications, and reduce adverse cardiovascular outcomes [19, 20]. However, it was reported that CKD awareness among both patients and healthcare providers remains unacceptably low, even in high-risk populations such as diabetes [21, 22]. It has been reported that fewer than 10% of individuals with CKD stages 1-4 is aware of their condition, despite its significant health implications [20]. Increased awareness not only facilitates early diagnosis and intervention but also empowers patients to adopt preventive measures, such as managing diabetes, controlling blood pressure, and avoiding nephrotoxic medications [22].

In Ethiopia, the burden of chronic kidney disease (CKD) among patients with diabetes mellitus (DM) is notably high [9, 23] with the median estimated time to detect ranging from 5 to 8.3 years [10-13]. Furthermore, 40% of annual deaths are owing to non-communicable disease (NCD), of which diabetes-associated kidney failure makes up 10 to 40 percent of all deaths in the Ethiopia [24]. Again, the recent estimates in the country suggest that awareness of CKD remains low among DM patients [25, 26]. While some studies in Ethiopia have tried to investigate the prevalence and associated factors of chronic kidney disease among diabetes patients using quantitative methods, there appears to be a scarcity of mixed-methods approach that integrates both approaches in this context. To our knowledge there is no study done in our country assessing awareness of CKD among diabetes patients qualitatively. Therefore, this study was aimed to assess the burden, awareness and associated factors of CKD among diabetes patient in Wolaita Sodo University Comprehensive Specialized Hospital, Southern Ethiopia using mixed method study.

2. Method and Materials

2.1. Study Design, Period and Setting

An institution-based cross sectional with concurrent qualitative design was conducted between March, 2023 and May, 2023 in Wolaita Sodo University Comprehensive Specialized Hospital (WSUCSH). The hospital found in Wolaita Sodo town 330 km away from Addis Ababa, the capital city of Ethiopia. It gives services to inpatient, outpatient, diagnostic and therapeutic services. Diabetes patients follow from Monday to Friday.

2.2. Sample Size Determination and Sampling Technique

Sample size for quantitative study was calculated using single population proportion formula using 82% of complication among diabetes patients done in other parts of country, with confidence level of 95%, and precision of 0.05 [27]. Adding 5% of inadequacy of medical chart, the final sample became 312. The study population included patients diag-

nosed with DM and age of 15 years and above. Those patients' carts without diagnosis time of diabetes mellitus were excluded from study. Simple random sampling technique was used to select medical charts.

For qualitative study convenience sampling technique was used to select adult diabetes patients to interview them. Fourteen (14) patients were interviewed until saturation of ideas.

2.3. Data Collection Tool and Procedures

Quantitative data was collected from medical charts of patients using the open data kit (ODK). Data abstraction tool was prepared from reviewing different relevant literatures [9, 10, 13] and used for extraction of study variables from the medical records of patients. The tool includes socio-demographic characteristics, clinical variables, duration of diabetes and patient's outcome. Medical registration number were used to access the medical charts of patients, then intake form, and follow-up sheet were reviewed and used as data source. Three BSc nurses were assigned to collect data. Principal investigator was supervising the data collection process.

The qualitative study questionnaire was developed from reviewing different literatures [25, 26, 28]. The data was collected among diabetes patients using a semi-structured open ended interview questions with consecutively probing patients' awareness level, perceptions about symptoms and risk factors of CKD. Trained and experienced professionals were assigned to collect using audio recording and note taking.

2.4. Operational Definitions and Measurements

Chronic kidney disease: abnormalities of the kidney structure or function that is marked by a glomerular filtration rate (GFR) <60 mL/min/1.73 m^2) present for >3 months and albuminuria >30 mg/24 hours and history of kidney transplantation [4]. The case was identified based on the physician's clinical judgment as documented in the patient's medical records. Glycemic control: The average of fasting blood sugar from their last three consecutive visits ≥ 130, and < 130 mg/dl or >70 mg/dl were categorized as poor and good glycemic control respectively [29].

2.5. Variables of Study

Sex, age, residence, family history of diabetes, systolic blood pressure (SBP), diastolic blood pressure (DBP), fasting blood sugar (FBS), proteinuria, type of diabetes, glycemic control, hypertension, diabetic retinopathy, acute complications of diabetes, diabetes regimen, lipid lowering agents.

2.6. Data Management and Analysis

The quantitative data were exported to STATA statistical software version 17 and cleaned up for analysis. Categorical and continuous variables were organized using frequency with corresponding percentage, and mean with corresponding standard deviation respectively. The binary logistic regression analysis model was used to determine the relationship between independent and dependent variables. Bivariate analysis was done and, variables with a p-value ≤ 0.25, were sent to multivariable analysis. Odds ratios (OR) with its corresponding p value were computed to determine statistical significance and strength of association. In multivariable analysis $P<0.05$ was considered as statistically significant. The overall model fitness was checked by Hosmer Leme how test and found satisfied.

The audio record of in-depth interview of qualitative study was transcribed and translated to English in verbatim manner. The codebook was developed by coders and themes were produced. Subthemes for each theme were produced with supporting quotes.

2.7. Data Quality Control

The data collection tool for quantitative part was pre-tested among 5% of the sample size, and necessary modifications and corrections were done accordingly. Variables like socio-demographic factors (education status, marital status), behavioral factors (history of smoking, history of drinking alcohol), and important blood tests were not recorded in complete form in the medical charts and removed from extraction checklist. Training was given for data collectors two days before actual data collection.

The qualitative interview questionnaire was prepared in English and translated to both Amharic and woliatigna (local language of study setting). Before the actual data collection began, the tool was assessed for its applicability, comprehensiveness, and clarity by asking diabetes patients and consulting physicians. Ambiguities raised by patients and feedback from experts were addressed, leading to necessary modifications. The questionnaire was continuously refined throughout the study period.

2.8. Patient and Public Involvement

Patients were not directly involved in formulating the research questions or choosing the study design. However, selected diabetes patients and representatives of the WSUCSH involved in the design of the questionnaire, the development of outcome measures, and selecting study participants. The final survey and qualitative interview tool were developed after incorporating their feedback. Representatives of all stakeholders, including patients, and hospitals, participated in the study disseminations workshops and provided feedback on further dissemination strategies. Moreover, key findings were presented to all stakeholders in briefs and in Power Point presentations.

3. Results

3.1. Socio-demographic Characteristics of the DM Patients

The majority 206 (66.03%) of study patients were male and the rest 106 (33.97%) were female. Accordingly, males had a higher prevalence of CKD (75%) compared to females (25%). The mean age of those with CKD was 44.48±12.79 years, slightly higher than those without CKD (42.91±14.24 years), with an overall mean age of 43.23±13.95 years. Majority 219 (70.19%) of the patients were residing in urban area. Additionally, significant portion of participants had a family history of diabetes 108 (37.11%) with about one third of CKD 23 (37.70%) had occurred in this group of patients. Lastly from 312 participants, 64 (20.5%) were diagnosed with CKD (Table 1).

Table 1. *Sociodemographic characteristics of DM patients at Wolaita Sodo University Comprehensive Specialized Hospital, Southern Ethiopia, 2023.*

Variables	Category	CKD		Total, n- (%)
		Yes, n (%)	No, n (%)	
Sex	Male	48 (75%)	158 (63.71%)	206 (66.03%)
	Female	16 (25%)	90 (36.29%)	106 (33.97%)
Age (years)	Mean ±SD	44.48±12.79	42.91±14.24	43.23±13.95
Residence	Rural	44 (68.75%)	175 (70.56%)	93 (29.81%)
	Urban	20 (31.25%)	73 (29.44%)	219 (70.19%)
Family history of diabetes	Yes	23 (37.70%)	85 (36.96%)	108 (37.11%)
	No	38 (62.30%)	145 (63.04%)	183 (62.89%)

3.2. Clinical, Treatment and Laboratory Related Characteristics of DM Patients

Majority of the participants, 227 (72.76%) were diagnosed with Type 2 diabetes mellitus. Regarding usage of diabetes regimen during on their last visit, 100 (32.05%) patients were on oral therapy, 114 (36.54%) on insulin and 98 (31.41%) were on combined therapy with relatively even distribution among CKD and non-CKD groups. The presence of proteinuria was notable, affecting 75 (24.04%) of the total population, with a higher prevalence 40 (62.50%) among CKD patients compared to those without CKD 24 (37.50%). Blood pressure levels were also higher in CKD patients, with an average systolic blood pressure (SBP) of 150.73±27.15 mmHg compared to 137.62±21.62 mmHg in non-CKD patients. Similarly, diastolic blood pressure (DBP) was 92.60±13.51 mmHg among CKD patients, which was higher than that of non-CKD patients (83.30±14.06 mmHg).

CKD patients had higher fasting blood sugar (FBS) levels (215.84±61.27 mg/dL) compared to non-CKD patients (190.67±66.66 mg/dL) with overall average of 184.18mg/dl. The use of lipid-lowering agents was reported in 104 (33.33%) diabetes patients. Glycemic control was poor among majority 165 (52.88%) participants. Among complications, retinopathy 77 (24.68%), neuropathy 69 (22.12%), and diabetic ulcer 25 (8.01%) were observed, with higher proportions among CKD patients. Additionally, 90 (28.85%) of patients had history of acute complications of diabetes, and 189 (60.58%) had hypertension. Cardiovascular disease (CVD) other than hypertension was present in 68 (21.79%) of the total participants, with 43 (67.19%) cases happened in CKD patients, while acute kidney injury (AKI) was reported in 48 (15.38%), affecting 35 (54.69%) CKD patients (Table 2).

Table 2. *Clinical, treatment and laboratory related characteristics of DM patients at Wolaita Sodo University Comprehensive Specialized Hospital, Southern Ethiopia, 2023.*

Variables	Category	CKD		Total, n- (%)
		Yes, n (%)	No, n (%)	
Type of DM	Type 2	55 (85.94%)	172 (69.35%)	227 (72.76%)
	Type 1	9 (14.6%)	76 (30.65%)	85 (27.24%)
Duration of diabetes	≥10 years	30 (46.88%)	47 (18.95%)	77 (24.68%)
	<10 years	34 (53.12%)	201 (81.05%)	235 (75.32%)
Therapy of DM	One oral therapy	3 (4.69%)	14 (5.65%)	17 (5.45%)
	>1 oral therapy	18 (28.2%)	65 (26.21%)	83 (26.60%)
	Insulin	19 (29.69%)	95 (38.85%)	114 (36.54%)
	Both	24 (37.50%)	74 (29.84%)	98 (31.41%)
Proteinuria	Yes	40 (62.50%)	35 (14.11%)	75 (24.04%)
	No	24 (37.50%)	213 (85.89%)	237 (75.96%)
SBP	Mean ± SD	150.73±27.15	137.62±21.62	139.93±23.46
DBP	Mean ± SD	83.30±14.06	92.60±13.51	85.20±14.43
FBS	Mean ± SD	190.67±66.66	215.84±61.27	184.18±66.57
Lipid lowering agents	Yes	29 (45.31%)	75 (30.24%)	104 (33.33%)
	No	35 (54.69%)	173 (69.76%)	208 (66.67%)
Glycemic control	Good	25 (39.06%)	122 (49.19%)	147 (47.12%)
	Poor	39 (60.94%)	126 (50.81%)	165 (52.88%)
Diabetic retinopathy	Yes	33 (51.56%)	44 (17.74%)	77 (24.68%)
	No	31 (48.44%)	204 (82.26%)	235 (75.32%)
Neuropathy	Yes	19 (29.69%)	50 (20.16%)	69 (22.12%)
	No	45 (70.31%)	198 (79.84%)	243 (77.88%)
Diabetic ulcer	Yes	10 (15.62%)	15 (6.05%)	25 (8.01%)
	No	54 (84.38%)	233 (93.95%)	287 (91.99%)
Acute complication of DM	Yes	20 (31.25%)	70 (28.23%)	90 (28.85%)
	No	44 (68.75%)	178 (71.77%)	222 (71.15%)
Hypertension	Yes	54 (84.38%)	135 (54.44%)	189 (60.58%)
	No	10 (15.62%)	113 (45.56%)	123 (39.42%)
CVD	Yes	43 (67.19%)	25 (10.08%)	68 (21.79%)
	No	21 (32.81%)	223 (89.92%)	244 (78.21%)
AKI	Yes	35 (54.69%)	13 (5.24%)	48 (15.38%)
	No	29 (45.31%)	235 (94.76%)	264 (84.62%)

3.3. Factors Associated with Chronic Kidney Disease Among Diabetes Patients

In univariate analysis factors such as sex, age, type of diabetes, duration of diabetes, diabetes regimen, hypertension, proteinuria, diabetic retinopathy, FBS, lipid lowering agents, SBP and DBP were become candidate for multivariable analysis based on p value ≤0.25.

However, after adjusting for confounders in the multivariable model, only four (4) variables remained statistically significant. The duration of diabetes for ten or more years continued to be a strong predictor of CKD (AOR = 3.42, 95% CI: 1.58-7.38, p = 0.002). Proteinuria remained the most significant risk factor, with patients experiencing it being over five times more likely to have CKD (AOR = 5.13, 95% CI: 2.40-10.96, p < 0.001) than their counterparts. Diabetic retinopathy also showed a significant association (AOR = 2.36, 95% CI: 1.07-5.18, p = 0.032), suggesting that diabetic eye disease is an important risk factor for CKD. Additionally, FBS levels of 150 mg/dL or higher were independently associated with CKD (AOR = 2.40, 95% CI: 1.10-5.23, p = 0.026) (Table 3).

Table 3. *Bivariate and multivariable analysis of factors associated with chronic kidney disease among DM patients at Wolaita Sodo University Comprehensive Specialized Hospital, Southern Ethiopia, 2023.*

Variables	Category	COR (95%CI)	P-value	AOR (95% CI)	P-value
Sex	Male	1.75 (0.91,3.18)	0.091	1.31 (0.59,2.93)	0.501
	Female	Ref		Ref	
Age (years)	≥ 45	1.83 (1.05,3.19)	0.033	1.12 (0.52,2.43)	0.763
	<45	Ref		Ref	
Duration of diabetes (years)	≥10	3.77 (2.10,6.77)	<0.001	3.42 (1.58,7.38)	0.002
	<10	Ref		Ref	
Type of diabetes	Type 2	2.70 (1.6,5.74)	0.010	1.14 (0.27,4.75)	0.851
	Type 1	Ref		Ref	
Therapy of diabetes	Insulin	0.61 (0.42,1.72)	0.160	1.01 (0.30,3.36)	0.984
	single oral therapy	0.66 (0.17,2.49)	0.541	0.97 (0.16,5.88)	0.979
	>1 oral therapy	0.85 (0.42,1.71)	0.656	1.14 (0.48,2.72)	0.758
	Both (oral &injection)	Ref	Ref	Ref	
Hypertension	Yes	4.52 (2.20,9.28)	<0.001	1.99 (0.70,5.64)	0.194
	No	Ref		Ref	
Proteinuria	Yes	10.14 (5.4518.84)	<0.001	5.13 (2.40,10.96)	<0.000
	No	Ref		Ref	
Diabetic retinopathy	Yes	4.93 (2.73,8.89)	<0.001	2.36 (1.07,5.18)	0.032
	No	Ref		Ref	
FBS	≥150	4.23 (2.23,8.11)	<0.001	2.40 (1.10,5.23)	0.026
	<150	Ref		Ref	
Lipid lowering agents	Yes	1.91 (1.08,3.35)	0.024	0.99 (0.47,2.08)	0.985
	No	Ref		Ref	
SBP		1.02 (1.01,1.03)	<0.001	1.00 (.99,1.02)	0.419
DBP		1.04 (1.02,1.05)	<0.001	1.02 (0.99,1.05)	0.053

3.4. Qualitative Findings Concerning Awareness on CKD Among Diabetes Patients

The sociodemographic characteristics of respondents

A total of fourteen (14) diabetes patients were participated in qualitative study. Majority 10 (71.43%) of the participants were male, while the rest 4 (28.57%) were female. All participants were over 18 years old, with majority 8 (57.43%) of them were above 45 years of age. All lived in the Wolaita Zone and maximum 9 (64.28%) were residing in urban area (Table 4). Additionally, there are five main themes identified through thematic framework analysis including limited awareness and understanding of chronic kidney disease, low perceived susceptibility, external and internal barriers to implementing preventive measures, inadequate communication between patients and healthcare providers, and the emotional and social factors influencing chronic kidney disease. The findings are presented based on these themes.

Table 4. *The sociodemographic characteristics of participants of qualitative study at Wolaita Sodo University Comprehensive Specialized Hospital, Southern Ethiopia, 2023.*

Variables	Category	Frequency
Sex	Male	10 (71.43%)
	Female	4 (28.57%)
Age (years)	<45	6 (42.57%)
	≥45	8 (57.43%)
Residence	Urban	9 (64.28%)
	Rural	5 (35.72%)
Religion	Muslim	1 (7.43%)
	Orthodox	6 (42.57%)
	Protestant	7 (50.0%)
Marital status	Married	11 (78.57%)
	Widowed/separated	2 (14.28%)
	Unmarried/single	1 (7.15%)

Theme 1. Low awareness and understanding about chronic kidney disease

Subtheme 1.1 No prior knowledge of chronic kidney disease

Despite being diagnosed with diabetes—a condition closely linked to kidney complications—many patients had not received or retained any information about CKD. Their responses reveal that CKD is often overshadowed by more commonly discussed conditions like hypertension and diabetes, leaving patients unaware of the potential consequences. The absence of personal illness history related to the kidneys was also cited as a reason for not being informed, suggesting that preventive education may not be emphasized until symptoms appear. This in-depth interview with diabetes patients has identified lack of prior knowledge and familiarity with the term chronic kidney disease; for example, 53 years old woman claimed that;

"I don't know about chronic kidney disease, but I heard about blood pressure and diabetes".

The other 65 years old male respondent, who stayed with diabetes for about 13 years said: "No, I don't know (chronic kidney disease), don't ask me rather than diabetes and hypertension".

Thirty-eight-years old respondent again supported above idea as... "No, I don't know about chronic kidney disease. sorry! Actually, kidney is very important organ. With out it we cannot even move, or survive, but to talk the truth I don't know what you said (CKD), because I never had such kind of illness so far".

Subtheme 1.2 Misconceptions and lack of clarity about symptoms of CKD

Patients often had vague or inaccurate ideas about CKD symptoms. Participants demonstrated confusion and misinformation about the symptoms of chronic kidney disease. Some associated kidney issues with general body pain or strain from physical activity, such as walking long distances or lifting heavy objects. Others believed that symptoms like flank pain could be relieved simply by drinking water. Several respondents also assumed that the absence of symptoms meant their kidneys were healthy, revealing a lack of understanding about the silent progression of CKD. Supporting above idea;

Thirty-eight-years-old male with diabetes when asked about symptoms of CKD said... "It may be pain over flank during long distance walking.... or they (individuals with this case) may unable to move with high-heeled shoes".

Other 42 years old male respondent said.... "After carrying heavy objects, they (someone with this problem), would feel pain over here and here (pointing his flank with his fingers)... also I myself had pain over flank before I get diagnosed with diabetes, I used to drink a lot of water and it get resolved, but now this sugar has continued to be a problem for me".

Another respondent, a 51-years-old who had been living with diabetes for ten years, shared his lack of knowledge about the symptoms of chronic kidney disease as follows; "Oh! I do not know symptoms of CKD! It does not happen to me. I checked yesterday (showing the investigation report in his hand), they said your kidney is normal, earlier today also I checked it with urine but it was normal".

Subtheme 1.3 Lack of understanding about their current case (diabetes) could lead chronic kidney disease

Several respondents showed limited awareness of the connection between diabetes and kidney damage. Some ex-

plicitly stated that healthcare providers had never informed them about this link, while others placed full responsibility for such knowledge on health workers. The belief that diabetes and kidney disease are unrelated suggests that many patients may not recognize the long-term risks of uncontrolled diabetes or the importance of early prevention.

Nineteen years old female student who stayed with diabetes for five years asked about whether she knew about her longstanding diabetes could lead chronic kidney disease replied her understanding as follow..... "No, I am not aware of it. I wasn't aware that diabetes could cause damage to the kidneys".

Another 65 years old respondent added supporting above idea when asked about link between DM and CKD....."I don't know! "They have not told me that it (DM) affects my kidney: I don't know, please tell me what are symptoms of renal damage or failure? (he asks the interviewer)".

Other respondent added replying for above question....."I don't know about that, it is health worker's job..... I have no clue on it....."I do not know. I don't think diabetes has relation with kidney disease".

Subtheme 1.4 Perceived causes and risk factors of chronic kidney disease

When discussing about the causes of chronic kidney disease, many participants relied on assumptions or common beliefs rather than medical understanding. Some associated CKD with long-term use of oral medications (tablet) of diabetes, while others linked it to low water intake. A few respondents cited unrelated or unclear factors such as kidney stones, heavy workload, high salt intake, physical strain, or lack of surgical interventions without touching mainly identified risk factors like diabetes, high blood pressure, heart failure, or family history. These responses reflect a limited and often inaccurate perception of actual CKD risk factors. Participants expressed their view as follow;

One sixty-five years old individual asked about main risk factors of CKD replied and showed about his lack of understanding that.... "I don't know.... May be long-term diabetes medication use; especially tablet could cause chronic kidney disease.....I know nothing about it.....what they told me was to only use prescribed medications appropriately".

Other 51 years old male respondent with both diabetes and hypertension expressed his unsure awareness about what causes CKD as follow; "Most of the time the awareness I have is long standing medication of diabetes and hypertension have direct effect on kidney. I heard that from somewhere but I don't know how much sure it is. "By the way how much sure it is, tell me" (asks the interviewer to assure).

Causes of CKD also linked to low water intake. A 39 years old widowed woman expressed understanding on causes of CKD linking with drinking water as follow; "I drink a lot water, in beginning just after I took medication, I drink two cups of water, then I just wake up at mid night and drink at least two cups of water, again at early morning I drink again two cups, I finish at least 2 litre each night".

Seventy (70) years old male patient replied with unclear and assumption-based answer about causes of CKD as follow: chronic kidney disease is due to heavy workload.....Stone...I mean kidney stone.... again, due to salt.....not removing something from kidney that could be removed from it by surgery.... walking long distance.....carrying heavy objects".

Theme 2. Low perception and beliefs about susceptibility

Subtheme 2.1 Waiting symptoms to get checked for health status of kidney (screening)

Despite living with diabetes, many respondents expressed that they would only consider kidney screening after symptoms appeared. The idea of checking kidney health without any visible signs of illness was repeatedly questioned and dismissed. Participants often emphasized that unless there was pain, difficulty urinating, or other noticeable discomfort, there was no reason to seek testing. Even though some patients have showed favourable response regarding screening, significant portions of the patients waiting symptoms to get checked for kidney health and they have not started to think themselves as at risk compared to other population.

For instance, one respondent with diabetes duration of above ten years said as follow about checking their kidney status before showing symptoms... "How come! Why someone without symptoms get checked for it. What is its importance? For example, if someone has pain over it (kidney) or difficulty on urination, they may get checked for it".

One 38 years old male patient expressed his perception about susceptibility to CKD as follow; "I did not check for it still.....I have no symptoms of it..... of course, how dare someone without symptoms can check for it (CKD)?".

The same supporting idea raised by other 50 years old woman by saying....."How come! Why without symptoms or sign of illness one should be checked for it. I do not know diabetes can affect my body part (thinking of kidney) without showing symptoms.... I do not know, if it does that or not.....I do not know even symptoms. What I know only is come and tell them I am feeling this.....and that.....then in turn they order me to give sample of this (something).... then prescribe me medication....and then I just go back to my home".

Forty-two years old male respondent again demonstrated his perception about screening by saying... "No, I even not think about it (checking health status of kidney without symptoms) if am not sick. Why? Because I am healthy, because I do not know what is happening inside my body. From the very beginning, you would come to hospital and check in laboratory about something, when you have symptoms of illness. Unless and otherwise who you think yourself are, and come and ask doctor to check your status, while you are looking healthy".

Subtheme 2.2 Inconsistent self-care and disease manage-

ment practices

Although preventive practices are essential for slowing the progression of chronic kidney disease, many participants reported inconsistent or poor self-care behaviours. Some acknowledged stopping their medications for extended periods, others admitted to eating without restriction despite being aware of dietary recommendations. Exercise was also undervalued or abandoned entirely. These choices were often justified by frustration over persistent high blood sugar levels or beliefs that lifestyle changes were ineffective compared to medication. The respondents have struggle with directly appreciating what are the preventive measure of chronic kidney disease. Even though the interview indirectly tried to get their insights about the preventive measures and the trend of the practice, there are individuals with poor practice of those actions.

One 56 years old male diabetes patient expressed his trend of self-care practice as follow.....“This season I admitted to emergency unit; because I was using the treatments not appropriately”. “Even it (his sugar level) reached out 378. It had never been reached that level, it was my fault, I stopped the medication”. “I believe food optimization is enough to control diabetes. Even though I prefer to eat every food”. I eat every food”.

A forty-six years old male respondent replied his inconsistent self-care and disease management practices as follow.....“Previously I do exercise but now I stopped it. Because it could not replace medication, so what is its importance? So, I stopped it” “I just take only medications I never do other thing... Also, I never take care of food.....it is because there is no change on my sugar level, whatever I do it is still above 200; Always above 200..... I even stopped taking medication. I stopped taking medication about four years.....I stopped by myself, what is the importance of swallowing chalks always I said that and I stopped”.

Theme 3. Low patient to provider communication and Vise-versa

Sub theme 3.1 Incomprehensive diabetes education

The interviews revealed a notable communication gap between healthcare providers and diabetes patients regarding kidney health. Several respondents reported receiving diabetes education that did not include any information about chronic kidney disease, indicating an incomplete approach to patient education.

One respondent asked about if they told him about chronic kidney failure from the very beginning, together with diabetes education? “No, they never touched about chronic kidney disease. Firstly, the doctor diagnosed me were from Dawro (near town from study setting), it was very long time ago, he had been working in Sodo high school area, but I remember he never touched about this issue”.

Sub theme 3.2 Decreased provider’s initiative to communicate and encourage kidney health checks

Furthermore, many patients shared that their providers never encouraged or initiated discussions about kidney screening, even in long-term diabetes cases. In this interview, we identified both decreased provider initiative to announce the kidney status to their clients and lack of encouragements to their clients to check their kidney health.

For example, one young female individual with long duration of diabetes asked if she heard from her physicians that she should be checked for her kidney, status replied as... “No: they did not tell me about it”.

Sub theme 3.3 Patients’ ignorance to ask and know their kidney status

In some instances, patients themselves admitted they had never asked their health care providers about their kidney status, assuming the responsibility lay solely with the physician. This mutual silence suggests a missed opportunity for early detection and prevention of CKD.

One patient asked about if he asked his physician about his kidney status he replied as follows... “No, I never raised or asked them to announce my kidney health status, but if I asked, they would have told me”.

Theme 4. External and internal barriers to execute preventive measure

Subtheme 4.1 Low family support

Several participants described inadequate emotional and practical support from family members, which negatively influenced their ability to manage their condition. Some respondent openly stated that spouse was more of an obstacle than a help, to the extent that they regretted marriage. They also expressed deep disappointment in their children, saying they neither reminded about treatment nor accompanied them to the hospital. Instead, they had to manage everything on their own, while children prioritized their own schedules.

One 43 years old male respondent expressed support from his spouse as follow; “My wife is obstacle for me, I even some time think it is better if I would not have married”.

One 49 year’s old widowed woman asked about support from here children and replied as follow..... “Forget about it: nowadays this generation don’t care about you. They do not think about me as I do to them..., they do not remind me. They do not control me in the way my case needs. I came to hospital by myself to take medicine; they were busy by themselves (by their schedules)”.

Subtheme 4.2 Low-income status

Poverty was a recurring barrier in following dietary recommendations and maintaining consistent self-care. Respondents admitted to breaking dietary restrictions due to financial constraints, often consuming maize-based foods and other inexpensive items not advised by health professionals. Some expressed gratitude for survival despite eating forbidden foods, while another explained that limited family income had to be stretched across competing needs like children’s expenses, food, and medications—making disease management extremely challenging.

Respondents expressed their barrier for self-care practice and disease managements follows;

"The main barrier is poverty.... It is lack of money (poverty) you know that".

"Diabetes patients are ordered not to eat maize, bread, drink tea, but mostly ordered to prevent eating maize, bread and anything wheat included inside. However, I eat breaking the rules given if my family conditions are not suitable to have above things. I even its maize bread.....Yea, if we cannot afford and access ordered food items appropriately, I use those prevented one. But thanks to God I am still alive".

"Yea! Income is problem. Of course, it is huge problem, I am currently getting only retirement salary, my wife also gets insufficient salary, that is expected to handle children cost, other household expenditures and mine (he is saying his medication and food cost)".

Subtheme 4.3 Problems related to accessibility of inputs to preventive measures

Participants also raised concerns about the limited availability and high cost of essential items for prevention. Access to vegetables was restricted by geography, requiring travel to nearby towns. Medication costs were described as overwhelming, especially for those relying on limited income. Respondent even compared the situation unfavourably to other countries were government support for patients with chronic illnesses, highlighting systemic gaps in local healthcare affordability.

"Vegetables are usually not accessible, we most of the time buy it from Sodo town or humbo town".

"I am amazed. It is about availability of drug... we come with our CBHI or without it, but most of the time there is no drug in hospital, we get obliged to buy from outside. How poor could survive with such think. It is very costly...in other country... and other government help individuals with such condition (the scenario about his friend in dialysis)".

Theme 5. Emotional and social influences on CKD

Subtheme 5.1 Fear triggered by others' experiences

There are very few numbers of participants who met individuals with chronic kidney disease or last stage of chronic kidney disease. They have undeniable responses to these scenarios, and those encounters left strong impressions. One respondent recalled a friend undergoing dialysis, emphasizing how the financial burden and visible suffering pushed him to take his own symptoms seriously and seek medical care promptly. This reaction highlights how witnessing the realities of CKD in others can heighten personal fear and influence health-seeking behaviours.

For instance, participant in our study asked about if they had experience of exposure individual with this type of case and effect on their perception answered like as follows;

"I remember I have one friends in dialysis.... he gives all his money every month to it.....he lives in Addis Ababa.....after I saw his situation I come to hospital whatever I feel wrong about my kidney".

One other individual added "I never met with individuals with that condition in person, rather I hear the rumours. However, I heard about it (chronic kidney disease, or patients in dialysis and causes of it) from YouTube and TV also, it seems the condition also belongs me. So, I started taking care of and following the new information strictly".

Subtheme 5.2 Coping through faith or denial

Emotional denial and avoidance were noticeable in the way some participants responded to questions about CKD complications. One long-term diabetes patient, when asked about their perception of CKD-related outcomes such as death, refused to engage with the topic, stating, "Please don't force me to talk about what I don't want to talk. I do not like to talk about it....it is enough." This resistance to discussing serious complications may indicate underlying fear, emotional fatigue, or reliance on coping mechanisms that avoid confronting painful possibilities. Showing denial or preparation less has been commonly identified through out conversation.

4. Discussion

Chronic kidney disease (CKD) is a common and severe complication among diabetes patients, affecting approximately one-third of individuals with the condition. High blood sugar levels over time can damage the tiny blood vessels and nephrons in the kidneys, leading to diabetic kidney disease, the most common cause of kidney failure globally. Additionally, diabetes-related hypertension further exacerbates kidney damage, making CKD a significant contributor to morbidity and mortality in this population. Increasing awareness, early detection, and effective management of blood sugar and blood pressure are critical to slowing disease progression and improving outcomes.

The proportion of chronic kidney disease among diabetes in this study was found to be 20.5% (95%CI: 18-29%). This is similar to studies done in Gondar (21%) [30] North west Ethiopia and Jimma (26%) [26] Southwest Ethiopia. However, our finding was lower than study done in Dessie (31.5%) [31] Northern Ethiopia, Spain (27.9%) [32], Netherlands (28%) [33], and USA (39.6%) [34], whereas it is higher than study done in Gondar 14.7% [35], and Bahir Dar 16.7% [36]. The differences in observed CKD prevalence may be explained by variations in the methods used to assess it—for instance, some study relied solely on eGFR, whereas others incorporated both eGFR and proteinuria [31]. Additional factors such as differences in patient populations included (some studies included both type 1 and type 2 diabetes patients, while others focused exclusively on type 2), variations in sample sizes, and diverse ethnic backgrounds may contribute to the observed discrepancies.

In our study, long duration of diabetes mellitus has been identified as a significant predictor of chronic kidney disease. This is supported by a 2021 systematic review and meta-analysis of Ethiopian studies which found that prolonged DM duration (typically>5-10 years) independently increases CKD risk, aligning with findings from regional cross-sectional analyses [23]. For instance, a Northwest

Ethiopian study revealed that patients with DM duration >10 years had a 3.2-fold higher odds of CKD compared to those with shorter durations (p = 0.004) [35], while research in Harari region showed a 253% increased CKD hazard (adjusted hazard ration (AHR = 3.53, 95% CI: 1.43-8.71)) for durations exceeding five years [37]. The mechanism likely involves prolonged hyperglycaemia causing glomerular hyperfiltration, endothelial dysfunction, and cumulative microvascular damage [38]. With Ethiopia's diabetic population facing limited access to routine renal screening, these results underscore the critical need for intensified CKD monitoring starting nearly post-diagnosis and aggressive glycemic control strategies to mitigate nephropathy risks [23, 35].

Moreover, proteinuria emerged as a significant predictor of CKD in this study, aligns with existing research that highlights its critical role in both the diagnosis and prognosis of kidney disease. For instance, the Modification of Diet in Renal Disease (MDRD) study identified high proteinuria (>1.0 g/day) as a predictor of renal progression, consistent with our finding [39]. Similarly, a mass screening in Okinawa, Japan, involving 107,192 participants, identified proteinuria as the most powerful predictor of end-stage renal disease (ESRD) risk over 10 years [40]. A retrospective cohort study of 494 diabetic patients in Eastern Ethiopia found positive proteinuria increased CKD risk by 3.78 times (AHR = 3.78, 95% CI: 1.80-7.91) using Gompertz regression analysis [37]. This might be due to exposure of renal tubules to urinary proteins induces interstitial inflammation, fibrosis, and apoptosis in proximal tubular cells, accelerating CKD progression. Studies highlight that proteinuria in diabetic patients arises from glomerular hyperfiltration, endothelial dysfunction, podocyte damage, and reduced tubular reabsorption capacity. Early intervention, even before microalbuminuria develops, is crucial to mitigate kidney damage and improve outcomes in diabetic patients [40, 41].

In addition, diabetic retinopathy has significantly associated with chronic kidney disease in our study. Studies have consistently demonstrated that retinopathy severity is a strong predictor of CKD progression in diabetic patients. For example, research in Ethiopia and global studies have shown that diabetic retinopathy (DR) is associated with a higher prevalence of CKD, end-stage kidney disease (ESKD), and coronary heart disease. In a study involving 1,592 type 2 DM patients, those with non-proliferative DR had a 2.9-fold higher risk of CKD progression, while those with proliferative DR had a 16.6-fold higher risk compared to patients without DR [42, 43]. This indicates a dose-response relationship between DR severity and CKD progression. Additionally, retinopathy progression has been found to correlate with renal lesions and ESKD risk, suggesting that DR may serve as a prognostic tool for diabetic kidney disease [42]. A meta-analysis done in Ethiopia revealed that diabetic retinopathy significantly increased the risk of CKD by 4.54 times compared to patients without retinopathy [35]. This might be due to retinopathy, a microvascular complication of diabetes mellitus (DM), is closely linked to chronic kidney disease (CKD) due to shared underlying pathological mechanisms. The shared mechanisms include endothelial dysfunction, inflammation, and oxidative stress, which contribute to both retinal and renal microvascular damage [44, 45]. These underscore the importance of regular ophthalmologic evaluations in diabetic patients to identify retinopathy early, as it can provide valuable insights into kidney health and guide timely interventions to mitigate CKD progression.

Again, fasting blood sugar level above 150 mg/dl was significantly associated with chronic kidney disease. Studies have shown that fasting hyperglycaemia is a strong predictor of diabetes-related complications, including chronic kidney disease (CKD). A study found that fasting blood sugar levels were significantly higher in CKD patients compared to controls with the mean FBS was 111 mg/dL in the CKD group versus in the control group, with a statistically significant difference (p=0.001) [46]. In Ethiopia, for example, fasting blood sugar levels above 150 mg/dL were associated with a higher risk of CKD in diabetic populations, emphasizing the need for early intervention [9]. Globally, fasting hyperglycaemia is recognized as a modifiable risk factor, with lifestyle changes such as diet modification, weight management, and physical activity playing a pivotal role in its control. Monitoring fasting blood glucose is essential for early detection and management of diabetes and its complications, underscoring its significance.

Despite the high prevalence and significant risk factors for CKD, our qualitative findings revealed a critical lack of awareness and understanding of the disease among diabetes patients in the study setting. Despite being at high risk, many respondents had never heard of CKD, misunderstood its symptoms, or were unaware of the link between diabetes and kidney damage. Misconceptions, such as associating CKD with heavy lifting or medication use rather than diabetes or hypertension, were common. Patients often waited for symptoms before seeking screening and showed inconsistent self-care practices, which were further hindered by poverty, lack of family support, and poor access to essential resources. Communication gaps between healthcare providers and patients also contributed to low awareness, with many reporting they were never informed about CKD or encouraged to undergo kidney health checks.

Emotional and social factors also strongly influenced patient behaviour. Fear sparked by observing others with CKD prompted some to seek care, while others showed denial or emotional avoidance when discussing the disease's serious consequences. A general lack of initiative from both patients and providers contributed to missed opportunities for early detection and intervention. Additionally, structural barriers such as low income and medication costs made sustained disease management difficult. These emphasize the need for stronger patient education, improved provider engagement, and targeted community interventions to better awareness,

and support prevention and early identification of CKD in at-risk populations.

5. Strength and Limitations of Study

Being the first study in our country to qualitatively investigate patients' awareness level of chronic kidney disease among diabetes, and its mixed approach was main strengths of this study. Unbale to get important sociodemographic and clinical variables from charts, and the drawbacks of cross-sectional nature of study were explainable limitations of this study.

6. Conclusion

Chronic kidney disease was found in every fifth of diabetic patients. Prolonged duration of diabetes, proteinuria, diabetic retinopathy, and elevated fasting blood sugar levels had become independent predictors of chronic kidney disease. Despite this, qualitative findings revealed alarmingly low awareness and understanding of CKD, compounded by misinformation, poor self-care practices, and limited communication between patients and healthcare providers. Comprehensive patient education, routine screening, and integrated care strategies that not only promote awareness but also address the significant predictors to enhance early detection and prevention of CKD in diabetic populations should be implemented.

Abbreviations

AKI	Acute Kidney Injury
AHR	Adjusted Hazard Ratio
AOR	Adjusted Odds Ratio
CVD	Cardiovascular Disease
CI	Confidence Interval
CKD	Chronic Kidney Disease
DBP	Diastolic Blood Pressure
DKD	Diabetes Kidney Disease
DM	Diabetes Mellitus
DR	Diabetic Retinopathy
ESRD	End-Stage Renal Disease
FBS	Fasting Blood Sugar
eGFR	Estimated Glomerular Filtration Rate
NCD	Non-Communicable Disease
RRT	Renal Replacement Therapy
SBP	Systolic Blood Pressure
WSUCSH	Wolaita Sodo University Comprehensive Specialized Hospital

Author Contributions

Amanuel Arota: Conceptualization, Data curation, Formal analysis, Methodology, Project administration, Validation, Visualization, Writing - original draft, Writing - review & editing

Yimer Seid: Conceptualization, Data curation, Formal analysis, Methodology, Project administration, Validation, Visualization, Writing - original draft, Writing - review & editing

Wakgari Deressa: Conceptualization, Data curation, Formal analysis, Methodology, Project administration, Validation, Visualization, Writing - original draft, Writing - review & editing

Feyisa Shasho Bayisa: Conceptualization, Data curation, Formal analysis, Methodology, Project administration, Validation, Visualization, Writing - original draft, Writing - review & editing

Consent for Publication

Not applicable.

Ethical Considerations

Ethical clearance was obtained from research and ethical review board of the School of Public Health at the College of Health Sciences in Addis Ababa University with (Ref. No. SPH/ 154/2023).

Data Availability Statement

All available data are with in manuscript.

Funding

We did not receive funds for conducting the study or for open-access publication from any funding organization.

Conflicts of Interest

The authors declare no conflicts of interest.

References

[1] G. Roglic, *"WHO global report on diabetes: a summary," International Journal of Noncommunicable Diseases*. Department for Management of Noncommunicable Diseases, Disability, Violence and Injury Prevention, World Health Organization, [Online]. Available: [Downloaded free from http://www.ijncd.org on Monday, November 14, 2022, IP: 196.190.61.239]

[2] D. J. Magliano, E. J. Boyko, and IDF Diabetes Atlas 10th edition scientific committee, *IDF DIABETES ATLAS*, 10th ed. in IDF Diabetes Atlas. Brussels: International Diabetes Federation, 2021. Accessed: Nov. 13, 2022. [Online]. Available: http://www.ncbi.nlm.nih.gov/books/NBK581934/

[3] H. Sun *et al.*, "IDF Diabetes Atlas: Global, regional and country-level diabetes prevalence estimates for 2021 and projections for 2045," *Diabetes Res. Clin. Pract.*, vol. 183, p. 109119, Jan. 2022, https://doi.org/10.1016/j.diabres.2021.109119

[4] S. Wilson, P. Mone, S. S. Jankauskas, J. Gambardella, and G. Santulli, "Chronic kidney disease: Definition, updated epidemiology, staging, and mechanisms of increased cardiovascular risk," *J. Clin. Hypertens. Greenwich Conn*, vol. 23, no. 4, pp. 831-834, Apr. 2021, https://doi.org/10.1111/jch.14186

[5] N. Samsu, "Diabetic nephropathy: challenges in pathogenesis, diagnosis, and treatment," *BioMed Res. Int.*, vol. 2021, 2021.

[6] H.-J. Anders, T. B. Huber, B. Isermann, and M. Schiffer, "CKD in diabetes: diabetic kidney disease versus nondiabetic kidney disease," *Nat. Rev. Nephrol.*, vol. 14, no. 6, pp. 361-377, Jun. 2018, https://doi.org/10.1038/s41581-018-0001-y

[7] Y. Deng *et al.*, "Global, Regional, and National Burden of Diabetes-Related Chronic Kidney Disease From 1990 to 2019," *Front. Endocrinol.*, vol. 12, p. 672350, 2021, https://doi.org/10.3389/fendo.2021.672350

[8] J. J. N. Noubiap, J. Naidoo, and A. P. Kengne, "Diabetic nephropathy in Africa: A systematic review," *World J. Diabetes*, vol. 6, no. 5, pp. 759-773, Jun. 2015, https://doi.org/10.4239/wjd.v6.i5.759

[9] W. S. Shiferaw, T. Y. Akalu, and Y. A. Aynalem, "Chronic Kidney Disease among Diabetes Patients in Ethiopia: A Systematic Review and Meta-Analysis," *Int. J. Nephrol.*, vol. 2020, p. 8890331, 2020, https://doi.org/10.1155/2020/8890331

[10] A. H. Geletu, A. S. Teferra, M. M. Sisay, and D. F. Teshome, "Incidence and predictors of chronic kidney diseases among type 2 diabetes mellitus patients at St. Paul's Hospital, Addis Ababa, Ethiopia," *BMC Res. Notes*, vol. 11, no. 1, p. 532, Jul. 2018, https://doi.org/10.1186/s13104-018-3618-9

[11] K. Tamru, F. Aga, E. Berhanie, Y. A. Aynalem, and W. S. Shiferaw, "Incidence of diabetic nephropathy in patients with type 2 diabetes mellitus at a tertiary healthcare setting in Ethiopia," *Diabetes Metab. Syndr.*, vol. 14, no. 5, pp. 1077-1083, 2020, https://doi.org/10.1016/j.dsx.2020.06.028

[12] S. A. Kebede, B. S. Tusa, A. B. Weldesenbet, Z. T. Tessema, and T. A. Ayele, "Incidence of Diabetic Nephropathy and Its Predictors among Type 2 Diabetes Mellitus Patients at University of Gondar Comprehensive Specialized Hospital, Northwest Ethiopia," *J. Nutr. Metab.*, vol. 2021, p. 6757916, 2021, https://doi.org/10.1155/2021/6757916

[13] M. A. Ahmed, Y. M. Ferede, and W. W. Takele, "Incidence and predictors of chronic kidney disease in type-II diabetes mellitus patients attending at the Amhara region referral hospitals, Ethiopia: A follow-up study," *PloS One*, vol. 17, no. 1, p. e0263138, 2022, https://doi.org/10.1371/journal.pone.0263138

[14] T. Liyanage *et al.*, "Worldwide access to treatment for end-stage kidney disease: a systematic review," *Lancet Lond. Engl.*, vol. 385, no. 9981, pp. 1975-1982, May 2015, https://doi.org/10.1016/S0140-6736(14)61601-9

[15] J. M. Norton *et al.*, "Social Determinants of Racial Disparities in CKD," *J. Am. Soc. Nephrol. JASN*, vol. 27, no. 9, pp. 2576-2595, Sep. 2016, https://doi.org/10.1681/ASN.2016010027

[16] "review." Accessed: Nov. 16, 2022. [Online]. Available: https://pubmed.ncbi.nlm.nih.gov/32061315/

[17] J.-C. Lv and L.-X. Zhang, "Prevalence and Disease Burden of Chronic Kidney Disease," *Adv. Exp. Med. Biol.*, vol. 1165, pp. 3-15, 2019, https://doi.org/10.1007/978-981-13-8871-2_1

[18] "Federation I. D., IDF Diabetes Atlas, Federation I. D., Tel Aviv, Israel, Eighth edition, 2017 - Google Search." Accessed: Nov. 17, 2022. [Online]. Available: https://www.google.com/search

[19] L. C. Plantinga, D. S. Tuot, and N. R. Powe, "Awareness of Chronic Kidney Disease among Patients and Providers," *Adv. Chronic Kidney Dis.*, vol. 17, no. 3, p. 225, May 2010, https://doi.org/10.1053/j.ackd.2010.03.002

[20] L. C. Plantinga *et al.*, "Patient Awareness in Chronic Kidney Disease: Trends and Predictors," *Arch. Intern. Med.*, vol. 168, no. 20, p. 2268, Nov. 2008, https://doi.org/10.1001/archinte.168.20.2268

[21] A. Muxunov *et al.*, "Awareness of chronic kidney disease and its risk factors in the former Soviet Union countries. Electron J Gen Med. 2023; 20 (6): em528," *Electron. J. Gen. Med.*, vol. 20, p. 6, 2023.

[22] C. D. Chu *et al.*, "Patient Awareness of CKD: A Systematic Review and Meta-analysis of Patient-Oriented Questions and Study Setting," *Kidney Med.*, vol. 3, no. 4, p. 576, Jun. 2021, https://doi.org/10.1016/j.xkme.2021.03.014

[23] T. Tolossa *et al.*, "Burden and Determinants of Chronic Kidney Disease Among Diabetic Patients in Ethiopia: A Systematic Review and Meta-Analysis," *Public Health Rev.*, vol. 42, p. 1603969, Apr. 2021, https://doi.org/10.3389/phrs.2021.1603969

[24] "World Health Organization. (2018). Noncommunicable diseases country profiles 2018. World Health Organization. https://apps.who.int/iris/handle/10665/274512 License: CC BY-NC-SA 3.0 IGO - Google Search." Accessed: Nov. 17, 2022. [Online].

[25] T. Fiseha and Z. Tamir, "Prevalence and awareness of chronic kidney disease among adult diabetic outpatients in Northeast Ethiopia," *BMC Nephrol.*, vol. 21, pp. 1-7, 2020.

[26] K. Kumela Goro *et al.*, "Patient awareness, prevalence, and risk factors of chronic kidney disease among diabetes mellitus and hypertensive patients at Jimma University Medical Center, Ethiopia," *BioMed Res. Int.*, vol. 2019, no. 1, p. 2383508, 2019.

[27] N. Gashaye Shita and A. Sharew Iyasu, "Predictors of blood glucose change and microvascular complications of type 2 diabetes mellitus patients in Felege Hiwot and Debre Markos referral hospital, North West Ethiopia," *BMC Endocr. Disord.*, vol. 22, no. 1, Art. no. 1, 2022.

[28] K. A. Murphy *et al.*, "Awareness and discussions about chronic kidney disease among African-Americans with chronic kidney disease and hypertension: a mixed methods study," *J. Gen. Intern. Med.*, vol. 35, pp. 298-306, 2020.

[29] W. Chekol Tassew, N. Birhan, and Y. Zewdu, "Incidence and predictors of acute kidney injury among newly diagnosed type 2 diabetes patients at chronic follow-up clinic of university of gondar comprehensive specialized hospital: a retrospective follow-up study," *Res. Rep. Urol.*, pp. 613-622, 2021.

[30] S. Damtie *et al.*, "Chronic Kidney Disease and Associated Risk Factors Assessment among Diabetes Mellitus Patients at A Tertiary Hospital, Northwest Ethiopia," *Ethiop. J. Health Sci.*, vol. 28, no. 6, Art. no. 6, 2018, https://doi.org/10.4314/ejhs.v28i6.3

[31] M. Adem, W. Mekonen, A. Ausman, M. Ahmed, and A. Yimer, "Prevalence of chronic kidney disease and its associated factors among diabetes mellitus patients in Dessie Referral Hospital, South Wollo, Ethiopia," *Sci. Rep.*, vol. 14, no. 1, p. 9229, Apr. 2024, https://doi.org/10.1038/s41598-024-59184-3

[32] A. Rodriguez-Poncelas *et al.*, "Prevalence of chronic kidney disease in patients with type 2 diabetes in Spain: PERCEDIME2 study," *BMC Nephrol.*, vol. 14, p. 46, Feb. 2013, https://doi.org/10.1186/1471-2369-14-46

[33] V. van der Meer *et al.*, "Chronic kidney disease in patients with diabetes mellitus type 2 or hypertension in general practice," *Br. J. Gen. Pract. J. R. Coll. Gen. Pract.*, vol. 60, no. 581, pp. 884-890, Dec. 2010, https://doi.org/10.3399/bjgp10X544041

[34] L. C. Plantinga *et al.*, "Prevalence of chronic kidney disease in US adults with undiagnosed diabetes or prediabetes," *Clin. J. Am. Soc. Nephrol. CJASN*, vol. 5, no. 4, pp. 673-682, Apr. 2010, https://doi.org/10.2215/CJN.07891109

[35] H. Alemu, W. Hailu, and A. Adane, "Prevalence of Chronic Kidney Disease and Associated Factors among Patients with Diabetes in Northwest Ethiopia: A Hospital-Based Cross-Sectional Study," *Curr. Ther. Res. Clin. Exp.*, vol. 92, p. 100578, Feb. 2020, https://doi.org/10.1016/j.curtheres.2020.100578

[36] D. Tesfe, M. Adugna, Z. M. Nigussie, A. E. Woldeyohanins, and Z. D. Kifle, "The proportion of chronic kidney disease and its associated factors among adult diabetic patients at Tibebe Ghion Specialized Hospital, Bahir Dar, Ethiopia," *Metab. Open*, vol. 15, p. 100198, Sep. 2022, https://doi.org/10.1016/j.metop.2022.100198

[37] A. Cheru, D. Edessa, L. D. Regassa, and T. Gobena, "Incidence and predictors of chronic kidney disease among patients with diabetes treated at governmental hospitals of Harari Region, eastern Ethiopia, 2022," *Front. Public Health*, vol. 11, p. 1290554, Jan. 2024, https://doi.org/10.3389/fpubh.2023.1290554

[38] H. Wondifraw, "Classification, Pathophysiology, Diagnosis and Management of Diabetes Mellitus," *J. Diabetes Metab.*, vol. 06, Jan. 2015, https://doi.org/10.4172/2155-6156.1000541

[39] C.-H. Chen *et al.*, "Proteinuria as a Therapeutic Target in Advanced Chronic Kidney Disease: a Retrospective Multicenter Cohort Study," *Sci. Rep.*, vol. 6, no. 1, p. 26539, May 2016, https://doi.org/10.1038/srep26539

[40] P. Cravedi and G. Remuzzi, "Pathophysiology of proteinuria and its value as an outcome measure in chronic kidney disease," *Br. J. Clin. Pharmacol.*, vol. 76, no. 4, pp. 516-523, Oct. 2013, https://doi.org/10.1111/bcp.12104

[41] C. S. Wong *et al.*, "Association of Proteinuria with Race, Cause of Chronic Kidney Disease, and Glomerular Filtration Rate in the Chronic Kidney Disease in Children Study," *Clin. J. Am. Soc. Nephrol. CJASN*, vol. 4, no. 4, p. 812, Apr. 2009, https://doi.org/10.2215/CJN.01780408

[42] H.-T. Lin *et al.*, "Diabetic Retinopathy as a Risk Factor for Chronic Kidney Disease Progression: A Multicenter Case-Control Study in Taiwan," *Nutrients*, vol. 11, no. 3, p. 509, Feb. 2019, https://doi.org/10.3390/nu11030509

[43] N. A. Bello *et al.*, "Retinopathy and clinical outcomes in patients with type 2 diabetes mellitus, chronic kidney disease, and anemia," *BMJ Open Diabetes Res. Care*, vol. 2, no. 1, p. e000011, Apr. 2014, https://doi.org/10.1136/bmjdrc-2013-000011

[44] J. Hong *et al.*, "Retinopathy and Risk of Kidney Disease in Persons with Diabetes," *Kidney Med.*, vol. 3, no. 5, p. 808, Jul. 2021, https://doi.org/10.1016/j.xkme.2021.04.018

[45] A. Rodr ́guez-Poncelas *et al.*, "Chronic Kidney Disease and Diabetic Retinopathy in Patients with Type 2 Diabetes," *PloS One*, vol. 11, no. 2, p. e0149448, 2016, https://doi.org/10.1371/journal.pone.0149448

[46] A. D. Anirban Ghosh Arpita Kaye, "Examining the relationship between chronic kidney disease, dyslipidaemia, and dysglycemia: a prospective study".