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Original Research Article

Determinants of Chronic Kidney Disease among Diabetes Mellitus Patients at Gatundu Level 5 Hospital, Kiambu County, Kenya

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Abstract: The prevalence of chronic kidney disease (CKD) is rising alarmingly throughout the world, and it is one of the major public health menace due to the significant morbidity and mortality it is associated with. The burden of CKD inexplicably affects low-income nations like Kenya, where the two main public health concerns for the CKD growth rate are hypertension and diabetes mellitus. The aim of this study was to identify the determinants of chronic kidney disease diabetes mellitus patients and also assess their awareness, perspectives and prevalence of CKD. A hospital based cross-sectional study design was conducted at a rural hospital in central Kenya among adult (≥18 years) diabetes mellitus patients. Sample size was determined using Yamane Taro formula. Informed written consent was obtained from each participant and data was collected by interview and chart review; Glomerular filtration rate (GFR) was estimated from serum creatinine using modification of diet in renal disease (MDRD) formula, while CKD was defined as eGFR of less than 60mls/min/1.73m^2 for more than three months. Multivariate logistic regression was used to identify independent determinants of CKD and a p-value of <0.05 was considered to be statistically significant. Majority of the participants (43.42%) were aged between50-60 years and 95 (62.5%) of them were females. Participants with history of high blood pressure had a 129.4 %(AOR;1.29495% CI, 2.401-.698) risk of having CKD, while those who did not perform physical exercises were found to be 123.3% (AOR 1.233, 95% CL,1.889-.805) times more likely to have CKD Only 39 (25.8%) of the participants had average awareness about CKD and its risk factors. The overall unadjusted prevalence of CKD among diabetic patients was 78.2% (n= 119, 95% CI). The researcher found that existing history of hypertension, lack of physical exercises, family history of kidney disease, rural residency and low levels of education were independent determinants associated with CKD. The researcher also found low levels of patient awareness (25%) and high prevalence of CKD (78.2%).

Keywords: Chronic kidney Disease, Diabetes, Diabetic, Hypertension, High blood pressure, Determinants.

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1. INTRODUCTION

Chronic kidney disease (CKD) was the 12th biggest cause of mortality globally in 2017, accounting for 1.2 million fatalities. According to current projections, approximately 70% of patients with complex renal illness would live in poor nations by 2030. It is further estimated that in 2040 CKD could cause between 2.2 to 4 million deaths to be the 5th leading cause of death globally. As the prevalence of major risk factors such as diabetes rises, developing nations may face more difficult health-care issues that they may not be able to address [1]. Diabetes mellitus is presently the 7th leading cause of death globally compared to the year 2000 when it was ranked 14th. It is also the principal cause of chronic kidney disease accounting for 44% of new cases [2]. The estimated global diabetes population will rise from 415 million (8.8%) in 2015 to 642 million (10.4%) in 2040, with the largest changes anticipated in the urban populations of low- to middle-income countries (LMICs) Among them, type 2 diabetes mellitus (T2DM) affects more

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than 90% of those who have the disease. With 477.9 million infected people living in urban areas and 163.9 million in rural areas by 2040, the gap is expected to widen globally [1].

Rapid urbanization and economic growth in LMICs may be to blame for the burden of diabetes and its complications by increasing calorie intake and encouraging sedentary behavior. More importantly, the most striking demographic change to diabetes prevalence in global terms also seems to be related to the increase in the number of the elderly persons.

2. METHODS AND PARTICIPANTS

2.1 Study Setting and Population

The study was conducted at Gatundu level 5 Hospital, which is in Kiambu County, Central Kenya Region. Adult (age ≥ 18 years) diabetes mellitus patients on regular follow- up and those who signed informed written consent were recruited to the study. Confirmed chronic kidney disease, short follow-up period (< 3 months), incomplete patient chart, pregnant women, and critically ill patients were excluded from the study.

2.2 Study Design

Hospital based cross-section study design was used to assess determinants, awareness and prevalence for chronic kidney disease among diabetic patients on regular follow-up. 700 patients with diabetes mellitus were screened between February and March 2022, 412 were exclude from the study while 288 were used to calculate the sample size. The sample size was calculated by using Yamane Taro (1964) formula, a 95% confidence interval, and sample error of 5%, N=288, and final sample size, n=168 (Figure 1).

2.3 Data Collection Procedures

Data collection tool was developed after reviewing different literatures; the tool has three parts: The questionnaire was composed of three main sections. Section A contained social demographic and clinical information; section B was about questions on awareness while section C questions was on perspectives. Using these tool participants were interviewed to obtain respective information when they came for their monthly check-up and medication refill. Patient's charts were also reviewed for information like blood pressure treatment, serum urea and creatinine levels. Participants' awareness was assessed using questions on knowledge while perspective was assessed using questions on prevention of CKD. Having awareness was when at least half of the awareness questions were answered correctly, and a positive perspective was when participants agreed with the perspective statements. Glomerular filtration rate (GFR) was estimated using MDRD equation while chronic kidney disease was defined as decreased glomerular filtration rate below 60mls/min/1.73m^2 and classified into five stages according to KDIGO classification system.

2.4 Ethics

Ethical approval was sought from the Kenyatta University Ethics and Research Committee, National Commission for Science, Technology and Innovation (NACOSTI), the County government of Kiambu and the hospital management board of Gatundu Level 5 Hospital. The researcher ensured that all participants voluntarily signed the consent. The researcher abided with the Ministry of Health regulations on Covid 19 control such as hand washing, keeping social distance and wearing of mask. The purpose and protocol of this study was explained to participants and written informed consent was obtained from each patient. The privacy of personal information was protected and kept confidential. Codes were used for patient identification instead of names. Patients with abnormal findings were informed and referred to physicians for further investigation and appropriate management.

2.5 Data Analysis

Data was checked for completeness, grouped, then entered to Windows Excel sheet, and exported to SPSS version 27 for analysis. Descriptive statistics like percentage and mean and standard deviation were used to present socio-demographic and clinical characteristics of participants. Bivariate logistic regression was used to assess the association between independent variables and CKD and variables with p-value ≤0.05were considered for multivariate logistic regression.

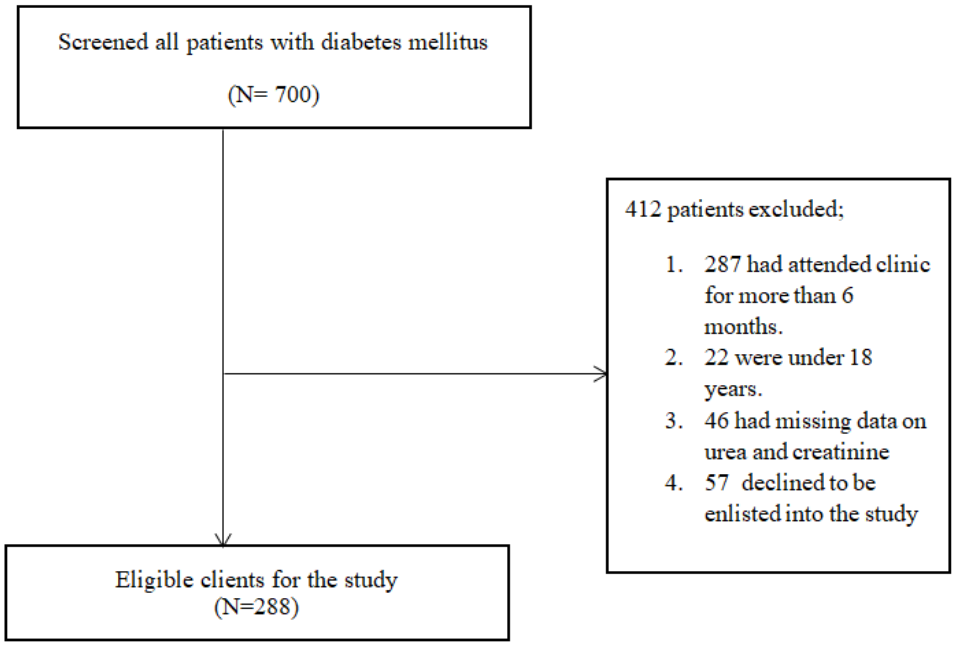

Figure 1: Study Flow Chart on the Selection of Eligible Patients

3. RESULTS

3.1 Socio-demographic Factors

A total of 152 diabetes mellitus patients were included in the study, of which 95 (62.5%) of the participants were females with mean age of 56.91 (±17.65) years. Majority of the study participants 118 (77.6%) were married, 96 (63.2%) were rural dwellers, and 57 (37.7%) were educated at least up to secondary school level. Other socio-demographic factors are as displayed (Table 1).

Table 1: Socio-Demographic Factors

Characteristics	Number	Percent	CKD	
			YES, 152 (%)	NO, 152(%)
Age (years)				
18 – 29	4	2.7	0	4 (2.7%)
30-49	22	14.5	15(10.3%)	5(3.5%)
50-60	66	43.4	47(30.9%)	24(16.4%)
>60	60	39.5	35(24%)	22(15.1%)
Sex				
Male	57	37.5	17	36(24.7%)
Female	95	62.5	44(28.9%)	55(37.7%)
Marital status				
Single	3	2.0	5(3.2%)	2 (1.3%)
Married	118	77.6	0	3(2.1)
Separated	24	15.8	48(31%)	71(48.6%)
Divorced	7	4.6	10(6.8%)	13(8.9%)
Educational level				
No education	19	12.5		
Primary School	43	28.5		
Secondary school	57	37.7		
College and above	33	21,9		
Residence				
Urban	56	36.8		
Rural	96	63.2		

3.2 Determinants of CKD

In regard to patient characteristics, the bivariate logistic regression identified 13 candidate possible determinants with a p value <0.05 including, alcohol consumption (p value 0.001), period lived with diabetes (p value, 0.002), family history of kidney disease, (p value 0.002), level of education (p value, 0.002), place of residence (p value 0.003), body mass index (p value 0.003), marital status (p value 0.005), sex (p value 0.009), serum urea levels (p value 0.016),

smoking (p value 0.12), age (p value 0.23) history of hypertension (p value 0.72), lack of physical exercises (p value 0.080) (Table 2).

The multi variate logistic regression identified 6 independent significant determinants of CKD. (i) History of high blood pressure (AOR;1.294, 95%CI, 2.401-.698). (ii) Lack of physical activities (AOR 1.233, 95% CL,1.889-.805) (iii) High serum urea levels, >7.1mmol/l, (AOR 1.054, 1.766-.629). (iv) Positive family history of kidney disease had a (AOR .9981, 95% CI .534-.649). (v) Rural residence (95%CI, .968(1.492-.628) (vi) low levels of education, (AOR .960, 95%CI, .082-.069) (Table 2).

Table 2: Determinants Associated With CKD among Diabetes Mellitus Patients

Variable	CKD		Bivariate Analysis		Multivariate analysis	
	YES, 146(%)	NO, 146(%)	COR (95%CL)	P value	AOR (95%CL)	P value
Sex						
Male	17(11.6%)	36(24.7%)	.683(1.390-.336)	.009	.785(1.246-.495)	.002
Female	38(26%)	55(37.7%)				
Age						
18-29	0	4(2.7%)	.298(.040-.030)	.026	.022(.049-.039)	.044
30-49	15(10.3%)	5(3.5%)				
50-60	41(28.1%)	24(16.4%)				
>60	35(24%)	22(15.1%)				
Marital status						
Married	0	3(2.1%)	.402(.442-.417)	.005	.443(.590-.564)	.005
Separated	42(28.8%)	71(48.6%)				
Divorced	10(6.8%)	13(8.9%)				
Education level						
No education	12(8.2%)	6(4.1%)	.057(.066-.054)	.002	.960(.082-.069)	.002
Primary level	23(15.8%)	19(13%)				
Secondary level	40(27.4%)	13(4.9%)				
College and above	13(4.9%)	16(11%)				
Residence						
Urban	59(40.4%)	35(24%)	.949(1.907-.472)	.003	.968(1.492-.628)	.003
Rural	20(13.7%)	32(21.9%)				
Family history of kidney disease						
Yes	54(37%)	32(21.9%)	.997(1.978-.502)	.002	.998(1.534-.649)	.002
No	37(25.3%)	22(15.1%)				
History of hypertension						
Yes	71(48.6%)	47(32.2%)	1.489(3.703-.599)	.072	1.294(2.401-.698)	.072
No	18(12.3%)	8(5.5%)				
BMI (Kg/m^2)						
Underweight (<18.5)	23(15.8%)	11(7.5%)	.754(.7245-.535)	.003	.234(1.245-.353)	.004
Healthy weight (18.5-24.9)	46(31.5%)	26(17.8%)				
Overweight (25-30)	20(13.7%)	17(11.6%)				
Obese (>30)	89(61%)	54(37%)				

3.4 Awareness of Chronic Kidney Disease

About 90 (58.9%) of the participants aware about the functions of the kidney, 57.5% (n= 87) were aware of the tests used to determine kidney health, 87 (57.5%) were aware of the risk factors for CKD, and 115 (75.8%) of the participants were not aware of the signs and symptoms of CKD (Table 3).

Table 3: Level of Awareness on CKD

Functions of The Kidney	True	False
The kidneys make urine.	85.5%	14.5%
The kidneys clean blood.	54.6%	45.4%
The kidneys help to normalize blood pressure.	50.7%	49.3%
The kidneys help to make blood	51.0%	49.0%
The kidneys help to keep the bones healthy.	52.6%	47.4%
Tests For Kidney Health		
A blood test	66.0%	34.0%
A urine test	49.0%	51.0%
Risk Factors Associated with Kidney Disease		

Having Diabetes	96.0%	4.0%
Having a positive family history of chronic kidney disease	82.8%	17.2%
Smoking of cigarettes	19.2%	80.8%
Lack of exercises	64.9%	35.1%
Being overweight	37.7%	62.3%
Having hypertension	55.0%	45.0%
Old age (being over 65 years)	46.8%	53.2%
Signs and Symptom of CKD		
Water retention (excess water in the body)	10.0%	90.0%
Nausea and vomiting	26.0%	74.0%
Loss of appetite	32.7%	67.3%
Increased fatigue (tiredness)	28.0%	72.0%
Complications of CKD		
Anaemia	88.0%	12.0%
Bone diseases	70.0%	30.0%
Heart diseases	71.3%	28.7%
Hypertension	76.0%	24.0%
Measures To Prevent CKD		
Put measures to prevent getting Diabetes	85.3%	14.7%
Put measures to prevent getting hypertension.	76.7%	23.3%
Avoid smoking of cigarettes	72.7%	27.3%
Engage in exercises at least 3 times a week	70.0%	30.0%
Avoid being overweight	76.7%	23.3%
Avoid having hypertension	69.3%	30.7%

3.5 Perspective on prevention of CKD.

The respondents had a positive perspective regarding prevention of CKD as the standard deviation was larger than 3.4 and less than 4.4, which indicate that most participants concurred with the different claims made about perspectives of diabetes mellitus patients on chronic kidney disease. Furthermore, the standard deviation numbers were less than 2, which is a modest standard deviation and shows that participants had identical viewpoints on the survey's objective. The findings revealed that participants agreed that kidney disease is a problem among persons with Diabetes Mellitus (M=3.9375, SD=1.37283), kidney disease among diabetic patients can be avoided (M=3.8275, SD=1.31393), it is important to know one's kidney status (M=3.8275, SD=1.31393), knowing the status of my kidneys will be beneficial to me (M=3.8000, SD=1.18642), knowing the status of my kidneys will make me less stressful (M=3.7875, SD=1.10801) kidney disease is a threat to persons with diabetes mellitus (M=3.9125, SD=1.19274), kidney disease can affect my life negatively (M=3.9250, SD=1.07650). The findings also revealed that persons with diabetes mellitus should be checked for kidney disease (M=3.5000, SD=1.13182), Persons with Diabetes Mellitus should control their blood sugars to avoid kidney disease (M=3.6375, SD=1.02924) and Persons with Diabetes Mellitus should take their medications as advised to avoid kidney disease (M=3.8732, SD=1.33671) (Table 4).

Table 4: Perspectives of Diabetes Mellitus patients on The Prevalence of Chronic Kidney Disease

	n	**Mean**	**Std. Deviation**
Kidney disease is a problem among persons with Diabetes Mellitus	**152**	**3.9375**	**1.37283**
Kidney disease among diabetic patients can be avoided	**152**	**3.8275**	**1.31393**
It is important to know ones kidney status	**152**	**3.6250**	**1.26666**
Knowing the status of my kidneys will be beneficial to me	**152**	**3.8000**	**1.18642**
Knowing the status of my kidneys will make me less stressful	**152**	**3.7875**	**1.10801**
Kidney disease is a threat to persons with diabetes mellitus	**152**	**3.9125**	**1.19274**
Kidney disease can affect my life negatively	**151**	**3.9250**	**1.07650**
Persons with diabetes mellitus should be checked for kidney disease	**152**	**3.5000**	**1.13182**
Persons with Diabetes Mellitus should control their blood sugars to avoid kidney disease	**152**	**3.6375**	**1.02924**
Persons with Diabetes Mellitus should take their medications as advised to avoid kidney disease	**152**	**3.8732**	**1.33671**

3.6 Prevalence of CKD among Diabetic patients

The estimated mean eGFR by the modification of diet in renal disease (MDRD) equation for was 44.3±16.7mL/min/1.73 m^2. The overall unadjusted prevalence of CKD (eGFR <60mls/min/1.73m^2) was 78.2%. The estimated mean eGFR by the modification of diet in renal disease (MDRD) formula was 78.5±26.7mL/min/1.73 m^2.

The overall unadjusted prevalence of CKD was observed to be particularly high in females (80%) than in males (75.4%) (Table 7) for the overall unadjusted prevalence of CKD) (Table 5).

Table 5: Prevalence of CKD

CKD Staging	eGFR	Male	Female	Total
Stage 1	>90mls/min	14	19	33
Stage 2	60-89 mls/min	21	38	59
Stage 3	30-59 mls/min	15	28	43
Stage 4	15-29 mls/	7	10	17
Mean eGFR (mls/min/1.73$m^{2)}$	78.2	75.4	80	

4. DISCUSSION

In our study we assessed the determinants of chronic kidney disease among diabetes mellitus patients and also assess their awareness, perspectives and prevalence of CKD. The study revealed that high blood pressure was an independent predictor of CKD, this is supported by previous reports where high blood pressure was associated with high risk of CKD and where 83% of participants had high blood pressure [5]. It was also in line with earlier findings, where high blood pressure was found to be a risk factor leading to high intra glomerular pressure, causing impaired glomerular filtration, microalbuminuria, or proteinuria, However, the same study did not find any statistical association between hypertension and occurrence of CKD [3].

Most of the respondents, (57.8%), in this study do not engage in regular exercise implying that most patients do not like exercising an act which plays an imperative role in prevalence of high blood pressure and BMI and CKD a scenario that relates positively with a period analysis by Barletta in 2018 [5]. Also a study in China revealed that a large number of participants, 64.3% who did not engage in physical exercises had CKD [6], a study by Zhang reported a different scenario where only 32.9% of the participants who did not exercise had CKD [8].

On serum urea levels (BUN), most patients (46.7%) had high BUN level ranging between 8 and 10mmol/l, this is however lower than what was reported in Ethiopia where participants had serum urea levels of 26.6mmol/l on average [7]. Another study conducted in rural china reported an even lower serum urea levels of 5.75mmol/l [6].

Having a positive family history of kidney disease was significantly associated with CKD, as participants with such had a 99.8% (AOR .9981, 95% CI 534-.649) risk of having CKD more than those who did not have a family history of kidney disease. The results are supported by a study in Northern Ireland which reported a three times increased risk for CKD to persons with a family history of kidney disease [10], however, a study in Iran reported only 28.6% of participants with a family history of kidney disease having CKD [9].

When comparing less educated persons to more educated people, the data demonstrated that more educated persons are less likely to suffer CKD. This might be related to the difference in the level of awareness between the two groups that reported an inverse link between college attendance and the chance of developing CKD [12].

This study revealed a 96.8% (95%CI, .968(1.492-.628) chance of getting CKD for those living in rural area than living in an urban area, this corresponds with results from a study done in Iran in which 73.4% of the participants living in rural area had CKD, however, a study in Panama gave a different finding as it reported a merger 28.6% of rural residence with CKD [13].

Regarding level of education, this study found out that those with low levels of education, not beyond secondary level, had a 96% (AOR .96, 95CI.082-.069) risk of having CKD than those that had high levels of education, this goes in line with a report by Duan in China in which he reported that 67.5% of participants with CKD had attended below primary school education [6], however in Iran it was reported that only 42.6%of participants were illiterate [9].

Overall general awareness about CKD was low with only 25.8%% of the participants having average knowledge which was similar with low awareness level reported from a community study in Tanzania and Nigeria where only 27% of study participants had good knowledge [11, 12], but lower than that report from Jordan where 50% of the participants scored >80%.

This difference might be due to difference in health literacy of the study population or in number and type of questions used to assess patients' knowledge.

Overall perspectives on prevention of CKD was high as most 116 (76.9%) concurred with the different claims made about perspectives of diabetes mellitus patients on the risks of chronic kidney disease. The study found that most (87.3%) patients agreed that kidney disease is a problem among persons with Diabetes Mellitus and kidney disease among diabetic patients can be avoided (87.9%); this was in agreement with report from Fiji which found 63.6% of the participants had positive attitude towards prevention of CKD and another one from rural Tanzania which reported a 100% willingness to seek medical help among diabetic patients [15, 11].

The prevalence of chronic kidney disease was found to be 78.2% (n= 119, 95% CI), which was higher than previous reports by jikantree[4] which was 61.3% and Ethiopia [9], which reported 26% prevalence rate. These discrepancies might be due to difference in the study setting difference and the large sample size used in the previous studies [4, 9].

Study Limitations

The study used cross-sectional study design in which cause and effect relationship between risk factors and the outcome cannot be determined while a single measurement of serum creatinine and serum urea was used to define CKD. Despite these limitations, the finding of this study can be used as input for researchers and healthcare providers because as to our knowledge there was no prior study assessing patient awareness of CKD and risk factors among patients with diabetes mellitus in the country; it will greatly contribute to increasing awareness of chronic kidney disease and its risk factors.

5. CONCLUSION

Our study found out a high prevalence rate of chronic kidney disease with low awareness coupled with positive perspectives towards prevention of CKD. The researcher also found out that high blood pressure, lack of physical exercises, high levels of urea, positive family history of kidney disease, rural residence, low levels of education, were independent predictors for chronic kidney disease. Our study delivers previously unrecognized data on the prevalence of CKD among diabetic mellitus patients in a suburban community.

Due to rapid urbanization and the increase in the elderly population, our findings support the well-recognized fact that routine surveillance is essential to prevent the development of chronic kidney disease in order to decrease the healthcare burden and costs-related to renal replacement therapy treatment. This study may also contribute to improved diabetes care management by the early identification and targeting of diabetic patients who are at high risk of developing CKD. Further studies are needed to assess the utility of integrating the clinical predictive factors of CKD among diabetic patients as a part of routine diabetes care and call for strategic goals and actions upon their recognition to reduce the CKD incidence or slow CKD progression. Ultimately, long-term holistic healthcare services in a primary care practice should be targeted based on multi-morbidity concepts, particularly in the elderly, to reduce the prevalence of CKD and mitigate the large public health effect of CKD in diabetic patients.

In summary, here we found a relatively high prevalence of CKD among T2DM patients in a suburban community in Kenya, particularly in the female population. Our study also underscores an important opportunity to identify diabetic patients who are at high risk of CKD through readily available and routinely obtained clinical factors in the primary care setting. Early identification may help optimize care and prevention programs for these populations.

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