Prevalence and Associated Factors of Chronic Kidney Disease Among Diabetic and Hypertensive Patients at Ambo Town Public Hospitals of West Shewa Zone, Oromia Region, Ethiopia

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Research Article

Keywords: chronic kidney disease, diabetic, hypertensive

Posted Date: January 13th, 2022

DOI: <https://doi.org/10.21203/rs.3.rs-1189532/v1>

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Abstract

Background: Chronic kidney disease is a global public health important disease that is associated with life threatening outcomes including renal failure and premature mortality unless diagnosed and treated promptly. Diabetes Mellitus and hypertension are the two major causes of chronic kidney disease worldwide. This study is aimed to determine prevalence and associated factors of chronic kidney disease among diabetes mellitus and hypertensive patients at Ambo town public hospitals, Ethiopia

Methods: A cross-sectional study was conducted at Ambo University referral and general hospitals on 308 study participants. The participants were interviewed using interviewer administered questionnaire when they come for follow up at a chronic illness follow-up clinic. The patient charts were reviewed to retrieve information regarding medications, blood pressure, serum Creatinine and glucose level. A chronic kidney disease epidemiology collaboration equation was used to estimate Glomerular filtration rate from serum Creatinine. Data were analyzed SPSS version 23 for statistical analysis. Binary logistic regression analysis was used to identify factors associated with chronic kidney disease. Variables with a p-value below 0.2 at bivariable analysis were entered into the multivariable logistic regression model. Multivariable logistic regression analysis was used to examine the association between dependent and independent variable and p-value less than 0.05 was used to declare statistical significance.

Results: A total of 308 diabetes mellitus and hypertensive patients were included in the study from Ambo town public hospitals. Of which 156 (50.6%) participants were female with mean ($\pm$ SD) age of 47.15 ± 12.06 years. The prevalence of chronic kidney disease (stage 3–5) was 20.5% with (95% CI: 16%-25%). Long duration of hypertension (AOR=4.89, 95% CI=1.93-12.40), elevated systolic blood pressure (≥ 140 mmHG) (AOR=3.20, 95% CI=1.36-7.51), family history (AOR=3.36, 95% CI=1.56-7.24) and age greater than 55 years (AOR=2.17, 95% CI=1.09-4.31) were predictors of chronic kidney disease.

Conclusion: The prevalence of chronic kidney disease was high. Older age, elevated SBP, long duration of hypertension and family history of kidney disease were independent predictors of chronic kidney disease. A preventive plan is mandatory to reduce the disease and complications in the community.

Background

Chronic kidney disease (CKD) is a worldwide public health problem, with undesired outcomes of renal failure and premature death if not diagnosed and treated promptly. CKD is defined as kidney damage or glomerular filtration rate (GFR) <60 ml/min/1.73 m² for 3 months. GFR can be calculated from standardized serum Creatinine and estimating equations, such as the Modification of Diet in Renal Disease (MDRD) Study equation or the Cockcroft-Gault formula. The severity of kidney disease can be classified into five stages according to the level of GFR which is resultant from age, race, sex, and serum Creatinine concentration. On the other hand, End-stage renal disease (ESRD) which is described as an eGFR of <15 ml/min/1.73 m², initiation of maintenance dialysis or receipt of preventive renal transplantation is classified as CKD stage five (1).

CKD is a chronic disease that deteriorates over time. The final stage of CKD is Kidney failure or end-stage renal disease (ESRD) indicating that the kidney has stopped working permanently. The symptoms will not be seen in most cases until the kidneys are severely damaged because CKD typically worsens over time. Once the kidneys are starting to fail, whichever of symptoms like itchy skin, vomiting, nausea, not feeling hungry, too much or inadequate urine, trouble catching breath and trouble sleeping, edema of feet and ankles and muscle cramps will be manifested (2).

To reduce the detrimental effect of CKD, early intervention is crucial which included identifying individuals with higher risk of renal disease. Factors such as race, gender, older age, and family history need due consideration. Additionally, DM, hypertension, smoking and obesity are the risk factors of kidney disease. Particularly, uncontrolled diabetes and/or hypertension can easily and quickly progress to an end stage renal disease (ESRD). Globally, Diabetes mellitus is the principal cause of both ESRD and CKD (5). Screening clinical indicators of renal dysfunction is the best way for the early detection of patients at risk of developing CKD. It is vital to enhance patient's awareness on the importance of life style modification in order to preventing the occurrence of the disease (3) .

The 2016 worldwide report indicated, there were more than 21 million new cases of CKD per year implying an increase of CKD by 88.76%, 276 million prevalent cases showing an increase of CKD by 86.95%, nearly 1.2 million deaths due to CKD indicating an increase of the disease by 98.02% from 1990. The upsurge in burden of CKD due to diabetes and hypertension happened at a much faster rate in third world countries than in developed countries (6). Globally, diabetes was reported among 415 million adult populations, hypertension among 1.4 billion, while 2.1 billion children and adults are overweight or obese. The magnitude of CKD amongst adults having type 2 diabetes is about 25% to 40%, depending on population factors. A prevalence of CKD was reported to be 30% and 70% among hypertension and obese adult of United States, respectively(4).

Africa is a continent where more than 1 billion populations reside. Among this, 961.5 million people live in sub Saharan Africa and 195 million are from Northern Africa. CKD complications impacted global healthcare resources significantly and only a handful of countries have sufficiently robust economies to meet the challenge posed by this disease(5) (8). Chronic kidney disease is a major public health issue globally and a principal predictor of poor health outcomes. In developed nations the burden of CKD is relatively well defined. However fewer studies had indicated greater CKD burden in developing countries(4).

In 2015, CKD is a most important cause of morbidity and mortality in both developed and developing countries, with an estimated 10% of the population worldwide having CKD. Studies have consistently shown that African descendants are at higher risk for CKD occurrence and progression to ESRD. A substantial rise in the number of people affected by CKD in Africa can be explained by the burden of this two problems(6). Factors such as increase in age, type 2 DM, hypertensive patients, poor awareness about the disease, and living with diabetes for longer duration, increased body mass index, and obesity are important contributing factors for the occurrence of CKD over the World. It is important to understand

effect of renal disease on metabolism and safe utilization of medications in order to delay the complication of CKD (7).

Nearly a quarter (13.2%) of sub-Saharan population has CKD while its magnitude among diabetic and hypertensive and patients is 24.7% and 34.5% respectively. The magnitude of CKD is increasing among diabetic and hypertensive patients. Similarly in Ethiopia, the magnitude of chronic kidney disease in hypertensive and diabetic patients ranges from 18.2% to 26% (8).

The burden of CKD and its related risk factors remain understudied in developing countries even if such interventions are available. This would be due to low awareness of the public, health care workers, government and other funders and may lead to the false perception that CKD is not an important problem in sub-Saharan Africa (8).

In Ethiopia, even if different studies have shown that the burden of CKD among diabetes and hypertension is high and treatment options are expensive, their results have varied regarding its prevalence. For example, the prevalence of CKD among diabetes patients is 21.8 and 26% ((9, 10) in Northern and Southwestern part of Ethiopia. Nevertheless, studies reporting prevalence of CKD and risk factors are still insufficient especially in the study area. Efforts to update the prevalence and identify the early risk factors then understanding those risk factors for CKD particularly, among diabetic and hypertensive patients are needed and will be beneficial for developing effective strategies for the prevention and controlling CKD. Therefore, the aim of this study is to assess prevalence and associated factors of CKD among diabetic and hypertensive patients attending at Ambo University referral and general hospitals of West Shewa Zone, Oromia Region, Ethiopia.

Methods

A Hospital based cross-sectional study was conducted at Ambo University referral and general hospitals of West Shewa Zone of Oromia Region, Ethiopia. All diabetic and hypertensive patients aged 18 years and above, enrolled in care for at least 3 months, with at least one visit in 2020 and at least one serum Creatinine result were included in to the study. Patients with a preexisting diagnosis of CKD, less than eighteen years age, incomplete patient chart, pregnant women, and critically ill patients will be excluded from the study.

The sample size was calculated by using both the single and two population proportion formula and the largest is taken. Simple random sampling was used to recruit 308 study participants.

Data collection tool was developed to collect information on socio-demographic, disease condition and other potential associated factors using structured questionnaire by trained health professionals. The tool has socio demographic and risk factors assessing parts. The tool was translated to local language and back translation was done to check consistency. Patient's chart was reviewed for information and results like blood pressure, fast blood sugar, serum Creatinine and urine albumin level. Then Glomerular

filtration rate was calculated using CKD–EPI equation (11) and CKD was defined using eGFR and classified into five stages according to KDIGO classification system(1).

Data were checked for completeness, coded and entered into Epi info version 7.2.2.6 then exported to SPSS version 23 for statistical analysis. Socio-demographic characteristics of the respondents were presented using descriptive statistics like mean, standard deviation, and percentages to summarize the information. Graphs and tables were used to present the finding of the determinants. A bivariable logistic regression analysis was used to examine the determinants of CKD and a p-value below 0.2 was entered into the multivariable logistic regression model. Multivariable logistic regression analysis was used to examine the association between determinant variables of CKD. A p-value of less than 0.05 in multivariable logistic regression analysis was considered as statistical significance that has association with outcome. Both crude and adjusted odds ratios were presented with a 95% confidence interval. Hosmer Leme show goodness-of-fit was used to test for model fitness. Explanatory variables were tested for multi collinearity before entering them into the multivariable model.

Results

Socio-demographic characteristics

A total of 308 diabetic and hypertensive patients were included in the study. Of which 156 (50.6%) participants were female with mean ($\pm$ SD) age of 47.15 ± 12.06 years. The majority, 194(63%) study participants were ≤ 55 years old, 267 (86.7%) were married, 198(64.3%) were urban dwellers and 118(38.3%) were educated up to elementary level (Table1).

Table 1
Socio-demographic characteristics of diabetic and hypertensive patients at
Ambo two public hospitals of West Shewa Zone, Oromia Region, Ethiopia,
2021

Variable	Category	Frequency	Percent
Gender	Male	152	49.4
	Female	156	50.6
Age	≤55	194	63.0
	>55	114	37.0
Educational status	No education	93	30.2
	Elementary	125	40.6
	High school	47	15.3
	College and above	43	14.0
Occupation	Gov't employee	33	10.7
	Farmer	103	33.4
	Housewife	73	23.7
	Self-employed	99	32.1
Marital status	Single	15	4.9
	Married	267	86.7
	Widowed	26	8.4
Religion	Orthodox	214	69.5
	Protestant	64	20.8
	Muslim	18	5.8
	Others	12	3.9
Average Monthly income	<1000	203	65.9
	1001-2099	73	23.7
	≥3000	32	10.4
Residence	Urban	198	64.3
	Rural	110	35.7

Clinical and behavioral characteristics of diabetic and hypertensive patients

Among the study participants, 199(64.6%) had greater than 140 SBP and 192(62.3%) had DBP. Alcohol consumption habit and family history of CKD was found reported by 68(22.1%) and 49(15.9%) study participants respectively. The majority 276(89.6%) of the study participants had body mass index of 18.5 to 24.9 and 296 (96.1%) had no history of smoking (Table2).

Table 2
Behavioral and clinical characteristics of diabetic and hypertensive patients at public hospitals
West Shewa Zone of Oromia Region, Ethiopia, 2021

Characteristics		Number	Percent (%)
Systolic pressure	<140	109	35.4
	≥140	199	64.6
Diastolic pressure	<90	116	37.7
	≥90	192	62.3
Fasting blood sugar	<150	198	64.3
	≥150	110	35.7
Urine albumin	Positive	25	8.1
	Negative	283	91.9
Body Mass Index	Underweight (<18.5)	9	2.9
	Healthy weight (18.5-24.9)	276	89.6
	Overweight (25-29.9)	16	5.2
	Obese (≥30)	7	2.3
Knowledge about kidney disease	Good knowledge	127	41.2
	Poor knowledge	181	58.8
Family history of kidney disease	Yes	49	15.9
	No	259	84.1
Alcohol consumption	Yes	68	22.1
	No	240	77.9
Smoking habit	Smoker	12	3.9
	Never smoker	296	96.1
Duration of hypertension (years)	≤5	125	40.6
	6-10	103	33.4
	>10	80	26.0
Duration of diabetes mellitus (years)	≤5	142	46.1
	6-10	119	38.6
	>10	42	15.3

Characteristics		Number	Percent (%)
Creatinine	Mg/dl	1.06	0.7
Non-Steroidal Anti-Inflammatory Drugs	Yes	50	16.2
	No	258	83.8
CVD	Yes	19	6.2
	No	289	93.8

Magnitude and stages of chronic kidney disease

The proportions of the study participants with CKD based on Kidney Disease Improving Global Outcomes (KDIGO) stages (by eGFR) were: G1 61%, G2 18.5%, G3a 14.3% and G3b 3.2% and G4 2.9%. Sixty three of study patients had eGFR< 60 ml/min/1.73m². The overall prevalence of CKD (stage 3–5) was 20.5% with (95% CI: 16% - 25%). No participants were found to be at G5 (kidney failure) (Table3).

Table 3

Prevalence and stages of CKD among diabetic and hypertensive patients at Ambo town public hospitals of West Shewa Zone, Oromia Region, Ethiopia, 2021

Stage of CKD	Description	eGFR (ml/min/1.73m ²)	Number (%)
G1	Normal or high	≥90	188(61.0)
G2	Mildly decreased	60-89	57(18.5)
G3a	Mildly to moderately decreased	45-59	44(14.3)
G3b	Moderately to severely decreased	30-44	10(3.2)
G4	Severely decreased	15-29	9(2.9)
Total			308(100)

Factors associated with Chronic Kidney Disease

Long duration of hypertension and diabetes mellitus, gender, poor kidney disease knowledge, elevated systolic and diastolic blood pressure, age greater than 55 years and family history of kidney disease were associated significantly with chronic kidney disease during bivariate analysis. Then multivariable logistic regression analysis was used to identify independent predictors for chronic kidney disease and to declare statistical significance at p-value less than 0.05. Accordingly, patients more than 10 years of hypertension diagnosis is 4.89 times (AOR=4.89; 95%CI: 1.93, 12.40; P<0.001) more likely to develop CKD as compared to hypertensive patients of 10 years and below. Odds of developing CKD among study participants who have had a family history of CKD were of 3.36 (AOR=3.36; 95%CI: 1.56,7.24; P<0.002) as compared to

their counterparts. Similarly, the odds of developing CKD among individuals who had ≥ 140 mmHg SBP was 3.2 times higher (AOR=3.20; 95%CI: 1.36, 7.51; $P<0.008$) compared to those who had less than 140mmHg systolic blood pressure. On the other hand, study participants who were aged above 55 years are 2.17 times (AOR=2.17; 95%CI: 1.09,4.31; $P<0.026$) more likely to develop CKD as compared to those 55 and below years of age. Generally, the Hosmer-Leme show goodness of-fit was used to test for model fitness in this data analysis. Accordingly, the p-value result of Hosmer-Leme show test produced is 0.48 which indicates as the fitted model is correctly specified for analysis in this study (Table 4).

Table 4

Factors associated with CKD among diabetic and hypertensive patients at Ambo town public hospitals of West Shewa Zone, Oromia Region, Ethiopia, 2021.

Variables	CKD status		COR(95%CI)	P-value	AOR(95%CI)	P-value
	Yes N (%)	No N (%)				
Age (Years)	25(8.1)	169(54.9)	1	0.000	2.17(1.09-4.31)	0.026
≤55	38(12.3)	76(24.7)	3.38(1.90-5.99)			
>55			1			
Sex	37(12.0)	115(37.3)	1.61(0.92-2.82)	0.097	1.18(0.61-2.31)	0.623
Male	26(8.4)	130(42.2)	1			
Female			1			
Residence	37(12.0)	161(52.3)	1	0.303		
Urban	26(8.4)	84(27.3)	1.35(0.76-2.37)			
Rural			1			
Systolic BP	10(3.2)	99(32.1)	1	0.001	3.20(1.36-7.51)	0.008
<140	53(17.2)	146(47.4)	3.59(1.75-7.40)			
≥140			1			
Diastolic BP	15(4.9)	101(32.8)	1	0.012	1.59(0.73-3.44)	0.240
<90	48(15.6)	144(46.8)	2.24(1.19-4.23)			
≥90			1			
Fasting blood sugar	44(14.3)	154(50.0)	1.37(0.75-2.49)	0.303		
<150	19(6.2)	91(29.5)	1			
≥150			1			
Family history	43(14.0)	216(70.1)	3.46(1.79-6.68)	0.000	3.36(1.56-7.24)	0.002
Yes	20(6.5)	29(9.4)	1			
No			1			
Duration of HTN	14(4.5)	111(36.0)	1	0.178	1.77(0.67-4.68)	0.249
≤5	18(5.8)	85(27.6)	1.68(0.79-3.57)	0.000	4.89(1.93-12.40)	0.001
6-10	31(10.1)	49(15.9)	5.02(2.45-10.25)			
>10			1			

Variables	CKD status		COR(95%CI)	P-value	AOR(95%CI)	P-value
	Yes N (%)	No N (%)				
Duration of DM	23(7.5)	119(38.6)	1	0.626	0.78(0.32-1.89)	0.590
<5	22(7.1)	97(31.5)	1.17(0.62-2.23)	0.002	1.49(0.56-3.96)	0.428
6-10	18(5.8)	29(9.4)	3.21(1.53-6.72)			
>10						
Alcohol consumption	47(15.3)	193(62.7)	1.26(0.66-2.41)	0.477		
Yes	16(5.2)	52(16.9)	1			
No						
CKD knowledge	16(5.2)	111(36.0)	1	0.005	1.98(0.96-4.07)	0.063
Good	47(15.3)	134(43.5)	2.43(1.31-4.53)			
Poor						

Discussion

In this study we assessed the prevalence and risk factors of CKD among diabetic and hypertensive patients at Ambo town public hospitals using an estimated glomerular filtration rate (eGFR). The prevalence of chronic kidney disease was found to be 20.5% (95% CI: 16%-25%) which was in line with the study conducted in University of Gondar Hospital, Ethiopia which was 20.8%(9) and lower than reports from Jimma University hospita(10). According to survey result from previous reports in two Dutch primary health care centers, it was 27.5% among diabetics and 21.1% in hypertensive (12). However, higher than the prevalence reported from Spain which was 18% (13). These variations might be due to differences in the study population, study setting, sample size and stages of CKD they used to estimate the prevalence. The prevalence of the current study estimated from patients with eGFR <60mL/min/1.73m² due to CKD is defined as kidney damage or glomerular filtration rate with <60 mL/min/1.73 m² according to KDOQI definition and classification(1). However, prevalence in some studies estimated at eGFR <90mL/min/1.73m² and different age category among either diabetic or hypertensive.

Age was significantly associated with chronic kidney disease in this study and it is consistent with most findings (9, 11, 14, 15). However, study conducted at Jimma has reported no association between older age and CKD(10). This might be due to small sample size used in that study. Among the elderly population, more than one-half of the subjects screened had CKD stages 3-5 (GFR<60 ml/min/1.73m²) according to the National Kidney Foundation Kidney Disease Outcomes Quality Initiative (K/DOQI)

guidelines(3). Thus, the increment in age is more prone to develop CKD in population with diabetes and hypertension than general population.

Systolic blood pressure ≥ 140 mmHg was also found to be an independent factor to develop CKD. This finding was supported by study findings of cross-sectional study conducted in Jimma hospital of Oromia Region, Ethiopia in 2019(10). It was also in agreement with other study conducted at Gondar hospital, in which elevated SBP was independently associated with CKD(9). If people with diabetes keep their blood sugar and blood pressure levels within safe limits, their risk of getting CKD can be reduced by 33%-40% (2).

Long duration of hypertension (>10 years) was identified as independent predictor to increase the risk of CKD. Living with hypertension increases the probability of having kidney disease and this could be explained by the fact that when the disease progress over time, cell function, insulin secretion decreases and this in turn facilitate for advancement of CKD among the patients(16). This finding corresponds with several studies and it was also in line with research conducted in Southern Ethiopia and Jimma Hospital (10, 11). Essential hypertension is generally diagnosed between 25 and 45 years of age but overt kidney dysfunction does not develop unless the patient sustains at least 10 years of uncontrolled hypertension(3).

Additionally, family history of kidney disease was statistical significant predictor of chronic kidney disease in which odds of developing CKD among study participants were increased by factor of 3.36 as compared to absent of CKD family history. This finding is in line with the research conducted among diabetic patients in Butajira hospital, southern Ethiopia(11). This might be due to family members of CKD patients might have a high prevalence of CKD and its risk factors(3).

Even though elevated DBP, long duration of diabetes mellitus and poor knowledge of kidney disease were associated with bivariate logistic regression, they did not exhibit significant association at the final multivariable logistic regression analysis. Other factors like place of residence, sex, marital status, body mass index, physical activity, alcohol consumption habit and CVD were not significantly associated with CKD unlike other studies. This variation might be due to small sample size, difference in study area etc. Cardiovascular disease (CVD) is the primary cause of morbidity and mortality where CKD is regarded as an accelerator of CVD risk and an independent risk factor for CVD events(17).

This study was intended to assess the prevalence and factors of CKD among patients with diabetes and hypertension with additional lab methods on both serum Creatinine assessments (to estimate GFR). However, urine dipstick could not grade level of albuminuria since semi-quantitative urine albumin was measured. The methodological parts need particular attention due to this study is limited by its cross-sectional study design in which temporal relationship between risk factors and the outcome cannot be determined.

Conclusion

This study showed that the magnitude of CKD high. Older age, elevated SBP, long duration of hypertension and family history of kidney disease were found to be independent predictors for chronic kidney disease. Early detection and appropriate treatment, Awareness creation, and comprehensive preventive activity should be carried out at all levels to reduce CKD and its complications

Abbreviations

ACEI=Angiotensin-converting enzyme inhibitor, ARB =Angiotensin Receptor Blocker, BP = Blood Pressure, BMI=Body Mass Index, CKD=Chronic Kidney Disease, DM=Diabetes Mellitus, DBP=Diastolic Blood Pressure, EFETP=Ethiopian Field Epidemiology Training Program, ESRD=End-Stage Renal Disease, FBS=Fast Blood Sugar, GFR=Glomerular Filtration Rate, KEEP=Kidney Early Evaluation Program, MDRD=Modification of Diet in Renal Disease, SBP=Systolic Blood Pressure, SPHMMC=Saint Paul's Hospital Millennium Medical College.

Declarations

Ethics approval and consent to participate

The study protocol was submitted to and approved by Institutional review board of Saint Paul's Hospital Millennium Medical College. All methods were carried out in accordance with relevant guidelines and regulations. Written informed consent was secured from all the study participants and since all the study participants were above the age of 16 years. LARs of illiterate participants provided informed consent for the study.

Consent for publication

Not applicable.

Availability of data and materials

All data generated or analysed during this study are included in this published article [and its supplementary information files].

Competing interests

The authors declare that they have no competing interests.

Funding

This research work was supported by Saint Paul's Hospital Millennium Medical College.

Author's contributions

BD was involved in study conception, data analysis, drafting the manuscript. HE, JW and BG were involved in the advising, critically revising, and editing the manuscript for intellectual content. All authors have read and approved the manuscript.

Acknowledgement

Authors would like to thanks public health department of SPHMMC, Ambo University referral and general hospitals staffs for their technical support and program related issues. Additionally, we would like to express our appreciation for study participants for their willingness to give required information. Finally, we thank Saint Paul's hospital millennium medical college for the financial support to conduct this research.

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