



# Risk Factors of Chronic Kidney Disease Among Patients Attending at Dessie Comprehensive Specialized Hospital, Dessie, Amhara Region, Northeastern Ethiopia: Unmatched Case–Control Study

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## Research Article

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## Abstract

**Introduction:** The incidence of chronic kidney disease is rise, primarily due to its asymptomatic natures of the disease and poor access to early detection and management services. In Ethiopia, little is known about the context-specific risk factors. This study aimed to identify the risk factors of chronic kidney diseases in Northeast Ethiopia, focusing on patients attending Dessie Comprehensive Specialized Hospital, 2022.

**Methods:** A hospital-based unmatched case-control study was employed among chronic kidney diseases patients at Dessie Comprehensive Specialized Hospital, from May 10 to July 15/2022. Cases were all patients who were diagnosed with chronic kidney diseases at Dessie Comprehensive Specialized Hospital while controls were patients without chronic kidney diseases. For each case, two controls were selected using a systematic random sampling technique. A semi-structured interviewer-administered questionnaire with the support of a document review was used to collect the data. The data were entered into Epi data version 4.6 and exported to Stata version 14 software for analysis. During bivariable logistic regression analysis, variables having p-value <0.2 were entered and analyzed by multivariable logistic regression analysis to identify risk factors associated with chronic kidney diseases. Statistical differences were considered at  $P < 0.05$ , and the strength of association was assessed by adjusted odds ratio and respective confidence intervals.

**Results:** A total of 78 cases and 156 controls were included in this study. This study revealed that factors such as being male [AOR: 2.54, 95%CI (1.125- 5.754)], the presence of hypertension [AOR: 5.33, 95%CI (2.107-13.489)], diabetic-mellitus [AOR: 3.64,95%CI (1.530- 8.671)], kidney stone [AOR: 3.91,95%CI (1.492-10.257)], and underground water source usage [AOR:

2.63,95%CI (1.108-6.262] were statistically significantly associated factors with chronic kidney diseases.

**Conclusion:** In our study, being male, the presence of hypertension, diabetic mellitus, diagnosis with a kidney stone, and underground water usage were an independent risk factors of chronic kidney diseases. Therefore, policy-makers, health care providers, and other stakeholders should emphasize the aforementioned factors to forestall the development and progression of the disease. Furthermore, routine urinalysis and glomerular filtration rate for all hospitalized patients with hypertension and diabetes-mellitus could help to detect chronic kidney diseases at an early stage.

**Keywords:** Chronic Kidney Disease; Risk Factors; Unmatched Case-Control Study; Dessie; Ethiopia

**Abbreviations:** COR: Crude Odds Ratio; AOR: Adjusted Odds Ratio; UTI: Urinary Tract Infection; CKD: Chronic Kidney Disease; CKDEPI: Chronic Kidney Disease Epidemiology Collaboration; CVD: Cardiovascular Disease; GFR: Glomerular Filtration Rate; NCD: Non-Communicable Disease; ESRD: End-Stage Renal Disease; KDOQI: Kidney Foundation Disease Outcomes Quality Initiative; MDRD: Modification of Diet in Renal Disease; DBP: Diastolic Blood Pressure; OTC: Over-The-Counter Medicine; VIF: Variance Inflation Factor; IRERC: Institutional Research Ethical Review Committee.

## Background

Chronic kidney disease is defined as structural and/or functional abnormalities of the kidney or Glomerular Filtration Rate <60 ml/min/1.73m<sup>2</sup> for more than 3 month [1]. When these structural changes, it becomes conspicuous and results in a decrease in the kidney's ability to process wastes in the blood and perform other functions. During early stages, patients may present with average or slightly decreased Glomerular Filtration Rate and albuminuria [2-6]. According to Kidney Foundation Disease Outcomes Quality Initiative (KDOQI) Chronic kidney disease is divided into five stages from mild kidney dysfunction to complete failure [7]. Generally, a person with stage 3 or 4 of chronic kidney disease (CKD) is considered as having moderate to severe kidney damage. Stage 3 is broken up into two levels of kidney damage: 3A) a level of Glomerular Filtration Rate (GFR) between 45 to 59 ml/min/1.73 m<sup>2</sup>, and 3B) a level of GFR between 30 and 44 ml/min/1.73 m<sup>2</sup>. In addition, GFR for stage 4 is 15-29 ml/min/1.73 m<sup>2</sup> [7,8]. Later, it leads to end-stage renal disease. 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 [9].

A diagnosis of CKD is defined as presence of decreased GFR below 60 mL/min per 1.73m<sup>2</sup>, or GFR above 60 mL/min per 1.73 m<sup>2</sup>, but with markers of renal damage, as determined by the Chronic Kidney Disease Epidemiology

collaboration (CKD-Epi) equation [10] and at least one of the following:

- Contracted kidneys, hypo-echoic kidneys or loss of corticomedullary differentiation on renal imaging.
- Serum phosphate levels above 1.4mmol/l.
- Serum calcium level below 2.2mmol/l.
- History of kidney transplantation.
- History of documented kidney dysfunction for more than 3 months.
- Anemia of chronic disease (normochromic, normocytic, hyper proliferative picture), with a hemoglobin level of <10/dl [11].

Worldwide , the overall prevalence of CKD stages (1-5) ranges from 4.6% up to 15.8% in the general population [12]. The annual incidence rate is reached 8% [13]. Kidney disease is the ninth leading cause of death in the United States [14]. A meta-analysis report in Mexico revealed that between 1990 and 2017, the global standardized mortality rate increased by 41.5%, jumping from 11.4 to 16.1 deaths per 100 000 inhabitants [15]. A meta-analysis report in Africa revealed that Of all the chronic non-communicable diseases, CKD has had one of the most rapid recent increases in Africa and its prevalence ranges from 6.1% up to 16% [16]. The burden of CKD has been increasing In sub-Saharan Africa, the overall prevalence is significantly higher compared to north Africa for CKD stages 1-5 [16]. Nearly a quarter (13.2%) of the sub-Saharan population has CKD [17]. Though the problem is preventable, the prevalence of CKD in our country Ethiopia is increasing in the last few years following an increasing prevalence of diabetes, cardiovascular disease, and hypertension and its prevalence is estimated to be 12.2% [18].

Prior researchers confirmed that age, sex, family history of kidney disease, primary kidney disease, urinary tract infections, cardiovascular disease, hypertension, diabetes mellitus, nephrotoxins (non-steroidal anti-inflammatory drugs, antibiotics), the consumption of energy drinks, drug misuse and adulteration of chemical substances into herbal medicines are Statically significant associated factors of CKD

[14,16,19-22]. Nevertheless, in a study of CKD determinants like chat chewing, HIV AIDS status, sources of water use related variables were not well studied.

To address the CKD problem of Ethiopia sustained efforts from nongovernmental organizations (NGOs), governmental agencies, the pharmaceutical industry, and medical training programs are needed [23]. Even though there are shreds of evidence suggesting the high burden of CKD in Ethiopia it is concealed behind statistics [24]. Moreover, the existing data are hampered by the poor quality that limits inferences. Studies about CKD are almost non-existent and its determinant remain unknown. Further, with the existence of low or no dialysis/kidney replacement infrastructure, strong evidence based prevention interventions are recommended. Hence, in Ethiopia prevention and early detection of CKD to slow its progression are of paramount importance. Therefore, this study aimed to identify the determinants of chronic kidney disease among patients attending in Dessie comprehensive specialized hospital.

## Methods

### Study Setting, Design and Period

The study was conducted in Dessie Comprehensive Specialized Hospital, Dessie town, Amhara region, Northeast Ethiopia. A Hospital-based unmatched Case-control study was conducted during the study period from May 10 to July 15, 2022.

### Sample Size Determination and Sampling Procedure

**Sample Size Determination:** The sample size was calculated by considering the following assumption; 95% confidence level 80% power, 34.3% proportion of hypertension in previous study [25], adjusted odds ratio of 2.39, 10% non-response rate, and 2:1 controls to case ratio. Using unmatched case-control in Epi info version 7.2.2.6 software Stat Calc. Based on the above assumptions the estimated optimal sample size used for this study was 234 (156 controls and 78 cases).

**Sampling Technique and Procedure:** All cases with confirmed CKD disease by urologist and full-filling case selection criteria as indicated from their medical record and at the time of data collection were included in the study until total sample size was obtained. Primarily, patients with CKD in the hospital were small in number, thus all the available cases were considered to be included in the study. Controls were selected by a systematic random sampling method to get the required sample of controls. The average estimated total urological cases without including CKD in the total study

period using average weekly urological patient flows of May 2022 was 333 and K<sup>th</sup> interval from  $N/n = 333/156 = 2.13 \sim 2$ . Controls were selected by every 2 intervals and the first study subject of control was determined daily and selected by lottery method using medical record number of patients. On daily base control were selected proportionally for cases based on control to case ratio until the required numbers of cases were obtained.

### Study Variables

- Dependent Variable: Chronic Kidney Diseases (Yes/No)
- Independent variable: Socio-demographic characters like age of patients, sex, place of residence, educational level, occupation, and income
- Comorbidities like diabetes mellitus, hypertension, CVD, HIV/AIDS, kidney stone, recurrent urinary tract infection, family history of chronic kidney diseases, history of burn, anemia
- Behavioral and lifestyle factors like Smoking, Alcohol drinking, Chat chewing, physical exercise, consumption of unhealthy drinks and diet, Consumption of over the counter medications.

### Operational Definitions

Chronic kidney disease (CKD): is defined as structural/functional abnormalities of the kidney or decreased GFR  $<60 \text{ ml/min/1.73 m}^2$  for more than 3 months [17]. According to Kidney Foundation Disease Outcomes Quality Initiative (KDOQI) CKD is divided into five stages of kidney damage, from mild kidney dysfunction to complete failure [7]. Generally, a person with stage 1 (GFR  $>90 \text{ ml/min/1.73 m}^2$ ) considered to be normal, stage 2 (GFR between  $60\text{--}89 \text{ ml/min/1.73 m}^2$ ) which is mild, additionally CKD is considered as having moderate to severe kidney damage. Stage 3 is further broken up into two levels of kidney damage: 3A) a level of GFR between  $45\text{--}59 \text{ ml/min/1.73 m}^2$ , and 3B) a level of GFR between  $30\text{--}44 \text{ ml/min/1.73 m}^2$ . In addition, GFR for stage 4 is  $15\text{--}29 \text{ ml/min/1.73 m}^2$  [7,8] later, it leads to end-stage renal disease (ESRD).

End-stage renal disease (ESRD): kidney failure is defined as a GFR  $<15 \text{ mL/min/1.73 m}^2$  or very high albuminuria ( $>300 \text{ mg albumin/24 h}$ ) [12,13]. ESRD is irreversible and fatal unless treated by dialysis or kidney transplant [3-5]. Indicating that the kidney has stopped working permanently.

Glomerular Filtration Rate (GFR): is a measure of how well kidneys are cleaning blood-taking out extra water and waste. Specifically, it estimates how much blood passes through the glomeruli each minute [26]. It is central to the diagnosis and management of Chronic Kidney Disease and accepted as the best overall measure of kidney function.

GFR can be calculated from standardized serum Creatinine and estimating equations, such as the Modification of Diet in Renal Disease (MDRD), Study equation CKD-EPI or the Cockcroft-Gault formula [27]. The severity of kidney disease can be classified into five stages according to the level of GFR which is given as: According to Kidney Foundation Disease Outcomes Quality Initiative (KDOQI).

The CKD-EPI equation, expressed as a single equation, is:  

$$\text{GFR} = 141 * \min(\text{Scr}/\kappa, 1)^\alpha * \max(\text{Scr}/\kappa, 1)^{-1.209} * 0.993^{\text{Age}} * 1.018 [\text{if female}] * 1.159 [\text{if black}]$$
 Scr is serum creatinine (mg/dL),  $\kappa$  is 0.7 for females and 0.9 for males,  $\alpha$  is -0.329 for females and -0.411 for males, min indicates the minimum of Scr/ $\kappa$  or 1, and max indicates the maximum of Scr/ $\kappa$  or 1.

**Diabetic Mellitus:** defined as random blood sugar >200mg/dl or FBS> 126mg/dl and/or self-reported on anti-hyperglycemic medication [28].

**Hypertension:** defined as a systolic (SBP)  $\geq$ 140 mmHg and/or diastolic blood pressure of (DBP)  $\geq$ 90 mmHg or self-reported on anti-hypertension drugs [28].

**Renal replacement therapy:** a therapy that replaces the normal blood-filtering functions of kidneys are used when the kidneys are not working well [29].

**Hemodialysis:** a type of treatment that filters the blood through a machine. It

Removes harmful waste and extra fluids the body no longer needs. Also, hemodialysis helps

Control blood pressure, balance potassium, sodium, calcium, and bicarbonate [30].

**Over-the-counter medicine (OTC):** defined as nonprescription medicine, that can buy without a prescription including NSAID and some other commonly used drugs and herbal medications to treat aches and pains [31].

**Ever chat chewer:** defined as a respondent whoever chewed chat during his lifetime [32].

**Sufficient salt intake:** individuals who take no more than 6g of salt a day (2.4g sodium) which is equivalent to one teaspoon [33].

**Sufficient fat intake:** individuals who take up to 35% of the calories from fat that is equivalent to 97 gram in 2500calories diet [33].

**Sufficient sugar intake:** individual who consume no more than 150 discretionary calories of sugar this is equivalent to 38 g or 9 teaspoons (tsp) of sugar per day for men and no more than 100 discretionary calories of sugar equivalent to 25 g or 6 tsp of sugar per day for women [34].

**Significant alcohol intake:** individuals who take more than 2 standard drinks of alcohol for males and more than 1 per day for females. E.g. 1 standard drink=1 standard bottle of regular beer and the net alcohol content of a standard drink is approximately 10g of ethanol [35].

**Sufficient physical exercise:** Adults doing at least 150–300 min of moderate-intensity aerobic physical activity per week [33].

**Ever smoker:** A person who has ever been a cigarette smoker or cigar smoker [34].

**Underground water:** Are sources of water found beneath the land surface it includes springs and wells [36].

### Data Collection Tools and Procedures

Data were collected using semi-structured interviewer-administered questionnaire with supportive of medical records review to address all important variables using their medical record numbers when they return to outpatient department for checkup. The questionnaire was adapted from different literature and guidelines developed for a similar purpose by a different author.

Two data collectors and one supervisor were recruited and trained on how to collect data and check the completeness of data and training was given by the principal investigator for one day. There were continuous supervision by the principal investigator and trained supervisor.

### Data Quality Control

The questionnaires were originally prepared in English and it was translated to local language (Amharic) for the purpose of data collection and then translated back to English by language experts to ensure its correctness and consistency. Two weeks before commencements of the study, the semi-structured interviewer-administered questionnaires was pre-tested among 5% (4 cases and 8 controls) a total of 12 samples in Kombolcha general Hospital by their local languages to prevent information leakage for the purpose of checking whether questions is clear or not, then after necessary corrections was done for unclear questions based on the pretesting findings. Internal consistency of the data was checked using Cronbach's alpha with value of 0.75.

### Data Management and Statistical Analysis

After the data were checked for completeness and consistency, coded and entered into Epi data version 4.6 software. Finally, the data were exported to and analyzed by STATA version 14 software. Descriptive statistics like frequencies and percentages were calculated to see the distribution of the variable.

To find out risk factors of CKD, first bivariable logistic regression was conducted and variables having a P-value of < 0.2 were entered in multivariable logistic regression analysis to control the possible confounders. Finally, variables in the multivariable logistic regression analysis having a P-value of <0.05 and the corresponding AOR with 95% confidence level was declared as a statistically significantly associated variables with CKD. To check co-linearity between risk factors,



tolerance and variance inflation factor (VIF) were used. The Hosmer–Lemeshow test for the model was checked to assess whether the necessary assumptions for the application of multiple logistic regression are fulfilled or not.

### Ethical Consideration

Ethical clearance was obtained from Institutional Research Ethical Review Committee (IRERC) of Wollo University, College of Medicine and Health sciences ethically approved the study with a letter reference number (CMHS/345/2022 on the date of 23/04/2022). The procedure and purposes of the study were explained to Dessie's comprehensive specialized hospital. A letter of support was then obtained from Dessie comprehensive specialized hospital with a letter reference number (DCSH-2/742/2022 on the date of 03/05/2022). Then permission and support letters were written to the medical ward department. Clients were asked for their consent verbally to confirm their willingness to participate in the study. Before enrolling any of the eligible study participants, the purpose, benefits, and confidential nature of the study were described and discussed with each participant. Confidentiality was ensured by omitting the names of the respondents from the questionnaire. Only those that consented and proved their willingness to take part in the study were enrolled in the study. The importance of medical check-ups, early detection, prompt medical management, nutrition relevance to CKD, and lifestyle modifications were provided by the data collectors during the data collection period.

## Results

### Socio-Demographic Characteristics

A total of 234 study participants (78 cases and 156 controls) were enrolled into the study making the response rate of 99% and 100% respectively. Of which, 26(33.33%) of the cases and 70(44.87%) of the controls were females. The mean age of cases and controls was 52( $\pm$ 14SD) and 47( $\pm$ 17SD) respectively. Twenty-six (33.33%) of the cases and 37 (23.72%) of the controls were above 60 years of age. Forty-two (53.85%) of case and 89 (57.05 %) of controls were live in rural area .Eighteen (23.08 %) of the cases and 28 (17.95 %) of the controls were unable to read and write. Four (5.13%) of the cases and 29(18.59%) of the controls had tertiary and above educational level. In regarding to occupational status 37 (47.44 %) of cases and 58 (37.18%) of controls were self-employed, while 5 (6.41%) of cases and 20(12.82%) of controls were governmental workers. The mean monthly household income in ETB for cases and controls were 2588 and 3490 with standard deviation of  $\pm$  2243 and  $\pm$  2605 respectively See Table 1 for detail.

Characteristics	CKD	
	Cases N (%)	Controls N (%)
<b>Sex</b>		
Male	52(66.67)	86( 55.13)
Female	26(33.33)	70( 44.87)
<b>Age</b>		
18-30	6(7.69)	37( 23.72)
31-40	14( 17.95)	29( 18.59)
41-50	20( 25.64)	29( 18.59)
51-60	12( 15.38)	34( 21.79)
60+	26( 33.33 )	27( 17.31)
<b>Religion</b>		
Orthodox	29( 37.18)	70( 44.87)
Muslim	47( 60.26)	76( 48.72)
Protestant	2( 2.56)	10( 6.41)
<b>Residence</b>		
Urban	36( 46.15)	67( 42.95)
Rural	42( 53.85)	89( 57.05)
<b>Marital status</b>		
Single	3( 3.85)	31( 19.87)
Married	53( 67.95)	79( 50.64)
Divorced	13( 16.67)	20( 12.82)
Widow/widower	9( 11.54)	26( 16.67)
<b>Educational status</b>		
Cannot read and write	18( 23.08)	28( 17.95)
Primary education(1-8)	46( 58.97)	73( 46.79)
Secondary education (9-12)	10( 12.82)	26( 16.67)
Tertiary education (>12)	4( 5.13)	29( 18.59)
<b>Occupational status</b>		
Unemployed	36( 46.15)	78( 50.00)
Self employed	37( 47.44)	58( 37.18)
Governmental worker	5( 6.41)	20( 12.82)
<b>Average monthly income</b>		
<500	2( 2.56)	4( 2.56)
500-1000	32( 41.03)	34( 21.79)
1000+	44( 56.41)	118( 75.64)

Key: Average monthly income in Ethiopian Birr.

**Table 1:** Socio-demographic characteristics of study participants who were attending at Dessie Comprehensive Specialized Hospital, Ethiopia, 2022.

### Comorbidity Related Variables

Among the study participants, 65(83.33%) of cases and 49(31.41%) of controls had anemia. The mean hemoglobin level of participants among cases and controls was 10.2( $\pm$ 2.5SD) and 13.6( $\pm$ 2SD) respectively. The mean creatinine level of study participants among cases and controls was 3.26 and 0.88 with a standard deviation of  $\pm$  2.1 and  $\pm$ 0.5 respectively.

About 52 (66.67%) of cases and 44 (28.21%) of controls had hypertension. Among the participants, 25(48.08%) cases and 21(47.73%) controls had hypertension of fewer than five year duration. Thirty-two (41.03%) of the cases and 24(15.38%) of controls had diabetes mellitus, of which

14 (43.75%) of the case and 14(58.33%) of controls had diabetes mellitus less than five years duration.

About Fifth-nine (75.64%) of cases and 73(46.79%) of controls had cardio-respiratory diseases. Forty-two (53.85%) of cases and 95(60.90%) of controls had a history of burn. More than one-tenth (15.38) of cases and 26(16.67%) of controls live with HIV/AIDS.

Roughly 64(82.05%) of the cases and 78(82.05%) of controls had a history of kidney stones. similarly, this study revealed that about twenty-five (32.05%) of cases and 32(20.51%) of controls had a family history of kidney disease See Table 2 for details.

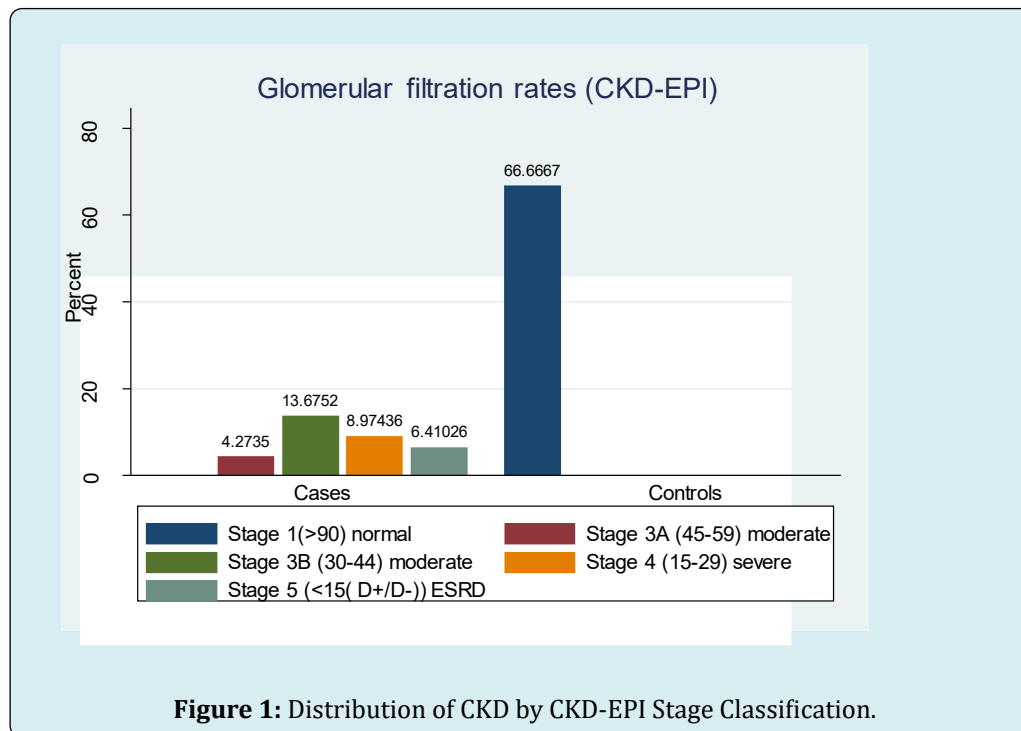
Characteristics	CKD	
	Cases N (%)	Controls N (%)
<b>Anemia</b>		
Yes	65(83.33)	49(31.41)
No	13(16.67)	107(68.59)
<b>Hypertension</b>		
Yes	52(66.67)	44(28.21)
No	26(33.33)	112(71.79)
<b>Durations of HTN</b>		
<5 years	25(48.08)	21 (47.73)
5-10 years	12(23.08)	17(38.64)
>10 years	15(28.85)	6(13.64)
<b>Diabetes mellitus</b>		
Yes	32(41.03)	24(15.38)
No	46(58.97)	132(84.62)
<b>Durations of DM</b>		
<5 years	14(43.75)	14(58.33)
5-10 years	8(25.00)	6(25.00)
>10 years	10(31.25)	4(16.67)
<b>Cardio-respiratory diseases</b>		
Yes	59(75.64)	73(46.79)
No	19(24.36)	83(53.21)
<b>Burn</b>		
Yes	42(53.85)	95(60.90)
No	36(46.15)	61(39.10)
<b>HIV/AIDS</b>		
Yes	12(15.38)	26(16.67)
No	66(84.62)	130(83.33)
<b>Durations of HIV/AIDS</b>		

<5 years	2(16.67)	8(30.77)
5-10 years	2(16.67)	5(19.23)
>10 years	8(66.67)	13(50.00)
<b>Kidney stone</b>		
Yes	64(82.05)	78(50.00)
No	14(17.95)	78(50.00)
<b>Recurrent UTI</b>		
Yes	58(74.36)	90(57.69)
No	20(25.64)	66(42.31)
<b>Family history of kidney disease</b>		
Yes	25(32.05)	32(20.51)
No	53(67.95)	124(79.49)

**Table 2:** Comorbidity related factors of study participants who were attending at Dessie comprehensive specialized hospital, Dessie, North-east of Ethiopia, 2022.

Among 78 cases who participated in this study, 32(13.67%) were in stage 3B (30-44) or had a moderate decrease in glomerular filtration rates. About 21(8.8%) of cases were on stage 4 or had a severe decrease in GFR. Ten

(4.27%) of cases were on stage 3A (45-59) or had a mild to moderate decrease in GFR. About 15(6.4%) of cases reached on end stages of renal diseases (ESRD) or had GFR < 15 with or without dialysis See Figure 1 for detail.



### Life Style And Behavioral Factors

Among interviewed study participants, 26(33.33 %) of cases and 20(12.82 %) of controls had a history of cigarette smoking. About 42(53.85%) of cases and 72(46.15%) of controls had a history of chat chewing. Seventy-five (96.15%)

of cases and 111(71.15 %) of controls consumed high in salt foods, whereas 74(94.87%) of cases and 104(66.67%) of controls consumed high in fat foods. About 37 (47.44%) of cases and 58 (37.18%) of controls had a history of alcohol drinking. About 70(89.74%) of cases and 89(57.05%) of controls used Non-steroid Anti-inflammatory drugs as a

means of controlling pain. Fifty-two (66.67%) of cases and 65(41.67%) of controls consumed or used herbal drugs as

a means of medication See Table 3 for detail.

Characteristics	CKD	
	Cases N(%)	Controls N(%)
<b>Cigarette smoking</b>		
Yes	26(33.33)	20(12.82 )
No	52(66.67)	136(87.18)
<b>Chat chewing</b>		
Yes	42(53.85)	72(46.15)
No	36(46.15)	84(53.85)
<b>Consumption of high in salt foods</b>		
Yes	75(96.15)	111( 71.15)
No	3(3.85)	45(28.85)
<b>Consumption of high in fat foods</b>		
Yes	74(94.87)	104(66.67)
No	4(5.13)	52(33.33)
<b>Alcohol drinking</b>		
Yes	37(47.44)	58(37.18)
No	41(52.56)	98(62.82)
<b>Consumption of high sugar/carbonated drinks</b>		
Yes	68(87.18)	109(69.87)
No	10(12.82)	47(30.13)
<b>Consumption of caffeinated drinks</b>		
Yes	77(98.72)	139(89.10)
No	1(1.28)	17(10.90)
<b>Types of water source use</b>		
Piped water	22(28.21)	82(52.56)
Underground water	34(43.59)	40(25.64)
Bottled water	22(28.21)	34(21.79)
<b>Consumption of NSAID drugs</b>		
Yes	70(89.74)	89(57.05)
No	8(10.26)	67(42.95)
<b>Consumptions of herbal medication</b>		
Yes	52(66.67)	65(41.67)
No	26(33.33)	91(58.33)
<b>Physical activity</b>		
Yes	25(32.05)	56(35.90)
No	53(67.95)	100(64.10)
<b>Duration of physical activity</b>		
<150 min per week	21(84.00)	33(58.93)
150-200 min per week	2(8.00 )	12( 21.43)
>200 min per week	2(8.00)	11( 19.64)

**Table 3:** Life style and behavioral factors of study participants who were attending Dessie comprehensive specialized hospital in Dessie town, Amhara region, North-east of Ethiopia 2022.



### Factors Associated with Chronic Kidney Disease

Chi-square assumption was tested for further analysis and to determine determinants of Chronic Kidney Disease (CKD). Bivariable and multivariable logistic regression analysis were conducted. In bivariable analysis variables with p value <0.2 were selected for multivariable analysis and using average standard error those variables with average standard error of 2.0 and above were not analyzed in the final model (like Educational status, salt, fat, caffeinated drinks, NSAID drug usage and anemia) finally 14 variables from 29 variables (Sex of the participants, Age, hypertension status, diabetes-mellitus, cardio-respiratory diseases, ... Herbal medication usage history) were analyzed in multivariable analysis. The Hosmer–Lemeshow goodness of fit test for final model were conducted for multiple logistic regression (p-value = 0.3595) the model was good since p-value was >0.05 and the odds ratios were adjusted for all other variables keeping constant

in the final models and Significant was declared using 95% CI with chronic kidney disease.

After keeping the other variables constant the odds of developing CKD among males was 2.54 [AOR; 2.54, 95%CI (1.125- 5.754)] times higher than females. Similarly, the odds of developing CKD were 5.33 [AOR; 5.33, 95%CI (2.107- 13.489)] times higher for patients who had hypertension compared to those who had not. Furthermore, the odd of developing CKD among patients who had diabetes- mellitus was 3.64 [AOR; 3.64, 95%CI (1.530- 8.671)] times higher compared to their counterparts. Patients with kidney stones were 3.91 times odds of developing CKD compared to those without kidney stones [AOR; 3.91, 95%CI (1.492-10.257)]. This study also confirmed that the use of underground water was a positive factor of CKD development [AOR; 2.63, 95%CI (1.108- 6.262)] See Table 4 for detail.

Characteristic	CKD			
	Cases (n=78)	Controls (n=156)	COR (95%CI)	AOR (95%CI)
<b>Sex</b>				
Male	52	86	1.63(.923- 2.871)	2.54(1.125-5.754)*
Female	26	70	1	1
<b>Age</b>				
18-30	6	37	1	1
31-40	14	29	2.97(1.018-8.703)	2.65( .684- 10.302)
41-50	20	29	4.25(1.512-11.957)	1.72(.492- 6.026)
51-60	12	34	2.17(.735-6.440)	1.12( .295- 4.25)
60+	26	27	5.93(2.147-16.417)	2.28( .644 8.109)
<b>Hypertension</b>				
Yes	52	44	5.09( 2.833-9.145)	5.33(2.107-13.489)**
No	26	112	1	1
<b>Diabetic -mellitus</b>				
Yes	32	24	3.82(2.044-7.160)	3.64( 1.530 8.671)**
No	46	132	1	1
<b>Cardio-respiratory disease</b>				
Yes	59	73	3.53(1.927- 6.466)	1.33(.520-3.431)
No	19	83	1	1
<b>Kidney stone</b>				
Yes	64	78	4.57(2.367-8.826)	3.91(1.492 - 10.257)*
No	14	78	1	1
<b>Recurrent Urinary tract infections</b>				
Yes	58	90	2.12( 1.167-3.872)	1.67(.678-4.143)
No	20	66	1	1

Family history of kidney diseases				
Yes	25	32	1.82(.989-3.377)	1.33(.570-3.140)
No	53	124	1	1
Smoking				
Yes	26	20	3.4(1.748-6.609)	1.82(.694-4.803)
No	52	136	1	1
Chat				
Yes	42	72	1.36(.789 -2.347)	1.06(.492- 2.317)
No	36	84	1	1
Alcohol				
Yes	37	58	1.52(.879-2.643)	.84(.381-1.865)
No	41	98	1	1
Carbonated drinks				
Yes	68	109	2.93(1.389-6.187)	1.94(.708-5.323)
No	10	47	1	1
Water sources				
Piped water	22	82	1	1
Underground water	34	40	3.16(1.643- 6.105)	2.63(1.108-6.262)*
Bottled water	22	34	2.41( 1.18-4.92)	1.44(.550- 3.774)
Herbal medication usage				
Yes	52	65	2.79( 1.586-4.942)	1.60(.761-3.388)
No	26	91	1	1

Note: Statistically significant at \*P<0.05, \*\*P<0.01.

**Table 4:** Multivariable binary logistic regression on risk factors of CKD among patients attending at Dessie Comprehensive Specialized Hospital, Dessie, Amhara region, North-east Ethiopia, 2022.

## Discussion

The aim of this study was to identify risk factors of chronic kidney diseases among patients attending Dessie Comprehensive Specialized Hospital, Dessie town, Amhara region, Northeastern Ethiopia, 2022.

The study found that males had higher odds of developing CKD than females did. It is consistent with other research conducted in Taiwan, Yemen, and Mexico [14,21,37]. The explanation could have something to do with testosterone's negative effects on males and estrogen's protective effects on females. Additionally, gender norms or social practices related to physical mobility may limit females' opportunities for different behaviors, as evidenced by the differences between male and female behavioral activity levels because males tend to be more active, mobile, and involved in various behaviors like chat chewing, smoking, drinking alcohol, and involvement in war and accidents than females. Males are therefore more likely to develop lung cancer, physical impairments, and drug addictions, which can lead to non-

communicable diseases like hypertension, diabetes mellitus, and cardiovascular disease, which can then result in the development of CKD [1,38,39]. However, studies conducted in Indonesia, Iran, and India showed that sex has no association with CKD [40-42]. These controversies might be due to great variation of population by gender in the current study (66.67 % of cases and 55.13 % of controls) were males. Additionally, prior studies on the diagnosis of NCDs have focused more on men than on women [34].

In this study, those with a history of hypertension were five times odds of developing CKD than those without. This finding is coherent with several related studies [17,19,21,40,42,43]. Meanwhile, there is a cyclical relationship between hypertension and CKD. One possible explanation is that hypertension is one of the leading causes of CKD due to the negative effects that elevated blood pressure has on kidney vasculature. Uncontrolled high blood pressure causes high intra-glomerular pressure, which impairs glomerular filtration. Damage to the glomeruli causes an increase in

protein filtration, resulting in abnormally high levels of protein in the urine (microalbuminuria or proteinuria), which leads to renal vascular nephropathy, which gradually leads to a decrease in glomerular filtration rate and allows enough time for other renal diseases to develop; alternatively, nephrons in the kidney are supplied by a dense network of blood vessels, and a large volume of blood flows through them; uncontrolled high blood pressure can cause arteries surrounding the kidney to narrow, weaken, or harden over time. These damaged arteries are unable to deliver enough blood to the kidney tissue, resulting in CKD [2,20,28,44,45]. As a result hypertensive patients have a high probability of developing CKD compared to non-hypertensive patients. Nonetheless, an Indian study found no statistically significant link between hypertension and CKD [41]. This disagreement could be attributed to the small sample size (61 cases and 50 controls), study population differences, and study settings.

In the current study, a history of diabetes was associated with higher odds of developing of CKD. This finding is in line with the findings of other related studies [14,21,28,46]. It is not surprising that individuals with diabetes have a higher risk of developing CKD because diabetes is a significant risk factor for kidney function and approximately 40% of individuals with diabetes end up with CKD [17,44]. One possible explanation could be Diabetes mellitus is a risk factor for the onset and progression of diabetes, characterized by high blood glucose (sugar) levels. High levels of sugar in the blood cause damage to the arteries leading to the kidneys over time. Poor glycemic control leads to a variety of renal structural alterations, including thickening of the glomerular basement membrane, which parallels the thickening of the capillary and tubular basement membranes. Then there will be increased peripheral artery resistance due to vascular remodeling and increased body fluid volume associated with insulin resistance-induced hyperinsulinemia and hyperglycemia, which will lead to complications such as diabetic nephropathy, secondary hypertension, and eventually CKD [41,47]. As a result patients with diabetes have a high probability of developing CKD compared to their counterparts. Nonetheless, a study conducted in Nepal revealed that diabetes has no statistically significant relationship with CKD [48]. This disagreement may be due to differences in the study setting, methods, and sample size.

When compared to those who did not have kidney stones, those who had kidney stones had roughly four times odds of developing CKD. This result is in agreement with other studies conducted in Yemen, England, Kenya, and Ambo town [14,22,27,49]. This might be due to insufficient water intake or a lack of access to clean water services, as more than half of the study participants (53.85 percent of cases and 57 percent of controls) lived in rural areas, where the primary source of water was underground water, as well as living in hot climates and

eating foods high in protein, salt, and sugar. These conditions may impair renal function. As a result patients with kidney stone has a high probability of renal function impairment as it likely involves multiple different pathways [15,41]. Stones that obstruct urine flow have the potential to cause kidney damage. Moreover, unilateral ureteral obstruction has been shown to cause severe renal vasoconstriction, and the reduction in renal blood flow can result in significant ischemia and permanent renal parenchymal damage. As a result, nephropathy can cause inflammation and fibrosis in the kidneys, resulting in severe kidney damage [33]. Nevertheless, studies conducted in Indonesia and Taiwan revealed that kidney stone has no statically significant association with CKD [37,40]. These discrepancies may be the result of variations in the study area, including environmental factors, dietary practices, or the study environment.

Chronic kidney diseases was positively linked to groundwater source usage compared to those who used piped water sources. This finding is in line with other studies on the same subject [36,46,50,51]. The possible reason might be a large number of water quality studies to date investigated a range of harmful constituents in these ground waters as potential causative agents of the disease and were insufficient to ensure the microbial safety of the product water, moreover there is high demand for product water, lack of technical capacity of the local communities, poor maintenance practices, and lack of rules and regulations for water treatment could lead to numerous environmental and public health problems [36,51]. As a result, the groundwater's alkalinity, hardness, and microbiological parameters exceeded the maximum allowable levels (MALs) for drinking. Furthermore, the total dissolved solids (TDS) and magnesium levels exceeded the MALs. There were no significant seasonal differences in groundwater quality or chemical composition. The best examples of such contaminants are iconicity (primarily related to  $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$ , and  $\text{Na}^{+}$ ), some toxic heavy metals and metalloids (e.g., cadmium, lead, arsenic, and silica), agrochemical residues, organic matter, bacterial toxins, and certain viruses. As a result of the synergistic effect of these chemicals, the water becomes hard, contaminated, and nephrotoxic, and these conditions may reduce renal function, leading to chronic kidney diseases of unknown etiology (CKDU) [36,50]. Nevertheless, studies employed in Indonesia, and Taiwan revealed that sources of water have no statically association with CKD [37,40]. These discrepancies might be explained by variations in the study area, study setting, and sample size.

### Limitation

Since it is a facility-based study and mainly on governmental health facility, this may overlook the whole community and those who have served in private health

facilities. Hence, the conditions might underrate or overrate the conclusion. Since the study did not use the appropriate measurement for some variables like the presence of anemia, kidney stone size and HIV test during data collection rather than using documented information and history, this may distort the information.

## Conclusion

This research was conducted to identify determinants of chronic kidney disease (CKD). Study participants, who were male, had a history of hypertension, diabetes, and kidney stones, and those who used underground water sources were prone to developing CKD. Therefore, the need for increased emphasis on screening and managing the modifiable risk factors early enough so as to forestall the development and progression of the disease, Furthermore, Routine urinalysis and estimation of glomerular filtration rate (GFR) for all patients, especially those with hypertension, diabetes, kidney stones and underground water source users, could help detect CKD at an earlier stage for a better prognosis, given that the disease's course is irreversible.

## Declarations

### Ethics Approval and Consent to Participate

Ethical clearance letter was gained from the ethical committee of Department of public health, Wollo University. Before delivering the questionnaire, written consent was obtained from every participant. No names and possible identifying issues written on the questionnaire to secure the data confidential.

## Authors' Contribution

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