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ORIGINAL RESEARCH

Prevalence Of Anemia And Its Associated Factors Among Chronic Kidney Disease Patients At University Of Gondar Hospital, Northwest Ethiopia: A Hospital-Based Cross Sectional Study

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Video abstract

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Background: Chronic kidney disease (CKD) is a global public health problem associated with progressive decline in kidney function and adverse cardiovascular outcome. Anemia of CKD has substantial adverse outcomes in CKD patients. There is paucity of published data on prevalence of anemia and its associated factors among CKD patients in Northwest Ethiopia.

Objective: This study aimed to determine the prevalence of anemia and its associated factors among CKD patients at the University of Gondar hospital, Northwest Ethiopia.

Methods: A hospital-based cross-sectional study was conducted from May 1, to September 30, 2018. Consecutive sampling was used to recruit 251 study subjects. Patients were interviewed to obtain demographic data, and the patients' medical records were reviewed to obtain information on relevant medical history and laboratory parameters. Data was analyzed using SPSS version 20. Bivariate and multivariate logistic regression analyses were used to identify independently associated factors of anemia among CKD patients. *P*-value <0.05 was used to declare association.

Results: The overall prevalence of anemia in CKD patients was high (64.5%), and the magnitude worsened as kidney function declined. Hypertension (45%), chronic glomerulonephritis (24%) and diabetes (20%) were common causes of CKD. Multivariate logistic regression analysis revealed rural residence (AOR= 2.75, 95%CI: 1.34–5.65, *P*=0.006), BMI <18.5 kg/m^2 (AOR=6.78, 95%CI: 1.32–34.73, *P*=0.022) and BMI of 18.5–24.9 kg/m^2 (AOR=5.04, 95%CI: 1.26–20.10, *P*=0.022), and having hemodialysis history (AOR=3.59, 95%CI: 1.24–10.38, *P*=0.018) were independently associated with anemia among CKD patients.

Conclusion: Periodic screening and intervention programs for anemia of CKD should be practiced to change the existing situation in the setting.

Keywords: chronic kidney disease, anemia, Northwest Ethiopia

Introduction

Chronic kidney disease (CKD) is progressive, irreversible damage to the kidneys, which leads to inability of the kidneys to perform homeostatic, synthetic and excretory functions. Estimated epidemiological prevalence of CKD in global and sub-Saharan Africa was reported to be 15% and 10% respectively.[1–7] The evident reasons for escalating burden of kidney failure in Africa were due to growing urbanization, environmental pollutant exposure, high burden of infectious diseases

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and increasing rate of noncommunicable diseases such as diabetes and hypertension.[5–7]

Common etiologies of CKD in Africa were hypertension, chronic glomerulonephritis and diabetes. Ten percent of HIV-positive patients were documented to have renal dysfunction. Complications of CKD included anemia, metabolic bone disease, metabolic acidosis, fluid and electrolyte imbalance and uremia, which imposed considerable burden on health care resources.[5–7,11–14]

Anemia is a common and significant complication in CKD patients. Study-based estimated prevalence of anemia was 15% in US CKD patients, 45–55% in Asian CKD patients, and 50–90% in African CKD patients.[3,4,11–13]

The etiopathogenesis of anemia in CKD is multifactorial and includes erythropoietin deficiency from reduced renal mass, uremic environment-induced inhibitors of erythropoiesis, shortened red cell survival, and disordered iron homeostasis.[8,9]

Anemia in CKD patients is significantly associated with worsening CKD, and development of heart failure and stroke. It contributes to impaired physical activity, neurocognitive dysfunction and poor quality of life.[9–13,15,16,22–24]

Documented predictors of anemia in CKD include, but are not restricted to, female gender, advanced stage of CKD, diabetic nephropathy as etiology, nonsmoking status, nonobese body habitus, low serum albumin, abnormal bone minerals level (high phosphorus and low calcium levels), abnormal iron markers (transferrin saturation <20%), and low leukocyte count.[4,13,17]

However, prevalence of anemia of CKD in Northwest Ethiopia has not been fully investigated. Therefore, we aimed to disclose prevalence of anemia and its associated factors among CKD patients in the setting.

Methods

Study Settings And Design

A hospital-based cross sectional study was conducted from May 1, 2018 to September 30, 2018 at the University of Gondar hospital. The hospital is located in Northwest Ethiopia, which is 750 km away from the capital, Addis Ababa. The hospital has a catchment population of five million people.

Study Subjects And Variables

Source population was all CKD patients visiting University of Gondar hospital. Patients 18 years and above with an established diagnosis of CKD as per kidney disease/improving global outcomes (KDIGO) criteria regardless of its primary cause were considered as study population. Those study subjects who provided informed consent were included in the study. Patients with known cause of anemia other than kidney disease, pregnant women, and those unwilling to participate were excluded.

Sample Size And Sampling Procedure

The sample size was calculated using Fisher's formula[18] at a prevalence of 80% with a confidence interval of 95% and degree of precision of 5%. Consecutive sampling was used to recruit 251 study subjects.

Data Collection

Data were collected through an investigator administered pretested questionnaire. Patients were interviewed to obtain demographic data, and the patients' medical records were reviewed to obtain information on relevant medical history and laboratory parameters. The determination of the primary cause of kidney disease was based on clinical history, physical examination, and laboratory investigations including complete blood count, urinalysis, blood chemistry, ultrasound and HIV serology.

Blood and urine samples were collected for laboratory tests. Complete blood counts were obtained after processing the blood sample using AR-6300 (ARI Medical Equipment Co. Ltd, China) hematology analyzer. Serum glucose and creatinine were determined by enzymatic glucose oxidase and kinetic alkaline picrate method respectively using Mindray BS-480 (Shenzhen Mindray Bio-Medical Electronics Co., Ltd, China) clinical chemistry analyzer. Urine albumin was measured semiquantitatively by dip stick urinalysis (COMBINA 11S, Human) using fresh, midstream urine samples.

The hemoglobin level was used to define anemia according to WHO criteria.[19] The serum creatinine was used to estimate GFR using chronic kidney disease epidemiology collaboration (CKD-EPI) equation.[20]

Dependent variable: anemia was the dependent variable, as defined by WHO criteria.

Independent variables: sociodemographic factors including age, sex, place of residence, educational status and marital status; behavioral factors including smoking and alcohol drinking; and clinical parameters such as cause, duration and stage of CKD, presence of

comorbidity, dialysis status, body mass index (BMI), blood pressure level, presence/absence of albuminuria and treatment status for anemia.

Data Analysis

Data was entered into EPI Info version 4.4.1 and transported to SPSS version 20 for analysis. Descriptive statistics, such as median and IQRs were used to compute continuous variables, and counts with percentage for categorical variables. Both bivariate and multivariate logistic regression analyses were used to identify independently associated factors of anemia in CKD patients. Those variables with a *P*-value <0.2 in the bivariate analysis were exported to multivariate analysis to control the possible effect of confounders. Adjusted odds ratio (AOR) with 95%CI and *P*-value <0.05 were used to select variables associated with anemia in CKD patients.

Definition Of Terms

Chronic kidney disease (CKD) was defined as abnormalities of kidney structure or function present for more than three months, with implications for health. CKD is classified based on cause and GFR category (G1–G5). GFR was determined by using CKD-EPI equation for eGFR, stage 1, albuminuria with eGFR >90 mL/min/1.73m^2; stage 2, albuminuria with eGFR 60–89 mL/min/1.73m^2; stage 3a, eGFR 45–59ml/min/1.73m^2; stage 3b, eGFR 30–44 mL/min/1.73m^2; stage 4, eGFR 15–29 mL/min/1.73m^2; and stage 5, eGFR<15 mL/min/1.73m^2.

Anemia was defined as hemoglobin level <12g/dL in females and <13g/dL in males in patients aged 18 years of age and above. Severity of anemia was classified as mild (11–11.9 g/dL (females), 11–12.9 g/dL (males)), moderate (8–11 g/dL), and severe (<8 g/dL).

Albuminuria was defined as presence of albumin in the urine (from trace to 4+). Massive proteinuria is defined as albumin in urine of 2+ in two of three determinations over three months.

Hypertension was defined as the presence of persistently elevated systolic blood pressure ≥140 mmHg and/or diastolic blood pressure ≥90 mmHg in patients aged 18 years of age and above, history of hypertension, or the use of antihypertensive drug(s).

Hypertensive kidney disease was defined as presence of documented history of hypertension predated kidney disease (reduced eGFR).

Diabetes was defined as fasting serum glucose ≥126 mg/dL, history of diabetes, or use medications for diabetes.

Diabetic nephropathy (DN) was defined as long-standing known diabetes, and urinalysis evidence of significant proteinuria.

Chronic glomerulonephritis was defined as presence of proteinuria, hematuria, and/or ultrasound-proven reduced kidney size (≤8 cm) or loss of cortico-medullary differentiation.

Ethical Considerations

Ethical clearance was obtained from the Research Ethical Review Board of College of Medicine and Health Sciences, University of Gondar. Formal letter of permission was obtained from University of Gondar hospital administrative body. Written informed consent was obtained from participants, and confidentiality of information obtained was maintained by coding and restricting access to the questionnaire. During the data collection process, those patients who were found to have anemia were taken care of as per the recommendations of CKD guidelines, and advice on preventive measures was given to all participants.

Result

Sociodemographic Characteristics Of Study Participants

Among a total of 251 CKD patients, 161 (64.1%) were males and 90 (35.9%) were females. The median age of study subjects was 60 years (IQR=44–69). The majority of patients (61%) were aged from 45 to 75 years. Most of them were nonsmokers (95%), nonalcoholic (76%), married (77%), and Orthodox Christian by religion (84%). The majority 142 (57%) were urban dwellers and 118 (47%) joined formal education (Table 1).

Clinical and Laboratory Profile Of CKD Patients

Hypertension accounted for 45% as a cause of CKD, followed by chronic glomerulonephritis (24%) and diabetes (20%). HIV/AIDS was ascertained as etiology of CKD in 2% of cases (Table 2). Majority of the patients were in KDIGO stage 3 (49%), followed by KDIGO stage 5 (26%) and stage 4 (21%) (Figure 1). Two-thirds of patients 180 (71.7%) were positive for albuminuria

Table 1 Sociodemographic Characteristics Of CKD Patients (N=251)

Variables	Frequency (%)	Anemia		*P*-value
		Present	Absent	
Sex				
Male	161 (64.1)	102	59	0.599
Female	90 (35.9)	60	30	
Age (years)				
19–30	30 (12.0)	24	6	0.003
31–45	40 (15.9)	33	7	
46–60	78 (31.1)	40	38	
61–75	75 (29.9)	50	25	
76–85	28 (11.1)	15	13	
Residence				
Urban	142 (56.6)	76	66	<0.001
Rural	109 (43.4)	86	23	
Occupation				
Civil servant	43 (17.1)	21	22	<0.001
Merchant	37 (14.7)	18	19	
Farmer	61 (24.3)	52	9	
Housewife	60 (23.9)	43	17	
Self-employed	13 (5.2)	9	4	
Daily laborer	11 (4.4)	9	2	
Student	5 (2.0)	3	2	
Others[a]	21 (8.4)	7	14	
Religion				
Orthodox Christian	210 (83.7)	143	67	0.018
Protestant Christian	4 (1.6)	2	2	
Muslim	37 (14.7)	17	20	
Marital status				
Single	22 (8.8)	15	7	0.767
Married	193 (76.9)	124	69	
Divorced	21 (8.3)	12	9	
Widowed	15 (6.0)	11	4	
Educational status				
Unable to read and write	101 (40.2)	78	23	0.007
Able to read and write	32 (12.7)	20	12	
Primary education	41 (16.3)	25	16	
Secondary education	37 (14.7)	20	17	
College and above	40 (15.9)	19	21	

Note: [a]= retired or no job.

using urinalysis dipstick. One hundred four (53.3%) had massive proteinuria (≥2+ albuminuria). One-fifth 51 (20.3%) had ultrasound-proven bilateral shrunken kidneys (≤8 cm) (Table 3).

Table 2 Clinical Characteristics Of CKD Patients (N=251)

Variables	Frequency (%)	Anemia		*P*-value
		Present	Absent	
Treatment status for anemia				
Yes	42 (16.7)	42	0	<0.001
No	209 (83.3)	120	89	
Type of treatment for treated cases				
Blood transfusion (BT)	19	19	0	?
Hematinics only	14	14	0	
BT and hematinics	3	3	0	
Hematinics and ESA	5	5	0	
BT, hematinics, and ESA	1	1	0	
Smoking				
Yes	13 (5.2)	7	6	0.408
No	238 (94.8)	155	83	
Alcohol drinking				
Yes	61 (24.3)	39	22	0.909
No	190 (75.7)	123	67	
Presence of comorbidity				
Yes	88 (35.1)	58	60	0.014
No	163 (64.9)	104	59	
Taking other medications[a]				
Yes	212 (84.1)	132	79	0.132
No	40 (15.9)	30	10	
Family history of kidney disease				
Yes	10 (4.0)	9	1	0.085
No	241 (96.0)	153	88	
Underlying cause of CKD				
Chronic GN	60 (23.9)	54	6	<0.001
Hypertension	115 (45.4)	66	48	
Diabetes	51 (20.9)	23	28	
Others	26 (9.8)	20	6	
Hemodialysis history				
Yes	32 (12.7)	26	6	0.034
No	219 (87.3)	136	83	
SBP category (mmHg)				
≥160	38 (15.1)	22	16	0.151
150–159	68 (27.1)	41	27	
120–139	85 (33.9)	53	32	
90–119	60 (23.9)	46	14	

(*Continued*)

Table 2 (Continued).

Variables	Frequency (%)	Anemia		*P*-value
		Present	Absent	
DBP category (mmHg)				
≥100	21 (8.4)	16	5	0.033
90–99	52 (20.7)	31	21	
80–89	70 (27.9)	37	33	
60–79	108 (43.0)	78	30	
BMI (kg/m^2)				
<18.5	43 (17.1)	35	8	<0.001
18.5–24.9	160 (63.7)	109	51	
25–29.9	31 (12.4)	14	17	
≥30	17 (6.8)	4	13	

Note: [a]ACE inhibitors, calcium channel blockers, diuretics, insulin, oral antidiabetic drugs (metformin, glibenclamide), ASA and statins.

Prevalence Of Anemia Among CKD Patients

The overall prevalence of anemia in this study was 64.5% (58.6 to 70.5%). Anemia was significantly prevalent in glomerular disease among other underlying causes of CKD (*P*-value <0.001) (Figure 2). The prevalence of anemia increased with worsening kidney function: stage 1 and 2, 3A, 3B, 4 and 5 CKD were 20%, 44.8%, 46.4%, 81.1%, 93.8% respectively (Figure 3). Severe anemia (Hgb <8g/dL) was documented in 49/251 (19.5%) of CKD patients. One quarter (42/162) of patients received therapy among those who had documented anemia. Options of therapy among treated cases were packed blood transfusions 23/42 (55%),

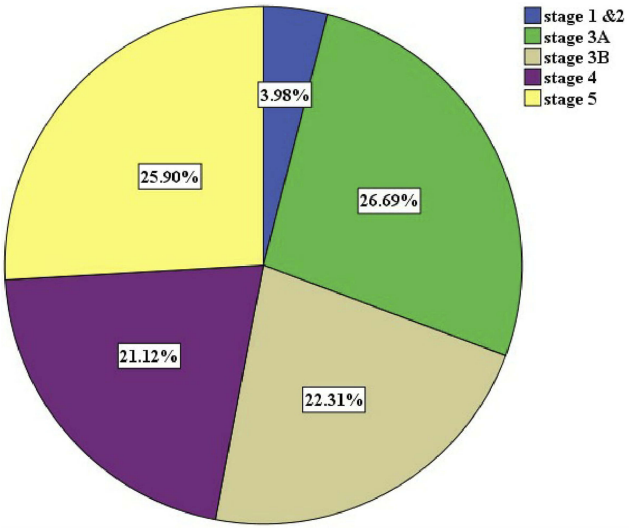

Figure 1 Stages of CKD by eGFR using CKD-EPI equation.

Table 3 Laboratory And Imaging Profile Of CKD Patients (N=251)

Variables	Frequency (%)	Anemia		*P*-value
		Present	Absent	
Albuminuria on urinalysis dipstick				
Present	180 (71.7)	120	60	0.264
Absent	71 (28.3)	42	29	
Degree of albuminuria				
Negative	71 (28.3)	42	29	0.025
1+	46 (18.3)	23	23	
2+	101 (40.2)	75	26	
3+	33 (13.2)	22	11	
eGFR (mL/min/1.73m^2)				
Early stage (stage 1/2)	10 (4.0)	2	8	<0.001
Stage 3A (45–59.99)	67 (26.7)	30	37	
Stage 3B (30–44.99)	56 (22.3)	26	30	
Stage 4 (15–29.99)	53 (21.1)	43	10	
Stage 5 (≤14.99)	65 (25.9)	61	4	
Renal ultrasound findings				
Normal sized kidneys	123 (49.0)	71	52	0.264
Shrunken kidneys	51 (20.3)	35	16	
Large kidneys	4 (1.6)	3	1	
Congenital anomalies	9 (3.6)	5	4	
Obstructive	15 (6.0)	11	4	
Others	49 (19.5)	37	12	
HIV status				
Reactive	12 (4.8)	10	2	0.002
Nonreactive	99 (39.4)	75	24	
Unknown	140 (55.8)	77	63	

hematinics 23/42 (55%), and erythropoiesis stimulating agent (ESA) 6/42 (14.3%) (Table 2).

Factors Associated With Anemia Among CKD Patients

Multivariate logistic regression analysis was used to identify independently associated factors of anemia among CKD patients. Accordingly, rural residence (AOR=2.75, 95%CI:

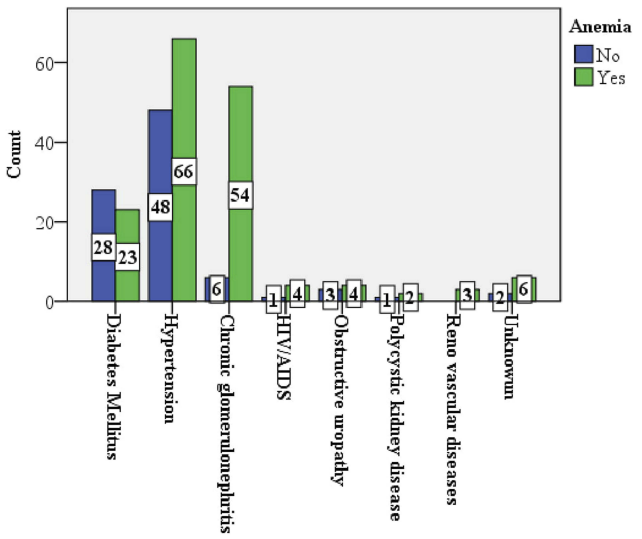

Figure 2 The prevalence of anemia across the underlying causes of CKD.

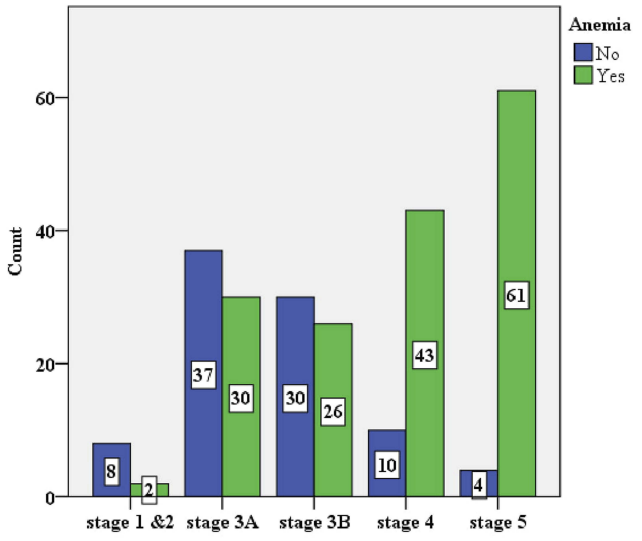

Figure 3 Prevalence of anemia across stages of CKD.

1.34–5.65, *P*=0.006), BMI <18.5 kg/m^2 (AOR=6.78, 95% CI: 1.32–34.73, *P*=0.022) and BMI of 18.5–24.9 kg/m^2 (AOR=5.04, 95%CI: 1.26–20.10, *P*=0.022) and, having hemodialysis history (AOR=3.59, 95%CI: 1.24–10.38, *P*=0.018) were found to be associated with anemia among CKD patients. Those with diastolic blood pressure (DBP) between 80 and 89 mmHg (AOR=0.37, 95%CI: 0.16–0.92, *P*=0.025) were at lower risk for anemia of CKD (Table 4).

Discussion

The overall prevalence of anemia among CKD stages 1–5 was 64.5%, with in the range in African studies report (51–87%).[8,11–13] Recent NHANES report in the United States revealed the prevalence of anemia was twice (15.4%) in CKD patients compared to the nonCKD population (7.5%).[2,3]

The study demonstrated prevalence of anemia increased with stage of CKD. A similar finding was reported from NHANES survey in the United States with prevalence of anemia from 8.4% at stage 1 to 53.4% at stage 5. Comparable trend was also observed from recent Korean cohort with prevalence of 10% at stage 1 to 96.5% at stage 5.[2,4]

The main etiologies of CKD were hypertension, chronic glomerulonephritis and diabetes, congruent with studies from low and middle-income countries.[5,7,9–14] Chronic glomerulonephritis remained an important cause of CKD, possibly related to high prevalence of viral, bacterial, protozoan and helminthic infections/infestations in sub-Saharan Africa.[9–13]

As in other developing countries, most patients (96%) in this study presented in advanced stage of CKD (stage 3–5), unlike the situation in developed countries. Presumed reasons for patients' late presentation for renal medical care might be due to low detection and treatment rate of CKD risk factors such as hypertension and diabetes, lack of regular CKD screening program and insufficient follow-up care, and preference to use alternative treatment.[4,6,7,10,12,13]

This study demonstrated anemia was significantly prevalent in CKD of chronic glomerulonephritis compared to other underlying causes of CKD (*P*-value <0.001). Studies from the Western world documented diabetic nephropathy were strongly correlated with anemia of CKD among other underlying causes. Putative reasons for high prevalence of anemia in diabetic nephropathy might be hyperglycemia-induced renal interstitial fibrosis, decrease in hypoxia-inducible transcription factor, and increase in inflammatory cytokines.[4,12,17]

This study showed that anemia was significantly prevalent in rural residents. The odds of being anemic were threefold higher in rural residents (AOR=2.75, 95%CI: 1.34–5.65, *P*=0.006) as compared to urban dwellers. Rural resident patients might visit health facility late due to lack of access to or remote from health care service. Concomitant presence of nutritional deficiencies, gastrointestinal blood loss or helminthic infestations might contribute to anemia in rural residents.[10,13]

Patients with nonobese body habitus had five to sevenfold increased risk for anemia compared to patients with obese body habitus. A cohort study in Korea showed lower BMI was associated with elevated risk of anemia, while

Table 4 Bivariate And Multivariate Logistic Regression Analysis Of Factors Associated With Anemia Among CKD Patients At University Of Gondar Hospital, Northwest Ethiopia, May 1, To September 30, 2018 (N=251)

Variable	Anemia		COR (95%CI)	AOR (95%CI)	*P*–value
	Present	Absent			
Sex					
Male	102	59	1		
Female	60	30	1.16 (0.67–1.99)		
Age (years)					
19–30	24	6	1	1	
31–45	33	7	1.18 (0.35–3.96)	1.30 (0.34–5.07)	
46–60	40	38	0.26 (0.01–0.71)	0.53 (0.16–1.71)	
61–75	50	25	0.50 (0.18–1.38)	1.00 (0.29–3.42)	
76–85	15	13	0.29 (0.09–0.92)	0.69 (0.16–2.94)	
Residence					
Urban	76	66	1	1	
Rural	86	23	3.25 (1.84–5.72)	2.75 (1.34–5.65)	0.006
Educational status					
Unable to read &write	78	23	3.75 (1.73–8.14)	1.65 (0.58–4.64)	
Able to read and write	20	12	1.84 (0.71–4.75)	1.46 (0.46–4.66)	
Primary education (1–8)	25	16	1.73 (0.72–4.17)	1.14 (0.38–3.37)	
Secondary education (9–10)	12	6	2.21 (0.69–7.05)	1.31 (0.33–5.17)	
Preparatory (11–12)	8	11	0.80 (0.27–2.42)	0.71 (0.17–2.88)	
College and above	19	21	1	1	
Marital status					
Married	124	69	1		
Single	15	7	1.19 (0.46–3.07)		
Divorced	12	9	0.74 (0.30–1.85)		
Widowed	11	4	1.53 (0.47–4.99)		
Alcohol drinking					
Yes	39	22	0.97 (0.53–1.76)		
No	123	67	1		
Presence of comorbidity					
Yes	58	30	1.01 (0.64–1.89)		
No	104	59	1		
Taking other medications					
Yes	132	79	0.56 (0.26–1.20)	0.79 (0.30–2.08)	
No	30	10	1	1	
SBP category (mmHg)					
90–119	46	14	1	1	
120–139	53	32	0.50 (0.24–1.06)	1.38 (0.52–3.65)	
140–159	41	27	0.46 (0.21–1.00)	1.03 (0.34–3.14)	
160+	22	16	0.42 (0.17–1.00)	0.96 (0.25–3.59)	
DBP category(mmHg)					
60–79	78	30	1	1	
80–89	37	33	0.43 (0.23–0.81)	0.38 (0.16–0.92)	0.025
90–99	31	21	0.57 (0.28–1.14)	0.62 (0.23–1.71)	
100+	16	5	1.23 (0.41–3.67)	1.69 (0.35–8.09)	

(*Continued*)

Table 4 (Continued).

Variable	Anemia		COR (95%CI)	AOR (95%CI)	*P*–value
	Present	Absent			
Hemodialysis status					
Yes	26	6	2.24 (0.93–5.39)	3.59 (1.24–10.38)	0.018
No	136	83	1	1	
BMI (kg/m^2)					
10–18.49	35	8	14.22 (3.66–55.32)	6.78 (1.32–34.73)	0.022
18.5–24.9	109	51	6.95 (2.16–22.36)	5.04 (1.26–20.10)	0.022
25–29.9	14	17	2.68 (0.71–10.07)	3.14 (0.63–15.77)	
30–50	4	13	1	1	
Proteinuria on urinalysis dipstick					
Absent	42	29	1		
Present	120	60	1.38 (0.78–2.43)		
Degree of proteinuria					
None	42	29	1	1	
1+	23	23	0.69 (0.33–1.46)	0.58 (0.23–1.47)	
2+	75	26	1.99 (1.04–3.82)	1.82 (0.83–4.00)	
3+	22	11	1.38 (0.58–3.28)	1.66 (0.57–4.80)	
WBC count	Median=6 (IQR=5–8)		1.09 (0.98–1.22)	1.07 (0.94–1.21)	
Neutrophil (%)	Median=70 (IQR=61–76)		1.01 (0.99–1.03)	1.02 (0.97–1.07)	
Lymphocyte (%)	Median=23 (IQR=14.7–30)		0.98 (0.96–0.99)	0.99 (0.95–1.05)	
Platelet count	Mean=247.91 (SD=102.7)		0.99 (0.99–1.00)		

Abbreviations: COR, crude odds ratio; AOR, adjusted odds ratio.

lower odds for anemia was reported for higher BMI. Malnutrition defined by protein-energy wasting is indicator of advanced renal disease.[4]

Patients with hemodialysis history had fourfold higher odds for anemia (AOR=3.59, 95%CI: 1.24–10.38, *P*=0.018) compared to patients without hemodialysis history. Various studies revealed hemodialysis requiring patients were those with advanced renal disease, in which presence and severity of anemia was prevalent. Intractable anemic state in later stages of CKD is mainly due to inflammation, protein-energy wasting and bone marrow fibrosis.[9,11,12]

There was a 63% less likely chance of developing anemia among patients with DBP (80–89 mmHg) (AOR=0.37, 95%CI: 0.16–0.92, *P*=0.025). Normal or controlled blood pressure in CKD patients might indicate early stage renal disease or attenuated renal disease progression respectively.[21]

Literatures revealed anemia of CKD caused maladaptive cardiovascular mechanisms leading to left ventricular hypertrophy, heart failure, and myocardial ischemia and infarction. Anemia with CKD was also associated with a substantial higher risk of stroke. As well, it increased risk of cardiovascular related morbidity and mortality.[9,15,16,22–25]

Suboptimal treatment of anemia with ESA and hematinics were noticed in this study, possibly explained by unavailability or high cost of drugs. Clinical studies have shown that correction of anemia using ESA and hematinics improved quality of life, physical activity and cardiac function, and might decrease kidney disease progression and morbidity.[11–13,16,20,25]

Limitation Of The Study

Data were cross-sectional, not longitudinal, preventing assessment of whether identified associated factors caused or resulted from CKD. Type and cause of anemia in CKD patients were not determined due to logistic reasons. Albuminuria was evaluated using a semiquantitative urine dipstick test due to unavailability of quantitative albuminuria test.

Conclusion

Hypertension (45%), chronic glomerulonephritis (24%) and diabetes (20%) were common causes of CKD. Anemia was prevalent across stages of chronic kidney disease, and worsened with progressive decline in kidney function. Rural residence, nonobese body habitus and having hemodialysis history were independently associated with anemia in CKD patients.

Recommendation

The authors recommend longitudinal studies to determine actual predictors of anemia in CKD patients. Periodic screening and intervention programs for anemia of CKD should be practiced to change the existing situation in the setting.

Abbreviations

CKD, chronic kidney disease; CGN, chronic glomerulonephritis; AOR, adjusted odds ratio; COR, crude odds ratio; eGFR, estimated glomerular filtration rate; ESRD, end stage renal disease; BMI, body mass index, KDIGO, kidney disease/improving global outcomes; CKD-EPI, chronic kidney disease epidemiology collaboration; ESA, erythropoiesis stimulating agents.

Ethics Approval And Consent To Participate

Ethical approval was obtained from College of Medicine and Health Sciences, University of Gondar. Informed consent was obtained from all study participants in written format.

Declaration Of Helsinki

The research was conducted in accordance with the "Declaration of Helsinki".

Availability Of Data And Materials

All data generated and analyzed are included in this research article.

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Author Contributions

All authors contributed to data analysis, drafting or revising the article, gave final approval of the version to be published, and agree to be accountable for all aspects of the work.

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Disclosure

The authors declare that they have no conflicts of interest in this work.

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