Original research

Prevalence of atherosclerotic cardiovascular diseases and risk factors among pre-dialysis chronic kidney disease patients at Tikur Anbessa specialized hospital, Addis Ababa, Ethiopia: A cross-sectional study

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Abstract

Objective: Cardiovascular disease (CVD) is the leading cause of morbidity and mortality among patients with chronic kidney disease (CKD). These patients have a higher prevalence of both traditional and non-traditional cardiovascular risk factors compared to the general population. Glomerular filtration rate (GFR) and proteinuria are independent predictors of cardiovascular outcomes. The objective of the study was to assess the prevalence of atherosclerotic cardiovascular diseases (ASCVD) and associated risk factors among pre-dialysis CKD patients at Tikur Anbessa Specialized Hospital.

Methods: A hospital-based cross-sectional study was conducted from April 5 to August 27, 2021, among 216 randomly selected pre-dialysis CKD patients attending renal clinics at Tikur Anbessa Specialized Hospital. Structured questionnaires were used to collect sociodemographic, clinical, laboratory, and imaging data. Data were anonymized, entered into Epi Info 3.1, and analyzed using SPSS version 25. Descriptive and multivariable logistic regression analyses were performed. Ethical clearance was obtained from the Institutional Review Board of the Department of Internal Medicine, Addis Ababa University.

Results: Out of 216 participants, 149 (69%) were male, with a mean age of 55.6 years (95% CI: 41.9–68.6). The leading causes of CKD were diabetes mellitus (41.7%) and hypertension (34.3%). The mean eGFR was 37.3 mL/min/1.73 m² (95% CI: 23.3–51.5). Hypertension and diabetes were prevalent in 91.2% and 48.1% of participants, respectively. Anemia and hypertriglyceridemia were each present in 36.8%. The prevalence of ischemic heart disease, cerebrovascular disease, and peripheral arterial disease were 14.4%, 11.1%, and 4.2%, respectively, resulting in an overall ASCVD prevalence of 27.8% (95% CI: 21.9–34.3). Left ventricular hypertrophy was present in 28.2%, diastolic dysfunction in 30.6%, and systolic dysfunction in 20.8%. Uncontrolled office blood pressure (AOR: 4.7; 95% CI: 1.17–18.7; p = 0.029) and khat chewing (AOR: 5.1; 95% CI: 1.10–24.66; p = 0.042) were significantly associated with ASCVD.

Conclusion: The burden of atherosclerotic cardiovascular disease among pre-dialysis CKD patients in this study was notably high. Hypertension, diabetes, anemia, and cardiac abnormalities were also highly prevalent. These findings highlight the need for early cardiovascular screening and risk factor management in this population.

Key words: Chronic kidney disease, cardiovascular diseases, risk factors, pre-dialysis, Ethiopia

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Introduction

Cardiovascular disease (CVD) is the leading cause of morbidity and premature mortality among patients with chronic kidney disease (CKD). Since the early observations by Richard Bright, the strong association between CKD and CVD has been well established (1). Although the elevated cardiovascular (CV) risk in end-stage renal disease (ESRD) is widely recognized, increasing evidence shows that patients across the entire spectrum of CKD are at significantly heightened risk for cardiovascular events (1, 2).

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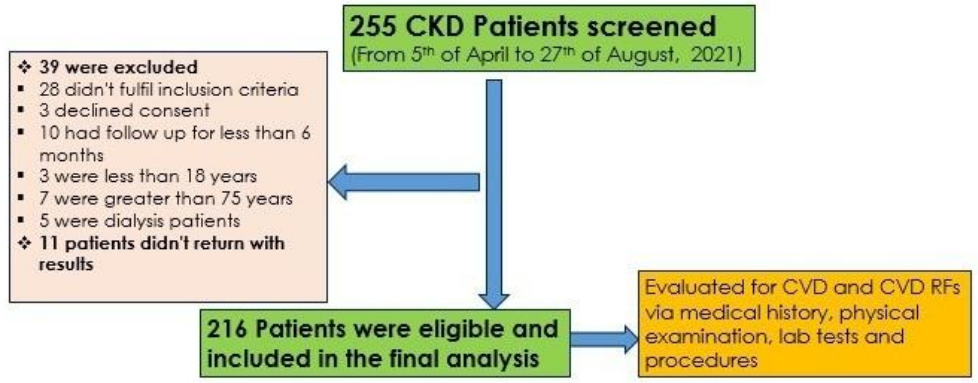

Association CV risk factors with CVD in patients with chronic kidney diseases
eGFR 30-45 - 0.31(0.09, 0.45), p= 0.040; Office BP -≥140/90 - 4.7(1.17, 18.71), p=0.029; Chat chewing - 5.1(1.1, 24.66), p=0.042

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Acronyms and abbreviations	
Abbreviation	**Definition**
ABI	Ankle brachial index
BSA	Body surface area
CKD	Chronic kidney disease
CKD-EPI	Chronic kidney disease epidemiology collaboration
CRIC	Chronic renal insufficiency cohort
CRISIS	Chronic Renal Insufficiency Standards Implementation Study
CVD	Cerebrovascular disease
eGFR	Estimated glomerular filtration rate
ESRD	End stage renal disease
HIV	Human immunodeficiency virus
IHD	Ischemic heart disease
iPTH	Intact parathyroid hormone
LVH	Left ventricular hypertrophy
PAD	Peripheral arterial disease

CKD patients exhibit a high prevalence of both traditional and non-traditional CV risk factors. Traditional risk factors such as hypertension, diabetes, dyslipidemia, smoking, obesity, and older age are common in both the general population and in those with CKD. In contrast, CKD-related (non-traditional) risk factors—including anemia, calcium-phosphorus imbalance, chronic inflammation, oxidative stress, hypoalbuminemia, and left ventricular hypertrophy—contribute further to the excess CV risk observed in this population (3, 4).

Both estimated glomerular filtration rate (eGFR) and albuminuria have been identified as independent, graded predictors of CV morbidity and mortality. CKD is now considered a cardiovascular risk equivalent, comparable to diabetes mellitus and coronary heart disease (5, 6).

Evidence from large community-based studies involving over 20,000 participants confirms that CKD is an independent risk factor for myocardial infarction, stroke, and CV death, even after excluding individuals with known baseline CVD (5). Notably, individuals of African descent appear to be at higher cardiovascular risk than other populations. Reported CVD prevalence among CKD cohorts includes 26.8% in CKD-ROUTE (Japan), 33.4% in CRIC (U.S.), 47.2% in CRISIS (U.K.), 39.1% in MERENA (Spain), and 9.8% in C-STRIDE (China) (7–11).

In Africa, limited data from observational studies also suggest a high burden of CVD among CKD patients. A study from South Africa reported a 47.5% prevalence of atherosclerotic vascular disease in CKD patients, while a Nigerian study found electrocardiographic abnormalities in 86%, diastolic dysfunction in 62.8%, and systolic dysfunction in 15.1% of patients. Similarly, a Ugandan study documented left ventricular hypertrophy (LVH) in 54.4%, systolic dysfunction in 18.9%, and diastolic dysfunction in 17.5% of pre-dialysis CKD patients (12–16).

A systematic review and meta-analysis further highlighted that male gender, advancing age, smoking, diabetes, established CVD, and elevated total cholesterol were associated with increased CV risk in CKD patients. In addition, non-traditional risk factors such as anemia, hypoalbuminemia, hyperphosphatemia, and hyperuricemia were significantly linked to higher rates of CVD events (17, 18).

A Ugandan study of 217 CKD patients demonstrated high prevalence rates of hypertension (90%), anemia (71.9%), hypocalcemia (44.7%), hyperphosphatemia (39.2%), diabetes (16.1%), obesity (10.2%), and smoking (11.5%), with these risks increasing in prevalence and severity as renal function declined. The same study also found that HIV prevalence among CKD patients was approximately twice that of the general population (13). The cumulative effect of traditional and non-traditional risk factors accelerates atherosclerosis and worsens CKD progression (17). Despite these findings from other settings, there remains a lack of data from Ethiopia, and only a few small studies have been conducted in similar resource-limited environments.

The aim of this study was to assess the prevalence and associated risk factors of atherosclerotic cardiovascular disease among pre-dialysis CKD patients at Tikur Anbessa Specialized Hospital**,** Addis Ababa, Ethiopia.

Methods

Study design and population

A cross-sectional study design was used.

Study area and study period

We conducted this study over five month's period from April 5 to August 27, 2021 at Tikur Anbessa Specialized Hospital (TASH), Addis Ababa. Addis Ababa is the capital city of Ethiopia. TASH is the country's largest teaching and tertiary hospital with more than 400,000 patients seen at an outpatient follow-up clinic annually. About 300 patients are screened at the renal clinic every month with three clinics weekly and CKD accounts for more than a quarter of these patients.

Population

Source Population

All pre-dialysis CKD patients on follow-up at the renal clinic at TASH were the source population.

Study Population

All randomly selected pre-dialysis CKD patients on follow-up at renal clinics at TASH were the study population.

Eligibility Criteria

Inclusion criteria: All pre-dialysis CKD patients on follow up at the renal clinic at TASH who fulfill the following eligibility criteria were included. These were: Men or women aged between 18 and 74 years, those who have specified estimated GFR and who had follow-up at TASH for more than 6 months.

Exclusion criteria: We excluded individuals who were very ill and unable to consent, individuals who were on dialysis and post renal transplant patient.

Sampling technique

Sampling was done by systematic random sampling. The total number of pre-dialysis CKD patients having follow-up at TASH was retrieved from HMIS data and simple random sampling was done.

Ethical approval

Data collection was carried out after approval of the research proposal by institutional review board of Department of Internal Medicine, School of Medicine, College of Health Sciences, Addis Ababa University. Appropriate measures were taken to protect confidentiality of the collected information. All collected data didn't contain patient identifications like names, patient's medical record number and residence addresses. Written informed consent was taken from eligible patients. Patients were provided with information on the objectives of the study and confidentiality issues. At the end of the session, patients were given the opportunity to enroll in the study at that time and continued the appropriate CKD care per Ethiopian Federal Ministry of Health and international standard of care guidelines. Those who want to discuss their participation in the study with family members were given an opportunity to do.

Data collection method

Sociodemographic data (age, sex, urban or rural residency, educational status -no formal education, primary school, high school, diploma degree and above) was collected by interview, chart review and electronic record review.

CKD related facts, traditional and novel risk factors, medications and some of the CVDs were retrieved by interview, and chart and electronic record review.

Trained physicians collected those data. In assessing the CVDs, cardiology fellows did echocardiography and trained medical interns did lower extremity Doppler ultrasonography.

Anthropometric and clinical data included body mass index (BMI), waist and hip circumferences, a mean waist-to-hip ratio, and ankle brachial index (ABI) and blood pressure.

Among laboratory analysis the following parameters were assessed: hemoglobin and hematocrit, total cholesterol, low density lipoprotein cholesterol (LDL), high density lipoprotein cholesterol (HDL), and triglycerides; fasting blood glucose (FBG) and hemoglobin A1c (HbA1c); intact parathyroid hormone (iPTH); serum calcium and phosphorus, serum uric acid and albumin; erythrocyte sedimentation rate (ESR), creatinine and estimated glomerular filtration rate (eGFR), 24-hour urinary protein excretion, and serostatus for HIV.

For CKD causes, we assessed presence of diabetes mellitus (DM), hypertension, obstructive uropathy, glomerulonephritis and autosomal dominant polycystic kidney disease (ADPKD). We evaluated treatment of DM and hypertension, and mineral and bone disease.

We determined behavioral and family history risk factors as smoking status (ex-smoker, never smoker, and current smoker), family history of CVD, active chewing chat, active alcohol drinking, physical exercise and menopause status in females.

CVDs included - ischemic heart disease (IHD), cerebrovascular disease (ischemic stroke, hemorrhagic stroke, transient ischemic attack, TIA), and peripheral arterial disease (PAD). We evaluated treatment of CVDs. Echocardiography was used to determine LVH, diastolic dysfunction, systolic dysfunction, pulmonary hypertension and left ventricular ejection fraction.

Variables

Outcome variables

- Prevalence of atherosclerotic CVD (ASCVD) in pre-dialysis CKD patients
-Prevalence of CVD risk factors in pre-dialysis CKD patients

Explanatory variables

- Specific CVD
- Contribution of novel and traditional risk factors and their control
- Specific causes of CKD
- Stage of CKD

Operational Definitions

CKD was defined as a decreased eGFR to <60 ml/min/m^2 of body surface area (bsa).

eGFR was calculated based on serum creatinine with CKD-EPI equation:

$(eGFR = 141 * \min(Scr/\kappa,1)^{\alpha} * \max(Scr/\kappa, 1)^{-1.209} * 0.993^{Age} * 1.018 [\text{if female}] * 1.159 [\text{if black}])$.

ASCVD included: Ischemic heart disease (echocardiography evidence or history of acute coronary syndrome), peripheral arterial disease (history of documented peripheral arterial disease), or cerebrovascular events (history of ischemic or hemorrhagic stroke or transient ischemic attack).

CKD staging was based on eGFR (Stages 3a, 3b, and 4: 45-59, 30-44, and 15-29 ml/min/1.72m^2 of BSA).

Traditional risk factors: risk factors established to increase the risk of ASCVD, which includes diabetes mellitus, hypertension, dyslipidemia, smoking, obesity, and family history.

Novel risk factors: were additional risk factors which are suspected culprits in both the development and progression of athero-thrombosis including CKD specific factors which includes anemia, albuminuria, hypoalbuminemia, increased inflammatory markers, and mineral bone disease.

Data quality control

The principal investigator undertook regular checkups of data collection methods and study protocol adherence. Regular checkup for completeness and consistency of the collected data was done. Two medical interns as data collectors were trained on the objectives of the study, interview technique, and data collection process. Cardiology fellows did echocardiography by standardized ultrasound machine (Philips). For office blood pressure measurement, (Sphygmomanometer- aneroid, China) and ankle brachial index measurement (hand held vascular Doppler- Lifedope L150R, India) internationally validated devices were used.

Statistical analysis

Sample size determination

The sample size is calculated using the single proportion formula

$$\frac{n = Z^2_{\alpha/2} pq}{d^2}$$

Z α/2 = is standard normal variant (at 5% type 1 Error (P <0.05) it is 1.96

d = margin of error was taken as 0.05.

p = expected proportion of the population with the event of outcome (prevalence) –the prevalence of CVD in CKD patients in a similar set up is 39.1%(13).

q =1-p: the probability of non-occurrence of the event of interest.

The calculated sample size was 366 patients.

Since the population size is less than 10,000, we made additional correction with

$$n = \frac{n0}{1 + \frac{n0}{N}}$$

n= Final sample size

n_0= Initial sample size (366)

N= Source population size (600)

The calculated sample size is 227 patients.

Data was checked for completeness, edited, coded and entered into Epi data version 3.1 and exported to SPSS version 25.0 statistical software for cleaning and analysis.

Frequencies and proportion were used to describe study subjects and socio-demographic characteristics. Continuous variables were expressed as means (standard deviation). Differences between group means were tested using two-tailed Student's t-test. Proportions were reported as percentages and compared between groups with Chi-square test. Pearson correlation analysis was used for evaluation of correlation between variables and CVD, while multiple logistic regression analysis was employed to establish determinative risk factors for CVD in patients with CKD.

A p value of less 0.05 was considered statistically significant.

Results

A total of 216 participants were included in this study, resulting in a response rate of 95%. Forty-one individuals were excluded for various reasons, as outlined in Figure 1. Nearly half of the participants (47.2%) were aged 60 years or older, with a mean age of 55.6 years (95% CI: 41.9–68.6). The majority were male, accounting for 69% (n = 149) of the study population. In terms of educational status, 12.5% (n = 27) had no formal education, while 31.5% (n = 68) had completed primary education, 28.7% (n = 62) had completed high school, 14.8% (n = 32) held a diploma, and 12.5% (n = 27) had a university degree. The detailed sociodemographic profile of the participants is summarized in Table 1.

Clinical and Laboratory Parameter Characteristics

In this study, the most common underlying cause of CKD was DM, accounting for 41.7% of cases, followed by hypertension (34.3%), obstructive uropathy (8.3%), glomerulonephritis (6%), and autosomal dominant polycystic kidney disease (ADPKD) (2.3%) (Table 2).

The mean estimated glomerular filtration rate (eGFR) was 37.3 mL/min/1.73 m² (95% CI: 23.3–51.5), and the median 24-hour urinary protein excretion was 745 mg (IQR: 342.2–1705.5).

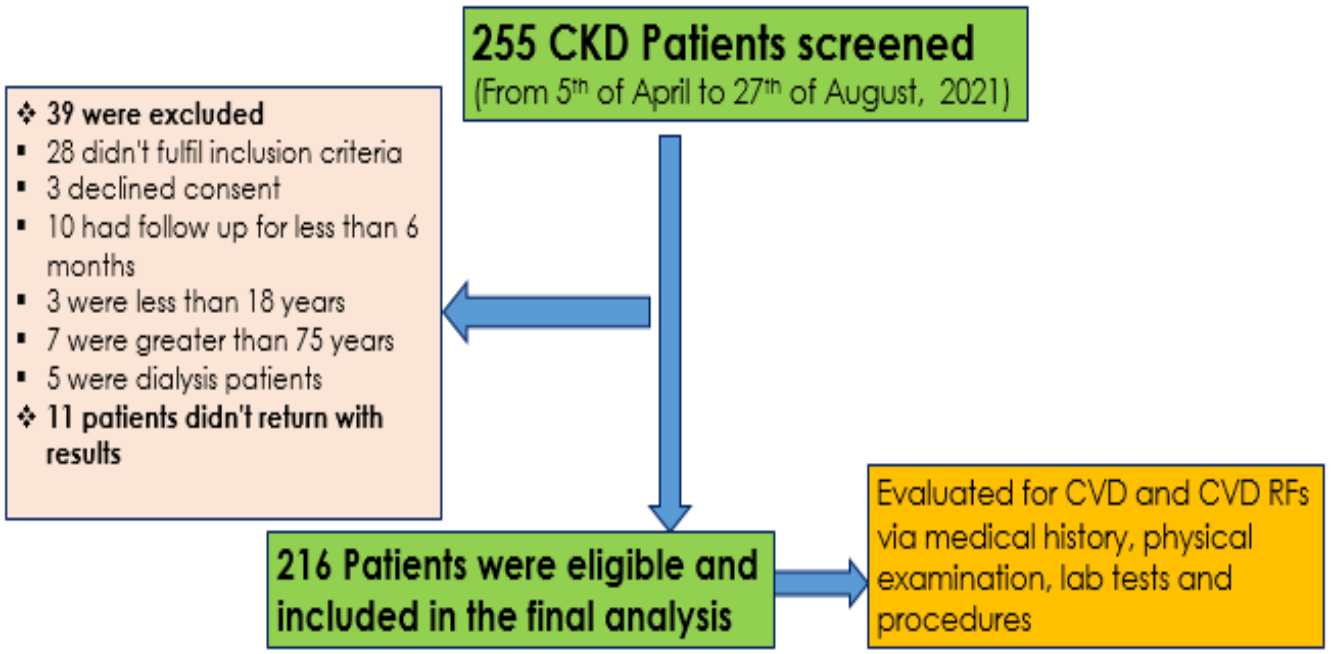

Figure 1. Participant`s flow chart showing number of patients screened, excluded and recruited in the study
CKD – chronic kidney disease, CVD – cardiovascular disease

Table 1. The sociodemographic characteristics of CKD patients at TASH renal clinic, Addis Ababa, Ethiopia, 2021

Variables	Frequency (n=216)	Percentage (%)
Age		
≤29 years	11	5.1
30-39 years	23	10.6
40-49 years	32	14.8
50-59 years	48	22.2
≥60 years	102	47.2
Gender		
Male	149	69.0
Educational status		
No formal education	27	12.5
Primary School	68	31.5
High school	62	28.7
Diploma	32	14.8
Degree and above	27	12.5
Residency area		
Urban	129	59.7
Rural	87	40.3

CKD – chronic kidney disease, TASH -Tikur Anbessa Specialized Hospital

Table 2. Characteristics of CKD in CKD patients at TASH renal clinic, Addis Ababa, Ethiopia, 2021		
Variables	**Frequency (n=216)**	**Percentage (%)**
Cause of CKD		
DM	90	41.7
Hypertension	74	34.3
Obstructive uropathy	18	8.3
Glomerulonephritis	13	6.0
ADPKD	5	2.3
Unknown	16	7.4
eGFR, ml/min/1.72m^2		
<30	73	33.8
30-45	74	34.3
>45	69	31.9
Dipstick		
-ve	52	24.1
+1	41	19.0
+2	56	25.9
+3	44	20.4
+4	23	10.6
ADPKD - autosomal dominant polycystic kidney disease. CKD – chronic kidney disease, eGFR – estimated glomerular filtration rate, TASH -Tikur Anbessa Specialized Hospital		

A total of 104 participants (48.1%) had DM. Among them, 71.1% were on insulin, while 29.7%, 10.6%, 4.8%, and 1% were

using metformin, sulfonylureas, sodium-glucose co-transporter 2 (SGLT2) inhibitors, and dipeptydil peptidase 4 (DPP-4) inhibitors, respectively. The mean FBS was 129.7 mg/dL (95% CI: 79.2–179.7), and the mean HbA1c level was 7.4% (95% CI: 5.2–9.6).

Hypertension was present in 197 participants (91.2%). The mean office systolic and diastolic blood pressures were 137.6 mmHg (95% CI: 117.5–157.7) and 75.5 mmHg (95% CI: 63.5–87.5), respectively. Calcium channel blockers were the most frequently prescribed antihypertensive agents, used by 80.2% of hypertensive patients. Renin-angiotensin-aldosterone system blockers (angiotensin converting enzyme inhibitors or angiotensin receptor blockers) were used by 67%, diuretics by 53.3%, and beta-blockers by 35.5%.

Regarding lipid profile, the mean total cholesterol, LDL, HDL, and triglyceride levels were 159.8 mg/dL (95% CI: 105.6–214), 105.0 mg/dL (95% CI: 63.8–146.2), 45.1 mg/dL (95% CI: 29.5–60.1), and 152.6 mg/dL (95% CI: 59–245.6), respectively. Statins were used by 120 participants (55.6%). The most common lipid abnormality was hypertriglyceridemia (36.8%), followed by low HDL (22.7%) and hypercholesterolemia (18.5%). Nearly half of the participants (49.1%) had LDL levels below 100 mg/dL, while only 4.3% had levels exceeding 190 mg/dL.

The mean hemoglobin and hematocrit levels were 13.4 g/dL (95% CI: 11–15.8) and 39.4% (95% CI: 32.6–45.4), respectively. Anemia, defined as hemoglobin <12 g/dL, was present in 30.6% of participants. Only 16 individuals (7.4%) were receiving treatment for anemia, all of whom were on oral iron; just one patient was on erythropoietin.

The median iPTH level was 94 IU/mL (IQR: 10–276). The mean serum calcium and phosphorus levels were 8.7 mg/dL (95% CI: 7.4–10) and 4.8 mg/dL (95% CI: 4.3–5.3), respectively. Treatment for mineral and bone disorder was documented in 22 participants (10.2%), with calcium and vitamin D supplements used in 19 (8.8%) and 7 (3.2%) participants, respectively.

The mean serum uric acid and albumin levels were 7.7 mg/dL (95% CI: 5.5–9.9) and 4.0 g/dL (95% CI: 3.5–4.5), respectively. The median erythrocyte sedimentation rate was 43 mm/hr (IQR: 28–70).

Physical measures and behavioral risk factors

Of the 216 participants, the majority (87%, n = 188) had never smoked, while 22 (10.2%) were former smokers and 6 (2.8%) were current smokers (Table 3). Among ever-smokers, the median pack-year history was 5 (IQR: 2.4–24). A total of 15 participants (6.9%) reported chewing chat, and 13 (6%) consumed alcohol.

A family history of early CVD was noted in only 3 participants (1.4%). Regular physical activity, defined as moderate exercise for at least 150 minutes per week, was reported by 50 participants (23.1%). Retroviral infection was identified in 14 participants (6.5%), all of whom were on antiretroviral therapy. Among female participants, 11 (16.4%) were postmenopausal.

The BMI was 24.7 kg/m² (95% CI: 20.2–29.2). The average waist and hip circumferences were 89.8 cm (95% CI: 74.4–104.8) and 95.2 cm (95% CI: 80.9–109.2), respectively, with a mean waist-to-hip ratio of 0.9 (95% CI: 0.8–1.0). The average ABI was 1.1 (95% CI: 0.8–1.4) on the right and 1.2 (95% CI: 0.9–1.5) on the left.

Table 3. Physical measures and behavioral risk factors of cardiovascular disease in CKD patients at TASH renal clinic, Addis Ababa, Ethiopia, 2021

Variables	Frequency (n=216)	Percentage (%)
Smoking status		
Current smoker	6	2.8
Ex-smoker	22	10.2
Never smoker	188	87.0
First degree relative with premature cardiovascular disease	3	1.4
Active chewing chat	15	6.9
Active alcohol drinking	13	6.0
Physical exercise at least 30 minutes 3*/week	50	23.1
Is the patient at menopause (for females n= 67)	11	16.7
Serostatus for HIV		
Positive	14	6.5
Negative	180	83.3
Unknown	22	10.2
BMI (n=75)		
<18.5 kg/m^2	3	4.0
18.5-24.9 kg/m2	42	56.0
BMI – body mass index, CKD – chronic kidney disease, HIV – human immunodeficiency virus, TASH -Tikur Anbessa Specialized Hospital		

Cardiovascular disease characteristics

Among the study participants, 31 (14.4%) had IHD, 24 (11.1%) had cerebrovascular disease, and 9 (4.2%) had PAD. The overall prevalence of ASCVD, encompassing IHD, cerebrovascular events, and PAD, was 27.8% (95% CI: 21.9%–34.3%). Of those with cerebrovascular disease, 13 (54.2%) had ischemic stroke, 10 (41.7%) had hemorrhagic stroke, and 1 patient had a documented TIA.

Among patients with IHD, only 3 (9.7%) had undergone coronary angiography and all had received percutaneous coronary intervention. The remaining cases were managed medically. Notably, all patients with ASCVD were on aspirin, and 57 (95%) were receiving statin therapy at the time of the study.

Echocardiographic assessments revealed LVH in 66 participants (30.6%). Systolic dysfunction was identified in 46 participants (21.3%), while diastolic dysfunction was present in 61 participants (28.2%) (Table 4). Of those with systolic dysfunction, 33 (71.7%) had mild, 10 (21.7%) moderate, and 3 (6.5%) severe left ventricular dysfunction. Among those with diastolic dysfunction, 52 (78.8%) had grade I, 10 (15.2%) grade II, 3 (4.6%) grade III, and 1 (1.5%) grade IV diastolic dysfunction. The mean left ventricular ejection fraction was 57.6% (95% CI: 46.3%–70.9%).

Only two participants in the study had cardiac prosthetic devices, both of which were permanent pacemakers.

Table 4. Cardiovascular disease characteristics of CKD patients at TASH renal clinic, Addis Ababa, Ethiopia, 2021		
Variables	**Frequency (n=216)**	**Percentage (%)**
Ischemic heart disease	31	14.4
Cerebrovascular disease Total	 24	 11.1
Ischemic stroke Hemorrhagic stroke	13 10	6.0 4.6
TIA	1	0.5
Peripheral arterial disease	9	4.2
Echocardiography		
Normal echocardiography	109	50.5
LVH	61	28.2
IHD	19	8.8
Diastolic dysfunction	66	30.6
Systolic dysfunction	46	21.3
Pulmonary hypertension	11	5.1
CKD – chronic kidney disease, IHD – ischemic heart disease, LVH – left ventricular hypertension, TIA – transient ischemic attack TASH -Tikur Anbessa Specialized Hospital		

The correlation of independent variables and CVD

In this study, several independent variables demonstrated a statistically significant positive correlation with the presence of CVD. Age showed a weak but significant positive correlation with CVD, with a correlation coefficient of r (216) = 0.190 (p = 0.005). eGFR) was also positively correlated with CVD, r(216) = 0.898 (p = 0.009), as was total cholesterol, r(216) = 0.916 (p = 0.008). Additionally, smoking pack-years showed a moderate positive correlation with CVD, r(216) = 0.456 (p = 0.048). These findings highlight the significant associations between both traditional and CKD-related risk factors and CVD among pre-dialysis CKD patients. The details of these correlations are summarized in Table 5.

Table 5. The correlation independent variable and cardiovascular disease in CKD patients at TASH renal clinic Addis Ababa, Ethiopia, 2021			
Variables	**Pearson Correlation**	N	p
Age	0.19	216	**0.005**
eGFR	0.898	216	**0.009**
24 hours	0.128	106	0.191
FBS	-0.026	166	0.740
HbA1C	-0.063	119	0.497
Total cholesterol	0.916	162	**0.008**
Triglyceride	0.046	163	0.564
Hemoglobin	0.145	216	**0.034**
Hematocrit	0.197	199	**0.005**
Calcium	-0.048	147	0.562
Smoking pack year	0.459	190	**0.048**
CKD – chronic kidney disease, eGFR – estimated glomerular filtration rate, FBS – fasting blood glucose, hemoglobin A1C, TASH -Tikur Anbessa Specialized Hospital			

Determinants of cardiovascular disease

The strength of association between independent variables and CVD was evaluated using both bivariate and multivariable logistic regression analyses (Table 6). In the bivariate analysis, age, sex, and office blood pressure were significantly associated with CVD. In the multivariable logistic regression model, an estimated glomerular filtration rate (eGFR) of 30–45 mL/min/1.73 m² was found to be protective, with participants in this group being 69% less likely to develop cardiovascular CVD; chat was associated with a markedly increased risk, with chat chewers having 5.1 times higher odds of developing CVD compared to non-chewers (AOR = 5.1, 95% CI: 1.10–24.66). Similarly, participants with uncontrolled blood pressure (≥140/90 mmHg) were 4.7 times more likely to have CVD compared to those with lower blood pressure readings (AOR = 4.7, 95% CI: 1.17–18.71).

Table 6. The association of risk factors and cardiovascular disease using binary logistic regression among participant having CKD in Addis Ababa, Ethiopia, 2021

Variables	Bivariate COR (95% CI)	p	Multivariate AOR (95% CI)	p
Gender				
Male	**2.2(1.1-3.3)**	**0.032**1	1.6(0.46, 5.55)	0.467
Female				1
Age category				
≤29 years	0.17(0.02, 1.37)	0.096	0.65(0.05, 8.85)	0.744
30-39 years	**0.25(0.07, 0.91)**	0.035	0.12(0.01, 1.26)	0.077
40-49 years	0.66(0.28, 1.57)	0.347	0.24(0.04, 1.45)	0.120
50-59 years	**0.39(0.17, 0.89)**	**0.025**1	0.29(0.08, 5.47)	0.063
≥60 years				1
eGFR, ml/min/1.72m2				
<30	0.67(0.31, 1.45)	0.312	0.71(0.24, 5.12)	0.536
30-45	1.5(0.74, 3.1)	0.2591	**0.31(0.09, 0.45)**	**0.040**
>45				1
DM	1.5(0.9, 2.1)	0.212	1.253(0.667-2.36)	0.484
FBS				
>130 mg/dL	1.3(0.66, 2.54)	0.457	1.4(0.52, 3.55)	0.53
Office BP				
≥140/90 mmHg	**2.9(1.16, 7.58)**	**0.023**	**4.7(1.17, 18.71)**	**0.029**
Chat chewing	**1.8(0.62, 5.34)**	**0.279**	**5.1(1.1, 24.66)**	**0.042**

BP – blood pressure, CKD – chronic kidney disease, DM – diabetes mellitus, eGFR – estimated glomerular filtration rate, FBS – fasting blood glucose, hemoglobin A1C, TASH -Tikur Anbessa Specialized Hospital

Discussion

This study demonstrates a substantial prevalence of ASCVD, notably ischemic heart disease and cerebrovascular disease, among pre-dialysis CKD patients. It further emphasizes the significant burden of both traditional and non-traditional CV risk factors contributing to the heightened cardiovascular morbidity observed in this population. CVD is a well-established complication across all stages of CKD, contributing significantly to morbidity and mortality. Patients with CKD often exhibit a combination of traditional cardiovascular risk factors—such as hypertension, diabetes mellitus, and dyslipidemia—as well as CKD-specific, non-traditional factors including anemia, chronic inflammation, and mineral-bone disorders. CKD is increasingly recognized as a major public health concern, particularly in low- and middle-income countries.

Although there are no population-based studies on CKD prevalence in Ethiopia, a systematic review in Sub-Saharan Africa estimated a regional prevalence of approximately 14%. In Ethiopia, CKD has been reported in 35.5% of diabetic patients and 22.1% of those with hypertension, underscoring the need for early detection and integrated CV risk management in these high-risk groups (2,19–21).

In our cohort, more than two-thirds of participants were male, aligning with findings from similar studies. Diabetes mellitus emerged as the leading cause of CKD, consistent with global epidemiological patterns. This finding contrasts with earlier reports from Ethiopia, which identified hypertension and undiagnosed glomerulonephritis as the predominant etiologies. The observed shift may reflect increasing urbanization, lifestyle changes, and the growing burden of metabolic syndrome. Furthermore, the relatively older age of our study population may have contributed to the higher prevalence of DM. The distribution of CKD stages was relatively balanced, with approximately one-third of participants in each of stages 3a, 3b, and 4 (20,22).

Hypertension was present in over 91% of participants — markedly higher than the 15.7% prevalence reported in the general Ethiopian population. This observation is consistent with findings from previous studies, including Babua et al. (13), which reported a 90% prevalence of hypertension among patients with CKD. In our cohort, one-third of participants were presumed to have hypertension as the underlying etiology of CKD. However, establishing causality remains challenging in the absence of renal biopsy or longitudinal data. Notably, the majority of patients had controlled blood pressure, with only 10% recording office blood pressure values ≥140/90 mmHg. Although the optimal target for blood pressure control in CKD continues to be a subject of ongoing debate, current international guidelines recommend maintaining systolic blood pressure between 130 and 139 mmHg. Despite this, only two-thirds of participants were receiving renin-angiotensin-aldosterone system inhibitors, indicating suboptimal adherence to guideline-recommended therapy (13,23,24).

The prevalence of DM in our cohort was notably high at 48.1%, significantly exceeding the national estimate of 3.2% and surpassing rates reported in comparable CKD studies. This elevated prevalence may be attributed to diabetes mellitus serving both as a major risk factor and as a leading cause of CKD. Despite the well-established renal and cardiovascular benefits of SGLT2 inhibitors, only a small proportion of patients in our study were receiving these agents. Their underutilization is likely due to limited access and affordability in the local healthcare setting (25, 26).

The mean hemoglobin level in our cohort was 13.4 g/dL, which is slightly higher than that reported in comparable studies—likely reflecting the earlier CKD stages of our participants. Despite this, 30% of individuals had hemoglobin levels below 12 g/dL, and only a small proportion were receiving treatment for anemia, underscoring a significant gap in care. In contrast, a study from Uganda documented hemoglobin levels below 11 g/dL in 71.9% of CKD patients; however, their cohort included a higher proportion of individuals with stage 5 CKD, which may account for the greater severity of anemia observed (13, 27).

The mean LDL cholesterol level in our cohort was 105 mg/dL, comparable to global CKD cohorts and lower than other high-risk populations in Ethiopia, likely due to the high rate of statin use (55.6%). Hypercholesterolemia prevalence (18.5%) was higher than the national average (5.2%), as expected in this high-risk group (25).

The prevalence of HIV in our cohort was 6.5%, markedly higher than the national average of 0.9%, yet lower than that reported in comparable regional studies, including one from Uganda. HIV remains a significant risk factor for the development of CKD in Sub-Saharan Africa. With respect to nutritional status, 40% of participants were classified as overweight, while none met the criteria for obesity. Notably, in advanced stages of CKD, a lower body mass index (BMI) has been paradoxically associated with poorer clinical outcomes—a phenomenon referred to as reverse epidemiology (28–30).

The ASCVD in our cohort was 27.8%, aligning with findings from several international CKD cohorts, including MERENA (Spain, 39.1%), CRISIS (UK, 47.2%), CRIC (US, 33.4%), CKD-ROUTE (Japan, 26.8%), and C-STRIDE (China, 9.8%). The relatively lower prevalence of PAD observed in our study may be attributable to underdiagnosis due to limited diagnostic resources.

When compared to the estimated 5% ASCVD prevalence in the general Ethiopian population, the markedly higher rate observed among CKD patients underscores the critical need for early CV risk assessment and integrated intervention strategies within CKD management (7–11).

LVH was identified in nearly one-third of our participants, a prevalence that appears lower than expected given the high rate of hypertension in the cohort.

In comparison, Babua et al. (13) reported an LVH prevalence of 54.4% among CKD patients, likely reflecting more advanced disease stages and suboptimal blood pressure control in their study population. The prevalence of systolic dysfunction, defined as an ejection fraction <50%, was 21.3% in our cohort—slightly higher than the 18.9% reported in a Ugandan study. This difference may be attributable to a greater burden of IHD in our study population(13, 31).

In our study, age, eGFR, total cholesterol, and smoking pack-years were all positively correlated with the presence of ASCVD. While the associations with age, elevated cholesterol, and tobacco exposure are well established in the literature, the positive correlation with eGFR was unexpected. A possible explanation is that individuals with more advanced CKD and lower eGFR may be more likely to develop non-atherosclerotic CV conditions, such as uremic cardiomyopathy, which were not specifically assessed in this study. Alternatively, patients with lower eGFR may receive more intensive management of modifiable risk factors, thereby attenuating their ASCVD burden. Multivariable logistic regression analysis identified chat chewing and uncontrolled office blood pressure (≥140/90 mmHg) as independent predictors of ASCVD, with adjusted odds ratios of 5.1 and 4.7, respectively. Previous studies have associated chat chewing with increased risks of myocardial infarction and stroke. Likewise, uncontrolled hypertension remains a well-recognized contributor to CV morbidity in both the general and CKD populations(32–35).

Strengths of the study

A major strength of this study is that it is the first to assess ASCVD and associated risk factors among pre-dialysis CKD patients in Ethiopia, using a robust sample size and detailed clinical and echocardiographic data.

Study limitations

However, several limitations must be acknowledged. First, the single-center design may limit generalizability. Second, non-consecutive recruitment may introduce selection bias. Third, although the sample size was reasonable, it remains small relative to the broader CKD population. Furthermore, most patients did not undergo renal biopsy, limiting the precision of CKD etiology classification. The diagnosis of IHD relied on clinical and echocardiographic criteria, with only three patients undergoing coronary angiography. Finally, the study focused on a limited set of CVDs and risk factors, which may underestimate the total CV burden in this population.

Conclusion

This study demonstrated a high prevalence of ASCVD among pre-dialysis CKD patients attending the renal clinic at Tikur Anbessa Specialized Hospital. In addition, there was a substantial burden of traditional and non-traditional cardiovascular risk factors, including diabetes mellitus, hypertension, anemia, and hypertriglyceridemia. These findings underscore the urgent need for early cardiovascular risk assessment and targeted interventions in this high-risk population.

Ethics: Data collection was carried out after approval of the research proposal by institutional review board of Department of Internal Medicine, School of Medicine, College of Health Sciences, Addis Ababa University. Appropriate measures were taken to protect confidentiality of the collected information. All collected data didn't contain patient identifications like names, patient's medical record number and residence addresses. Written informed consent was taken from eligible patients. Patients were provided with information on the objectives of the study and confidentiality issues. At the end of the session, patients were given the opportunity to enroll in the study at that time and continued the appropriate CKD care per Ethiopian Federal Ministry of Health and international standard of care guidelines. Those who want to discuss their participation in the study with family members were given an opportunity to do.

Peer-review- External and internal

Conflict of interest- None to declare

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