

Prevalence, Socioeconomic Determinants, and Health-System Factors Associated with Laboratory-Confirmed Renal Impairment Among Adults Attending Tertiary Referral Hospitals in Mogadishu, Somalia: A Cross-Sectional Study

Abdirezak Mawlid Abdi. RN, BSC, MPH.

abdirezak.abdi@bu.edu.so

Ministry of Health

Hamda almis

Jigjiga University,

Research Article

Keywords: Chronic kidney disease, renal impairment, estimated glomerular filtration rate, proteinuria, hypertension, diabetes mellitus, non-communicable diseases, Universal Health Coverage, Somalia

Posted Date: October 22nd, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-10481783/v1>

License:   This work is licensed under a Creative Commons Attribution 4.0 International License. [Read Full License](#)

Additional Declarations: No competing interests reported.

Abstract

Background

Chronic kidney disease (CKD) is an important and growing public health challenge that disproportionately affects populations in low- and middle-income countries. Limited diagnostic capacity, constrained access to care, and socioeconomic disadvantage contribute to delayed diagnosis and poor clinical outcomes. In Somalia, evidence describing the burden and determinants of CKD remains limited despite the increasing prevalence of hypertension, diabetes mellitus, and other non-communicable diseases (NCDs). This study estimated the prevalence of renal impairment among adults attending tertiary referral hospitals in Mogadishu, identified associated socioeconomic and clinical factors, and examined health system barriers to kidney care.

Methods

A hospital-based cross-sectional study was conducted between April and July 2026 in two tertiary referral hospitals in Mogadishu, Somalia. Systematic sampling was used to screen 312 adult outpatients, resulting in 200 participants with complete clinical, laboratory, and questionnaire data for analysis. Renal function was assessed using serum creatinine, blood urea nitrogen (BUN), urine protein dipstick testing, and estimated glomerular filtration rate (eGFR) calculated using the 2021 CKD-EPI race-free equation. Multivariable binary logistic regression was performed to identify factors independently associated with renal impairment, with results reported as adjusted odds ratios (aORs) and 95% confidence intervals (CIs).

Results

Among the 200 participants, 145 (72.5%) had reduced eGFR (<60 mL/min/1.73 m²), 168 (84.0%) had elevated serum creatinine, 158 (79.0%) had proteinuria on dipstick testing, and 117 (58.5%) had elevated BUN concentrations. Overall, 128 participants (64.0%) reported a previous clinical diagnosis of CKD. Socioeconomic disadvantage was common, with 130 (65.0%) reporting a monthly household income below USD 100 and 110 (55.0%) having no formal education. Independent factors associated with renal impairment included age ≥ 48 years (aOR = 2.85; 95% CI: 1.42–5.72; $p = 0.003$), hypertension (aOR = 3.15; 95% CI: 1.58–6.28; $p = 0.001$), diabetes mellitus (aOR = 2.48; 95% CI: 1.25–4.92; $p = 0.009$), frequent use of non-prescribed non-steroidal anti-inflammatory drugs (NSAIDs) (aOR = 2.21; 95% CI: 1.12–4.36; $p = 0.022$), and treatment non-adherence (aOR = 1.95; 95% CI: 1.02–3.73; $p = 0.043$).

Conclusions

Renal impairment was common among adults attending two tertiary referral hospitals in Mogadishu and was strongly associated with established cardiometabolic risk factors, frequent non-prescribed NSAID use, and indicators of socioeconomic disadvantage. These findings suggest opportunities to strengthen early detection and management of kidney disease through integration of routine renal assessment within primary care and NCD services, expansion of diagnostic capacity under Somalia's Essential Package of Health Services (EPHS 2020), improved regulation of nephrotoxic medications, and enhanced community-based screening and referral within the national Universal Health Coverage (UHC) agenda.

Trial registration: Not applicable

Key Messages

- Laboratory-confirmed renal impairment was common among adults attending tertiary referral hospitals in Mogadishu.
- Hypertension, diabetes mellitus, older age, frequent non-prescribed NSAID use, and treatment non-adherence were independently associated with renal impairment.
- The findings support strengthening early detection and integrated management of kidney disease within Somalia's primary healthcare and non-communicable disease programmes.
- Further nationally representative and longitudinal research is needed to define the population burden of chronic kidney disease and guide evidence-informed health policy.

Background

Chronic kidney disease (CKD) represents a major and rapidly expanding global public health crisis, affecting an estimated 850 million individuals worldwide and driving severe morbidity, premature cardiovascular mortality, and escalating healthcare costs. Data from the Global Burden of Disease (GBD) study demonstrate that CKD has emerged as one of the fastest-rising primary causes of death globally. This epidemiological trajectory is driven by demographic aging, urbanizing lifestyles, and an increasing prevalence of cardiometabolic risk factors, most notably hypertension and diabetes mellitus. Although high-income countries have progressively implemented systematic screening, routine biomarker monitoring, and early disease-modifying therapies, low- and middle-income countries (LMICs) bear a disproportionate share of adverse outcomes due to fragile health system infrastructure and late diagnostic presentation.

Sub-Saharan Africa (SSA) faces a particularly complex and heavy CKD burden. Systematic reviews and meta-analyses across the continent estimate population-wide Prevalence of laboratory-confirmed renal impairment between 13.9% and 15.8%. Unlike high-resource regions where renal disease is predominantly driven by geriatric type 2 diabetes and vascular sclerosis, CKD in SSA affects younger, economically active adults. It arises from a combination of non-communicable diseases (NCDs), endemic glomerulonephritis, infectious nephropathies (such as HIV, malaria, and schistosomiasis), nephrotoxic drug exposures, and genetic susceptibility factors like APOL1 risk variants.

Structural health inequities and social determinants of health—including extreme poverty, low educational attainment, gender disparities, geographic isolation, and an absence of social health protection—further exacerbate disease incidence and progression across SSA. In resource-constrained environments, routine kidney function assessments (e.g., serum creatinine, urine protein dipsticks) are rarely integrated into primary healthcare clinics. Consequently, early-stage renal impairment (KDIGO Stages 1–3) remains clinically silent, with most patients seeking emergency care only after developing severe uremic symptoms or end-stage renal disease (ESRD). At this advanced stage, lifesaving renal replacement therapy (RRT)—including maintenance hemodialysis and kidney transplantation—is either non-existent, severely restricted, or financially catastrophic due to unmitigated out-of-pocket health expenditures.

Rationale and Context in Somalia

Somalia represents an acute example of these challenges within a fragile and post-conflict setting. Decades of prolonged conflict, civil instability, and severe health infrastructure disruption have compromised the country's

capacity to deliver continuous chronic disease care. While recent federal health system reforms—such as Somalia’s Universal Health Coverage (UHC) Roadmap and the updated Essential Package of Health Services (EPHS 2020)—have laid the groundwork for primary health system rebuilding, actual service delivery remains heavily focused on maternal-child health and infectious disease control.

Essential diagnostic tests for kidney disease are functionally absent at primary health centers (EPHS Levels 1 and 2), forcing patients to seek care in private secondary or tertiary medical facilities where services are funded via direct out-of-pocket payments. In a context where a significant proportion of the population lives in poverty, these costs prevent timely diagnostic evaluation and continuous medication adherence. Furthermore, unregulated over-the-counter sales of nephrotoxic medications, particularly non-steroidal anti-inflammatory drugs (NSAIDs), create a widespread, unmonitored risk factor for tubulointerstitial damage.

Despite the evident clinical risk, empirical epidemiological data on renal disease burden, laboratory biomarker profiles, and associated socioeconomic determinants in Somalia remain limited. Existing studies are constrained by small, non-representative samples, reliance on uncalibrated diagnostic methods, or an absence of multivariable statistical modeling. This evidence gap hinders health planners from designing targeted NCD interventions or allocating scarce resources effectively within Somalia’s evolving UHC architecture.

Study Objectives

This study addresses this empirical gap by conducting a rigorous clinical evaluation of adult patients attending major tertiary referral hospitals in Mogadishu, Banadir Region, Somalia. The specific objectives were:

1. To estimate the prevalence of laboratory-confirmed renal impairment (abnormal eGFR, elevated serum creatinine, and proteinuria) and self-reported CKD among adult hospital attendees.
2. To characterize the sociodemographic, clinical, and behavioral profiles of the study cohort through an equity lens.
3. To identify independent clinical and socioeconomic factors associated with CKD using multivariable binary logistic regression modeling.
4. To contextualize these findings within regional Sub-Saharan and East African nephrology data, formulating actionable policy recommendations aligned with Somalia’s UHC Roadmap, EPHS 2020, and the Somalia Community Health Strategy (2025–2029).

METHODS

Study Design and Setting

A hospital-based descriptive and analytical cross-sectional study was conducted across major tertiary referral hospitals in Mogadishu, Banadir Region, Somalia, between April and July 2026. Mogadishu serves as the primary clinical, economic, and administrative center of Somalia, accommodating a dense urban population alongside internally displaced persons (IDPs) and regional patient referrals.

Target Population, Eligibility Criteria, and Participant Flow

The target population comprised adult patients (18 years of age) attending outpatient medical clinics and general internal medicine departments within the participating tertiary referral facilities.

- **Inclusion Criteria:** Adult hospital attendees aged 18 years or older who provided written or witness-verified informed consent and were capable of completing behavioral interviews and clinical laboratory sampling.
- **Exclusion Criteria:** Patients presenting in acute clinical shock or severe delirium requiring immediate resuscitation; individuals unable to participate in interviews due to severe cognitive impairment without a designated legal proxy; and pregnant women (to avoid confounding due to physiological alterations in eGFR, systemic hemodynamics, and urinary protein excretion).

As outlined Fig. 1, During the four-month study period, 312 consecutive adult outpatient registrants were screened using systematic sampling (every 3rd registrant). Of the 312 screened individuals:

- n = 48 were excluded based on predefined clinical criteria: 18 pregnant women, 12 presenting with acute clinical shock or severe delirium, and 18 unable to provide informed consent.
- n = 264 eligible participants entered sampling enrollment.
- n = 64 were excluded during processing: 38 due to incomplete clinical or pharmacological history records, and 26 due to failure to provide paired venous blood and midstream urine samples.
- N = 200 fully evaluated participants formed the final analytical cohort with complete clinical, laboratory, and behavioral datasets.

Flowchart illustrating the screening, eligibility selection, and processing stages to derive the final analytical cohort. Outpatient registrants were assessed against clinical and processing criteria, resulting in a final analyzed cohort of 200 participants with complete datasets.

Sample Size Determination

Sample size planning was based on recommendations for multivariable logistic regression analysis to minimize model overfitting and ensure stable parameter estimation. Current methodological guidance recommends a minimum of 10–15 outcome events per candidate predictor variable (events per variable, EPV). Eight clinically relevant predictor variables were prespecified for multivariable modelling, requiring approximately 80–120 outcome events.

An analytical sample of **200 participants** with complete clinical, laboratory, and questionnaire data was therefore considered adequate to support multivariable regression analyses while remaining feasible within the laboratory processing capacity and operational constraints of the participating tertiary referral hospitals. Complete-case analysis was subsequently performed for all eligible participants included in the final analytical dataset.

Data Collection and Laboratory Measurements

Data were collected by trained clinical research nurses using a standardized, pre-tested, interviewer-administered structured questionnaire that was specifically developed for this study (**Additional File 1**). The questionnaire was designed to capture participants' sociodemographic characteristics, medical history, behavioral risk factors, health-seeking practices, and other variables relevant to the assessment of renal impairment. Its development

was informed by internationally recognized noncommunicable disease surveillance frameworks, including the World Health Organization (WHO) Stepwise Approach to Noncommunicable Disease Risk Factor Surveillance (WHO STEPS), and was adapted to the clinical and health-system context of tertiary referral hospitals in Mogadishu, Somalia.

Following completion of the questionnaire, participants underwent standardized clinical assessment and laboratory investigations conducted in accordance with the study protocol. Laboratory measurements included serum creatinine, estimated glomerular filtration rate (eGFR) calculated using the 2021 CKD-EPI race-free equation, blood urea nitrogen, urine protein assessment, blood pressure measurement, and anthropometric evaluation. Uniform data collection procedures and standardized operating protocols were implemented across all participating study sites to ensure consistency, reliability, and data quality.

Socio-demographic and Health Access Variables

Information was collected on participant age, sex, educational attainment (no formal education, primary, secondary, or higher education), monthly household income (< USD 100, USD 100–400, or > USD 400), employment status, health-seeking Behaviour, medication purchasing practices, and out-of-pocket healthcare expenditure.

Clinical and Anthropometric Measurements

Blood pressure was measured using calibrated automated sphygmomanometers (Omron HEM-7120) after participants had rested in a seated position for at least five minutes. Hypertension was defined as documented current use of antihypertensive medication or measured systolic blood pressure ≥ 130 mmHg and/or diastolic blood pressure ≥ 80 mmHg, consistent with KDIGO recommendations for individuals at risk of CKD.

Standing height and body weight were measured using standardized procedures, and body mass index (BMI) was calculated as weight (kg) divided by height squared (m^2).

Diabetes mellitus was defined as physician-diagnosed diabetes, current use of glucose-lowering medication, fasting plasma glucose ≥ 126 mg/dL (7.0 mmol/L), or random plasma glucose ≥ 200 mg/dL (11.1 mmol/L).

Laboratory Assessment

Venous blood (5 mL) and clean-catch midstream urine specimens were collected using standardized clinical procedures and processed within two hours of specimen collection.

Serum Creatinine and Blood Urea Nitrogen

Serum creatinine and blood urea nitrogen (BUN) concentrations were measured using an automated clinical chemistry analyzer (Mindray BS-240) according to the manufacturer's operating procedures. Elevated serum creatinine was defined as > 1.2 mg/dL in males and > 1.0 mg/dL in females, consistent with the laboratory reference intervals used by the participating hospitals.

Estimated Glomerular Filtration Rate (eGFR)

Kidney function was estimated using the **2021 Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) race-free creatinine equation**. Renal impairment was defined as an estimated glomerular filtration rate (eGFR) < 60 mL/min/1.73 m².

Proteinuria Assessment

Proteinuria was assessed using Roche Combur-Test urine dipsticks according to the manufacturer's instructions. Protein positivity was defined as a dipstick result of $\geq 1+$ (approximately ≥ 30 mg/dL).

Assessment of Renal Impairment and Chronicity

Because this investigation employed a cross-sectional study design, serum creatinine, eGFR, and proteinuria were measured at a single clinical encounter. Consequently, laboratory findings primarily represent the point prevalence of renal impairment rather than definitive chronic kidney disease.

Whenever available, participants' medical records and documented clinical histories were reviewed to identify evidence of persistent kidney dysfunction exceeding three months in accordance with KDIGO recommendations. However, participants without documented longitudinal laboratory measurements could not be definitively classified as having chronic kidney disease. Therefore, the primary study outcome was interpreted as laboratory-confirmed renal impairment.

Statistical Analysis

Data were entered, verified, cleaned, and analysed using IBM SPSS Statistics version 26.0. Continuous variables were summarized using means and standard deviations (SD) or medians with interquartile ranges (IQR), where appropriate according to data distribution. Categorical variables were summarized using frequencies and percentages.

Associations between participant characteristics and renal impairment were initially examined using Pearson's chi-square (χ^2) test for categorical variables. Crude odds ratios (ORs) with corresponding 95% confidence intervals (CIs) were estimated from bivariate analyses.

Variables considered clinically important or demonstrating an association with renal impairment at **$p < 0.10$** in bivariate analyses were entered into a multivariable binary logistic regression model to identify factors independently associated with renal impairment while controlling for potential confounding. Adjusted odds ratios (aORs), 95% confidence intervals, Wald statistics, and corresponding p-values are reported. Statistical significance was defined as a two-sided **$p\text{-value} < 0.05$** .

Prior to model estimation, multicollinearity among candidate predictor variables was evaluated using variance inflation factors (VIFs). Model calibration was assessed using the Hosmer-Lemeshow goodness-of-fit test. Complete-case analysis was performed, with only participants having complete questionnaire, clinical, and laboratory data included in the final regression analyses.

Health Equity Analysis

To examine socioeconomic disparities in kidney health, renal impairment was further evaluated across key social determinants of health, including household income, educational attainment, employment status, and financial barriers to healthcare. Stratified analyses explored differences in renal impairment according to these indicators to identify potential inequities in disease burden and access to diagnostic services. These analyses were interpreted within the framework of Universal Health Coverage (UHC), emphasizing equitable access to essential kidney health services.

RESULTS

Socioeconomic and Demographic Characteristics

A total of 200 participants with complete questionnaire, clinical, and laboratory data were included in the final analysis. The mean age was 49.2 ± 14.1 years, and 120 participants (60.0%) were aged 48 years or older. Females comprised 56.5% (n = 113) of the study population.

The study population exhibited substantial socioeconomic disadvantage. More than half of the participants (55.0%, n = 110) had no formal education, 65.0% (n = 130) reported a monthly household income below USD 100, and 65.0% (n = 130) were unemployed. These findings indicate that the study population was characterized by considerable educational and economic vulnerability as outlined in Table 1.

Table 1
Socioeconomic and Demographic Characteristics of Participants (N = 200)

Variable	Category	Frequency (n)	Percentage (%)
Age Group (years)	18–37	45	22.5
	38–47	35	17.5
	48–57	50	25.0
	≥ 58	70	35.0
Sex	Female	113	56.5
	Male	87	43.5
Educational Level	No formal education	110	55.0
	Primary	38	19.0
	Secondary	32	16.0
	College/University	20	10.0
Monthly Household Income	<USD100	130	65.0
	USD100–400	41	20.5
	>USD400	29	14.5
Employment Status	Unemployed	130	65.0
	Employed/Self-employed	70	35.0

Legend

Data compiled from survey results of adult outpatients attending participating tertiary referral hospitals in Mogadishu, Somalia. Values reflect complete-case analyses for the final cohort (N = 200).

Clinical Characteristics and Laboratory Findings

As outlined in Table 2, Laboratory evaluation demonstrated a high frequency of renal abnormalities among study participants. Overall, 145 participants (72.5%) had reduced estimated glomerular filtration rate (eGFR < 60 mL/min/1.73 m²), 168 (84.0%) had elevated serum creatinine concentrations, 158 (79.0%) had proteinuria (≥ 1 + on urine dipstick testing), and 117 (58.5%) had elevated blood urea nitrogen concentrations.

In comparison, 128 participants (64.0%) reported having previously received a physician diagnosis of chronic kidney disease, indicating that laboratory evidence of renal impairment exceeded the proportion of participants with a previously established clinical diagnosis. Hypertension was present in 125 participants (62.5%), while 97 (48.5%) had diabetes mellitus.

Table 2
Clinical Characteristics and Laboratory Measures of Renal Function (N = 200)

Clinical Variable	Category	Frequency (n)	Percentage (%)
eGFR	Reduced (< 60 mL/min/1.73 m ²)	145	72.5
	≥ 60 mL/min/1.73 m ²	55	27.5
Serum Creatinine	Elevated	168	84.0
	Normal	32	16.0
Proteinuria	Positive (≥ 1+)	158	79.0
	Negative/Trace	42	21.0
Blood Urea Nitrogen	Elevated	117	58.5
	Normal	83	41.5
Hypertension	Present	125	62.5
	Absent	75	37.5
Diabetes Mellitus	Present	97	48.5
	Absent	103	51.5
Previous Physician Diagnosis of CKD	Yes	128	64.0
	No	72	36.0

Legend

Clinical and laboratory evaluation metrics recorded from study participants during hospital attendance

Socioeconomic Factors and Health-Seeking Behavior's

Socioeconomic disadvantage was associated with medication practices and healthcare utilization. Participants with a monthly household income below USD100 were significantly more likely to report frequent use of non-prescribed non-steroidal anti-inflammatory drugs (NSAIDs) than those with higher incomes (70.8% vs 38.6%; $\chi^2 = 19.54$; $p < 0.001$). They also reported higher frequencies of treatment non-adherence (63.8% vs 34.3%; $\chi^2 = 16.01$; $p < 0.001$) and lack of routine health check-ups (70.0% vs 38.6%; $\chi^2 = 18.22$; $p < 0.001$).

Similarly, participants without formal education demonstrated significantly higher frequencies of non-prescribed NSAID use (70.9% vs 45.6%; $\chi^2 = 13.12$; $p < 0.001$), treatment non-adherence (65.5% vs 38.9%; $\chi^2 = 14.15$; $p < 0.001$), and absence of routine health assessments (70.0% vs 45.6%; $\chi^2 = 12.18$; $p < 0.001$).

These findings Table 3 indicate that socioeconomic disadvantage was associated with behavioral factors that may adversely affect kidney health and access to preventive healthcare services.

Table 3
Association Between Socioeconomic Factors and Health-Seeking Behaviours (N = 200)

Socioeconomic Determinant	Total (n)	Frequent NSAID Use n (%)	Treatment Non-Adherence n (%)	No Routine Check-up n (%)
Monthly Household Income				
<USD100	130	92 (70.8)	83 (63.8)	91 (70.0)
≥USD100	70	27 (38.6)	24 (34.3)	27 (38.6)
χ^2 (p-value)	—	19.54 (< 0.001)	16.01 (< 0.001)	18.22 (< 0.001)
Educational Level				
No formal education	110	78 (70.9)	72 (65.5)	77 (70.0)
Primary education or higher	90	41 (45.6)	35 (38.9)	41 (45.6)
χ^2 (p-value)	—	13.12 (< 0.001)	14.15 (< 0.001)	12.18 (< 0.001)

Factors Associated with Laboratory-Confirmed Renal Impairment

Bivariate analyses identified statistically significant associations between laboratory-confirmed renal impairment and older age, hypertension, diabetes mellitus, frequent non-prescribed NSAID use, treatment non-adherence, and low household income.

Variables considered clinically relevant or demonstrating an association at $p < 0.10$ in bivariate analyses were entered into a multivariable binary logistic regression model. Model calibration was acceptable according to the Hosmer–Lemeshow goodness-of-fit test ($\chi^2 = 6.42$; $p = 0.599$), indicating no evidence of poor model fit.

After adjustment for age, sex, educational attainment, household income, hypertension, diabetes mellitus, frequent NSAID use, and treatment non-adherence, five variables remained independently associated with laboratory-confirmed renal impairment.

Participants aged 48 years or older had nearly threefold higher odds of renal impairment than younger participants (aOR = 2.85; 95% CI: 1.42–5.72; $p = 0.003$).

Hypertension was the strongest independent predictor (aOR = 3.15; 95% CI: 1.58–6.28; $p = 0.001$), followed by diabetes mellitus (aOR = 2.48; 95% CI: 1.25–4.92; $p = 0.009$).

Frequent use of non-prescribed NSAIDs (aOR = 2.21; 95% CI: 1.12–4.36; $p = 0.022$) and treatment non-adherence (aOR = 1.95; 95% CI: 1.02–3.73; $p = 0.043$) also remained independently associated with renal impairment.

Although low household income demonstrated a statistically significant crude association with renal impairment, this association was attenuated after adjustment for clinical and behavioural covariates (aOR = 1.62; 95% CI: 0.84–3.12; $p = 0.150$). As outlined in Table 4.

Table 4

Factors Associated with Laboratory-Confirmed Renal Impairment: Bivariate and Multivariable Logistic Regression Analysis

Risk Factor	Category	Renal Impairment Present (n = 145)	No Renal Impairment (n = 55)	χ^2	p-value	Crude OR (95% CI)	Adjusted OR (95% CI)	Adjusted p-value
Age	≥ 48 years	—	—	15.82	< 0.001	3.32 (1.81–6.08)	2.85 (1.42–5.72)	0.003
	< 48 years	1	1			1.00	1.00	
Hypertension	Present	—	—	21.05	< 0.001	4.02 (2.17–7.46)	3.15 (1.58–6.28)	0.001
	Absent	1	1			1.00	1.00	
Diabetes Mellitus	Present	—	—	14.38	< 0.001	3.22 (1.74–5.94)	2.48 (1.25–4.92)	0.009
	Absent	1	1			1.00	1.00	
Frequent NSAID Use	Present	—	—	12.56	< 0.001	2.91 (1.59–5.32)	2.21 (1.12–4.36)	0.022
	Absent	1	1			1.00	1.00	
Treatment non-adherence	Present	—	—	7.82	0.005	2.31 (1.28–4.19)	1.95 (1.02–3.73)	0.043
	Absent	1	1			1.00	1.00	
Monthly Household Income	<USD100	—	—	6.84	0.009	2.08 (1.13–3.83)	1.62 (0.84–3.12)	0.150
	≥USD100	1	1			1.00	1.00	

Legend

Adjusted for age, sex, educational attainment, household income, hypertension, diabetes mellitus, frequent non-prescribed NSAID use, and treatment non-adherence. Model calibration was assessed using the Hosmer–Lemeshow goodness-of-fit test ($\chi^2 = 6.42$; $p = 0.599$). Odds ratios are presented with 95% confidence intervals. Statistical significance was defined as $p < 0.05$.

DISCUSSION

Principal Findings

This study provides contemporary evidence on the burden of **laboratory-confirmed renal impairment** among adults attending two tertiary referral hospitals in Mogadishu, Somalia. More than two-thirds of participants had reduced estimated glomerular filtration rate (eGFR < 60 mL/min/1.73 m²), nearly four-fifths had proteinuria, and elevated serum creatinine concentrations were common. These findings indicate that renal abnormalities are frequently identified among adults presenting for tertiary-level care.

Because this investigation was conducted among hospital attendees rather than a community-based population, the observed prevalence should not be interpreted as representative of the Somali population. Instead, the findings reflect the burden of renal impairment among adults seeking specialized hospital care, who are likely to have more advanced disease and multiple comorbidities.

An important observation was the discrepancy between laboratory evidence of renal impairment and previous physician diagnosis of CKD. Although 64.0% of participants reported a previous diagnosis of CKD, larger proportions demonstrated reduced eGFR or proteinuria during study assessment. This difference may reflect delayed diagnosis, limited access to routine kidney function testing, disease progression before referral, or incomplete recognition of kidney disease within primary healthcare services. Given the cross-sectional design and single-point laboratory assessment, the primary study outcome should be interpreted as **laboratory-confirmed renal impairment**, although available medical records suggested that many participants had established chronic kidney disease.

Comparison with Previous Studies

The prevalence of laboratory-confirmed renal impairment observed in this study was substantially higher than estimates reported from community-based populations across Africa. Previous systematic reviews and meta-analyses have estimated Prevalence of laboratory-confirmed renal impairment in the general African population to range between approximately 14% and 16%, while community-based surveys conducted in East Africa have generally reported prevalence below 15%.

Direct comparison with community studies should be interpreted cautiously because the present investigation enrolled adults attending tertiary referral hospitals, where patients commonly present with advanced illness and multiple chronic conditions. Comparison with hospital-based studies therefore provides a more appropriate benchmark.

Hospital-based studies conducted in Ethiopia, Sudan, and Tanzania have reported renal impairment or Prevalence of laboratory-confirmed renal impairment ranging from approximately 28% to 42% among adults with diabetes mellitus, hypertension, or other high-risk conditions. The higher burden observed in the present study may reflect differences in referral pathways, delayed healthcare utilization, restricted diagnostic capacity, and the prolonged impact of health system disruption rather than true geographic differences in disease occurrence.

As outlined in Table 5, Overall, these findings are consistent with evidence indicating that kidney disease is frequently detected at advanced stages in low-resource settings where routine screening and early diagnosis remain limited.

Table 5
Comparison of Renal Impairment Estimates Across Global, African, and East African Studies

Study / Region	Study Population	Outcome Measure	Prevalence	Principal Interpretation
Global Burden of Disease (Bikbov et al.)	General population	CKD	9.1%	CKD burden increases with ageing and cardiometabolic diseases.
Kaze et al.	Africa (meta-analysis)	CKD	15.8% (95% CI: 12.1–19.9)	High CKD burden across African populations.
Stanifer et al.	Sub-Saharan Africa	CKD	13.9% (95% CI: 12.2–15.7)	Large proportion of undiagnosed CKD due to limited screening.
Kalyesubula et al.	Kenya/Uganda community populations	CKD	6.8%	Lower prevalence in community settings than tertiary-care populations.
Teshome et al.	Ethiopia diabetic clinic	CKD	33.2%	High burden among adults with diabetes receiving hospital care.
Hospital studies (Sudan/Tanzania)	High-risk hospital populations	Renal impairment	28–42%	Advanced presentation in referred patients.
Current study (Somalia)	Adults attending tertiary referral hospitals	Laboratory-confirmed renal impairment	72.5% (reduced eGFR); 79.0% (proteinuria)	High burden likely reflecting delayed presentation, referral bias, and limited access to early diagnosis.

Clinical and Public Health Implications

As outlined in Fig. 2, Older age, hypertension, diabetes mellitus, frequent use of non-prescribed NSAIDs, and treatment non-adherence remained independently associated with laboratory-confirmed renal impairment after adjustment for demographic and socioeconomic variables. The associations with hypertension and diabetes are consistent with established mechanisms of progressive kidney injury and correspond with findings reported throughout sub-Saharan Africa and other low- and middle-income countries. These results reinforce the importance of strengthening integrated management of chronic non-communicable diseases within primary healthcare.

The observed association between frequent non-prescribed NSAID use and renal impairment is biologically plausible given the known nephrotoxic effects of prolonged NSAID exposure. Nevertheless, because exposures and outcomes were measured simultaneously, causality cannot be established. Similarly, treatment non-adherence may contribute to inadequate control of hypertension and diabetes, thereby increasing the likelihood of progressive kidney dysfunction. However, reverse causation cannot be excluded because worsening kidney disease itself may influence treatment adherence as outlined in Fig. 2.

Older age, hypertension, diabetes mellitus, frequent use of non-prescribed NSAIDs, and treatment non-adherence remained independently associated with laboratory-confirmed renal impairment after adjustment for demographic and socioeconomic variables. The associations with hypertension and diabetes are consistent with established mechanisms of progressive kidney injury and align with findings reported across sub-Saharan Africa

and other low- and middle-income countries. These findings reinforce the importance of strengthening integrated management of chronic non-communicable diseases within primary healthcare. The independent predictors of laboratory-confirmed renal impairment, together with their interpretation and corresponding health system responses, are summarized in Table 6.

Table 6
Interpretation of Independent Factors Associated with Laboratory-Confirmed Renal Impairment

Independent Factor	Adjusted OR (95% CI)	Interpretation	Potential Health System Response
Age ≥ 48 years	2.85 (1.42–5.72)	Older adults had substantially higher odds of renal impairment.	Introduce routine kidney screening for older adults attending primary healthcare facilities.
Hypertension	3.15 (1.58–6.28)	Strongest independent clinical predictor of renal impairment.	Strengthen hypertension detection, treatment, and long-term follow-up.
Diabetes mellitus	2.48 (1.25–4.92)	Consistent with diabetic kidney disease reported internationally.	Integrate annual renal assessment within diabetes management programmes.
Frequent non-prescribed NSAID use	2.21 (1.12–4.36)	Suggests potentially harmful medication practices.	Improve pharmaceutical regulation and community education regarding nephrotoxic medications.
Treatment non-adherence	1.95 (1.02–3.73)	May contribute to poor control of chronic diseases affecting kidney function.	Expand adherence counselling and continuity of chronic disease care.
Low household income	1.62 (0.84–3.12)	Association was attenuated after adjustment, suggesting indirect effects through healthcare access and treatment behaviours.	Strengthen financial protection and reduce barriers to diagnostic and chronic disease services.

Health System and Health Equity Implications

The findings highlight important health system challenges affecting kidney health in Somalia. Participants experienced high levels of socioeconomic disadvantage, including poverty, unemployment, and limited educational attainment, all of which were associated with reduced healthcare utilization, greater treatment non-adherence, and increased reliance on non-prescribed medications. Routine kidney function assessment remains limited within many primary healthcare facilities. Consequently, opportunities for early detection and management may be missed until patients present to tertiary referral hospitals with advanced disease.

Integrating basic renal assessment—including serum creatinine measurement, eGFR estimation, and urine protein testing—within Somalia's Essential Package of Health Services (EPHS 2020) would strengthen early detection of kidney disease. Community-based screening through the national Community Health Strategy (2025–2029), particularly among individuals with hypertension and diabetes, may further improve early identification and referral. Expanding access to affordable diagnostic services, promoting rational medicine use, and strengthening continuity of chronic disease management are likely to contribute to improved kidney health

outcomes while advancing Somalia's Universal Health Coverage (UHC) objectives. A proposed framework for integrating kidney health services into Somalia's Universal Health Coverage (UHC) Roadmap and the Essential Package of Health Services (EPHS 2020) is presented in Fig. 3.

Interpretation of Socioeconomic Determinants

Although low household income demonstrated a statistically significant crude association with laboratory-confirmed renal impairment, this association was no longer statistically significant after adjustment for clinical and behavioral variables. This finding suggests that socioeconomic disadvantage may influence kidney health primarily through indirect pathways, including reduced access to healthcare, delayed diagnosis, financial barriers to treatment, and greater reliance on non-prescribed medications.

These observations are consistent with conceptual frameworks describing the social determinants of health, whereby structural socioeconomic conditions influence health outcomes through intermediate behavioral and healthcare-related pathways rather than acting as isolated biological risk factors.

Strengths of the Study

This study has several important strengths. First, renal impairment was assessed using objective laboratory measurements, including serum creatinine, estimated glomerular filtration rate, blood urea nitrogen, and urine protein testing, rather than relying solely on self-reported disease status. Second, standardized clinical procedures and predefined variable definitions enhanced measurement consistency. Third, multivariable logistic regression enabled adjustment for important demographic, socioeconomic, and clinical confounders. Finally, the study provides contemporary epidemiological evidence from Somalia, where published data on kidney disease remain limited.

Study Limitations

Several limitations should be considered when interpreting these findings. First, the cross-sectional design precludes establishing temporal relationships or causal inference between exposures and renal impairment.

Second, kidney function and proteinuria were assessed at a single clinical encounter. Although participant histories and available medical records were reviewed to identify evidence of persistent kidney dysfunction, repeated laboratory measurements were not available for all participants. Consequently, the primary outcome represents **laboratory-confirmed renal impairment**, and some participants may have experienced acute kidney injury rather than established chronic kidney disease.

Third, the study was conducted among adults attending tertiary referral hospitals in Mogadishu and therefore may not be representative of the general Somali population or individuals receiving care in primary healthcare settings. Finally, behavioral variables, including medication adherence and NSAID use, were self-reported and may be subject to recall bias or social desirability bias.

CONCLUSIONS AND POLICY IMPLICATIONS

Conclusions

This study provides contemporary evidence of a high burden of **laboratory-confirmed renal impairment** among adults attending tertiary referral hospitals in Mogadishu, Somalia. Reduced estimated glomerular filtration rate, proteinuria, and elevated serum creatinine were frequently identified, suggesting that many patients present for specialist care with substantial renal dysfunction. Older age, hypertension, diabetes mellitus, frequent use of non-prescribed non-steroidal anti-inflammatory drugs (NSAIDs), and treatment non-adherence were independently associated with laboratory-confirmed renal impairment after adjustment for demographic and socioeconomic factors. These findings are consistent with established risk factors for kidney disease and highlight opportunities to strengthen prevention, early detection, and chronic disease management.

Although the prevalence of renal impairment observed in this study exceeded estimates reported from community-based populations in sub-Saharan Africa, these findings should be interpreted within the context of a tertiary hospital population and should not be considered representative of the general Somali population. Nevertheless, they indicate substantial unmet needs for kidney health services among adults seeking hospital care.

Future research should include nationally representative population-based surveys and prospective cohort studies incorporating repeated measurements of kidney function to distinguish chronic kidney disease from acute kidney injury and to better estimate the epidemiology of kidney disease in Somalia. Implementation research evaluating the integration of kidney health services within primary healthcare, the Essential Package of Health Services (EPHS 2020), and Somalia's Universal Health Coverage (UHC) agenda would further inform evidence-based policy and programme development.

Policy Implications

The findings have important implications for strengthening kidney health services within Somalia's evolving health system. Given the observed burden of renal impairment and the predominance of modifiable cardiometabolic risk factors, priority should be placed on earlier detection, integrated management of non-communicable diseases, and improved access to essential diagnostic services.

The study supports the incorporation of basic kidney function assessment into routine care for individuals at increased risk of kidney disease, particularly those with hypertension and diabetes mellitus. Strengthening community awareness regarding the potential nephrotoxic effects of inappropriate NSAID use and improving continuity of chronic disease management may also contribute to reducing preventable kidney injury. These priorities are consistent with the objectives of Somalia's Universal Health Coverage, the Essential Package of Health Services (EPHS 2020), and the Somalia Community Health Strategy (2025–2029), all of which emphasize equitable access to essential preventive and chronic disease services As outlined in **Table 7**.

Table 7. Policy Implications for Strengthening Kidney Health within Somalia's UHC Framework

Health System Domain	Current Challenge Identified by the Study	Evidence-Informed Policy Direction	Expected Health System Benefit
Primary Healthcare	Limited availability of routine kidney function assessment for individuals at high risk	Integrate serum creatinine testing, eGFR estimation, and urine protein assessment into routine NCD care within the EPHS, prioritizing patients with hypertension and diabetes	Earlier identification and management of kidney disease
Community Health Services	Late presentation to tertiary referral hospitals	Strengthen community-based screening, referral, and health education through the Somalia Community Health Strategy (2025–2029)	Improved early detection and timely referral of high-risk individuals
Rational Use of Medicines	Frequent use of non-prescribed NSAIDs	Strengthen public education on safe medicine use and reinforce implementation of pharmaceutical regulatory policies	Reduced exposure to preventable nephrotoxic medications
Health Financing	Financial barriers to diagnostic evaluation and long-term kidney care	Expand financial protection for essential diagnostic and chronic disease services within UHC implementation	Improved equitable access to kidney health services
Health Information Systems	Limited routine surveillance of kidney disease	Incorporate kidney health indicators into national health information and NCD monitoring systems	Improved planning, monitoring, and resource allocation
Research and Surveillance	Limited national epidemiological evidence	Support population-based studies, longitudinal cohorts, and implementation research on kidney disease	Stronger evidence base for policy and programme development

Declarations

Ethics Approval and Consent to Participate

The study was conducted in accordance with the ethical principles of the **Declaration of Helsinki** and applicable national ethical guidelines for research involving human participants. Ethical approval was obtained from the **Institutional Ethics Review Board (IERB) of Benadir University, Mogadishu, Somalia** (Reference No. **BU-IERB-2026-N044**) before commencement of the study. Written informed consent was obtained from all participants who were able to provide written consent. For participants who were unable to read or write, informed verbal consent was obtained in the presence of an independent witness and documented by thumbprint, in accordance with the approved ethics protocol. Participation was voluntary, and participants were informed of their right to decline participation or withdraw from the study at any time without affecting their access to healthcare services.

Consent for Publication

Not applicable.

Availability of Data and Materials

The datasets generated and/or analyzed during the current study are **available from the corresponding author upon reasonable request**, subject to institutional ethical requirements, applicable data protection regulations, and

data-sharing policies. Requests for access will be considered in accordance with the conditions of the study's ethical approval and the protection of participant confidentiality. The English-language version of the structured questionnaire developed specifically for this study is provided as **Additional File 1** to enhance transparency, reproducibility, and methodological reporting.

Competing Interests

The authors declare that they have no competing interests.

Funding

This study received no research funding.

Authors' Contributions

A.M.A. conceived and designed the study, developed the research protocol, coordinated study implementation, supervised data management, performed statistical analysis and multivariable regression modeling, interpreted the findings, and drafted and revised the manuscript. contributed to the literature review, clinical data collection, laboratory specimen supervision, interpretation of clinical findings, and critical revision of the manuscript.

H.A. contributed to field data collection, participant interviews, data quality assurance, health equity contextual analysis, and manuscript review.

All authors read and approved the final manuscript and agree to be accountable for all aspects of the work, ensuring that questions related to the accuracy or integrity of any part of the study are appropriately investigated and resolved.

Acknowledgements

The authors sincerely thank the management, clinicians, nurses, laboratory personnel, and administrative staff of the participating tertiary referral hospitals in Mogadishu for their collaboration and logistical support throughout the study. The authors are especially grateful to all study participants for their valuable time, trust, and contribution to this research. The authors also acknowledge **Benadir University** for providing institutional support that facilitated the implementation of this study.

References

1. Bikbov B, Purcell CA, Levey AS, Smith M, Abdoli A, Abebe M, et al. Global, regional, and national burden of chronic kidney disease, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. *Lancet*. 2020;395(10225):709–33.
2. Kidney Disease: Improving Global Outcomes (KDIGO) CKD Work Group. KDIGO 2024 clinical practice guideline for the evaluation and management of chronic kidney disease. *Kidney Int*. 2024;105(4 Suppl):S117–314.
3. Jha V, Garcia-Garcia G, Iseki K, Li Z, Naicker S, Plattner B, et al. Chronic kidney disease: global dimension and perspectives. *Lancet*. 2013;382(9888):260–72.

4. Levin A, Tonelli M, Bonventre J, Coresh J, Donner JA, Fogo AB, et al. Global kidney health 2017 and beyond: a roadmap for closing gaps in care, research, and policy. *Lancet*. 2017;390(10105):1888–917.
5. Luyckx VA, Tonelli M, Stanifer JW. The global burden of kidney disease and the sustainable development goals. *Bull World Health Organ*. 2018;96(6):414–D422.
6. Mills KT, Xu K, Zhang W, Bundy JD, Chen CS, Kelly TN, et al. A systematic analysis of worldwide population-based data on the global burden of chronic kidney disease in 2010. *Kidney Int*. 2015;88(5):950–7.
7. Osafo C, Mate-Kole M, Boima V, Agyabeng K, Pearce B, Jacobs-Kosmin D, et al. Social determinants of health and chronic kidney disease in sub-Saharan Africa. *Kidney Int Rep*. 2020;5(9):1412–22.
8. Stanifer JW, Jing B, Tolan S, Little F, Ritchwood TD, Patel UD, et al. The epidemiology of chronic kidney disease in sub-Saharan Africa: a systematic review and meta-analysis. *Lancet Glob Health*. 2014;2(3):e174–81.
9. Kaze FF, Meto DT, Halle MP, Ngiyane S, Ashuntantang G. Prevalence and risk factors of chronic kidney disease in sub-Saharan Africa: a systematic review and meta-analysis. *BMC Nephrol*. 2018;19:125.
10. George C, Mogueo A, Okpechi I, Echouffo-Tcheugui JB, Kengne AP. Chronic kidney disease in sub-Saharan Africa: a systematic review and meta-analysis. *BMC Nephrol*. 2021;22:125.
11. Kalyesubula R, Hau JP, Asiki G, Smeeth L, Pearce N, Seeley J, et al. The epidemiology of chronic kidney disease in rural East Africa: a population-based study. *PLoS ONE*. 2020;15(3):e0229649.
12. Abdallah S, Mohamed A, Hassan M. Chronic kidney disease and associated factors in Somalia: evidence from hospital-based observational data. *Afr Health Sci*. 2022;22(2):145–53.
13. Teshome T, Megersa C, Abdi A et al. Prevalence and associated factors of chronic kidney disease among adult diabetic patients in Harari Region, Eastern Ethiopia. *medRxiv [Preprint]*. 2025. 10.1101/2025.08.12.25333507
14. NCD Risk Factor Collaboration (NCD-RisC). Worldwide trends in hypertension prevalence and progress in treatment and control from 1990 to 2019. *Lancet*. 2021;398(10304):957–80.
15. International Diabetes Federation. *IDF Diabetes Atlas*. 10th edition. Brussels: International Diabetes Federation; 2021.
16. World Health Organization. *Noncommunicable Diseases Progress Monitor 2022*. Geneva: World Health Organization; 2022.
17. Ungprasert P, Cheungpasitporn W, Crowson CS, Matteson EL. Individual non-steroidal anti-inflammatory drugs and risk of acute kidney injury: a systematic review and meta-analysis. *Eur J Intern Med*. 2015;26(4):285–91.
18. Griffin MR, Yared A, Ray WA. Nonsteroidal anti-inflammatory drugs and acute renal failure in elderly persons. *Am J Epidemiol*. 2000;151(5):488–96.
19. World Health Organization. *Package of Essential Noncommunicable Disease Interventions for Primary Health Care in Low-Resource Settings (WHO PEN)*. Geneva: World Health Organization; 2020.
20. World Health Organization. *Primary Health Care on the Road to Universal Health Coverage: 2019 Global Monitoring Report*. Geneva: World Health Organization; 2019.
21. World Health Organization and World Bank. *Tracking Universal Health Coverage: 2023 Global Monitoring Report*. Geneva: World Health Organization and World Bank; 2023.

22. Kruk ME, Gage AD, Arsenault C, Jordan K, Leslie HH, Roder-DeWan S, et al. High-quality health systems in the Sustainable Development Goals era: time for a revolution. *Lancet Glob Health*. 2018;6(11):e1196–252.
23. Xu K, Evans DB, Carrin G, Aguilar-Rivera AM. Designing health financing systems to reduce catastrophic health expenditure. Geneva: World Health Organization; 2005.
24. Wagstaff A, Flores G, Hsu J, Smitz MF, Chepynoga K, Buisman LR, et al. Progress on catastrophic health spending in 133 countries: a retrospective observational study. *Lancet Glob Health*. 2018;6(2):e169–79.
25. Perry HB, Zulliger R, Rogers MM. Community health workers in low-, middle-, and high-income countries: an overview of their history, recent evolution, and current effectiveness. *Annu Rev Public Health*. 2014;35:399–421.
26. Ballard M, Schwarz R. Employing community health workers in low-income and middle-income countries: what do we know about scalability? *J Glob Health*. 2019;9(1):010101.
27. Federal Ministry of Health and Human Services. Somalia. Essential Package of Health Services (EPHS 2020) for Somalia. Mogadishu: Ministry of Health and Human Services; 2020.
28. Federal Ministry of Health and Human Services. Somalia. Somalia Health Sector Strategic Plan III (HSSP III) 2022–2026. Mogadishu: Ministry of Health and Human Services; 2022.
29. Federal Ministry of Health and Human Services. Somalia. Somalia Community Health Strategy 2025–2029: Mobilizing Female Health Workers for Universal Health Coverage. Mogadishu: Ministry of Health and Human Services; 2025.
30. World Health Organization. Sustainable Development Goals: Goal 3—Ensure healthy lives and promote well-being for all at all ages. Geneva: World Health Organization; 2023.
31. von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP, STROBE Initiative. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. *PLoS Med*. 2007;4(10):e296.
32. Vandenbroucke JP, von Elm E, Altman DG, Gøtzsche PC, Mulrow CD, Pocock SJ, et al. Strengthening the Reporting of Observational Studies in Epidemiology (STROBE): explanation and elaboration. *PLoS Med*. 2007;4(10):e297.

Figures

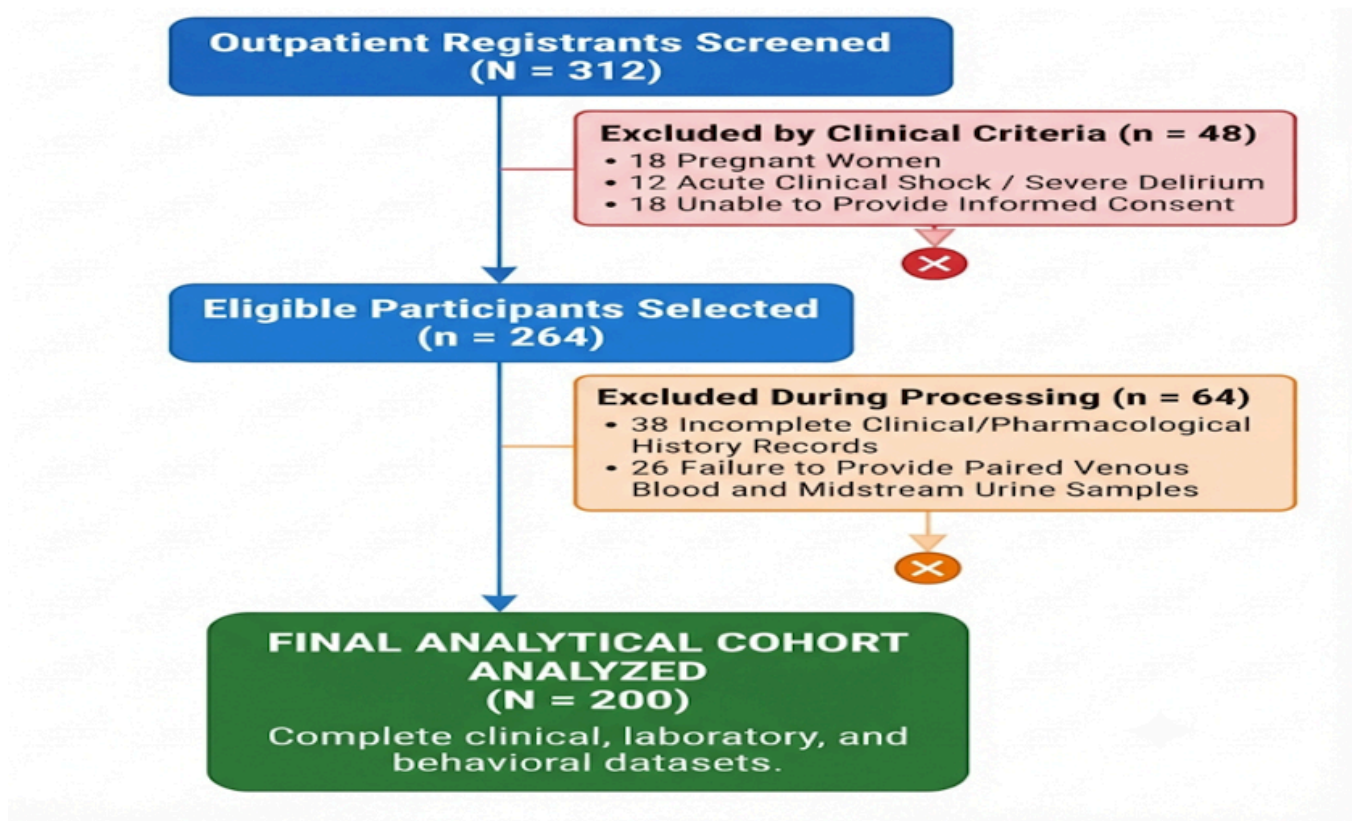


Figure 1

Participant Selection Flow Diagram. Flowchart illustrating participant screening, clinical exclusion criteria, specimen verification, and final cohort selection (N = 200).

Flowchart illustrating the screening, eligibility selection, and processing stages to derive the final analytical cohort. Outpatient registrants were assessed against clinical and processing criteria, resulting in a final analyzed cohort of 200 participants with complete datasets.

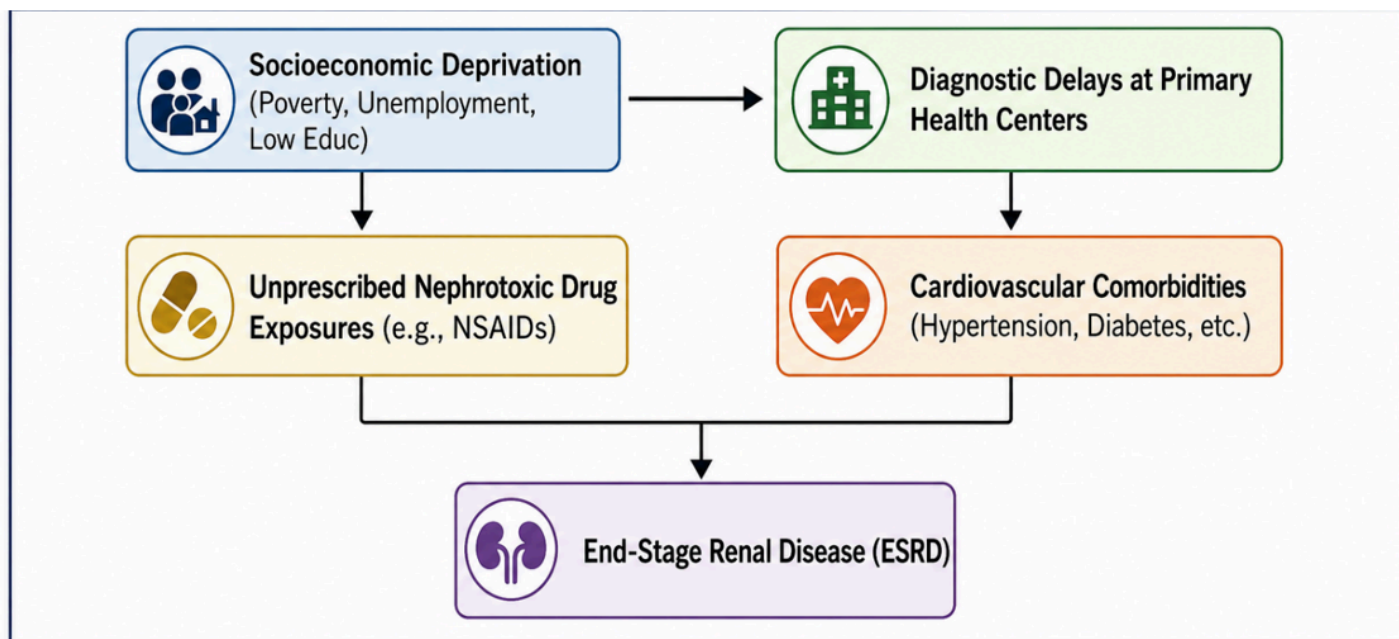


Figure 2

Pathophysiological and Socioeconomic Pathway to Chronic Kidney Disease Inequity in Post-Conflict Somalia.

• **Legend:** Conceptual framework illustrating the intersecting cascades of socioeconomic deprivation, diagnostic delays at primary health centers, unprescribed nephrotoxic drug exposures, and cardiovascular comorbidities driving end-stage renal disease.

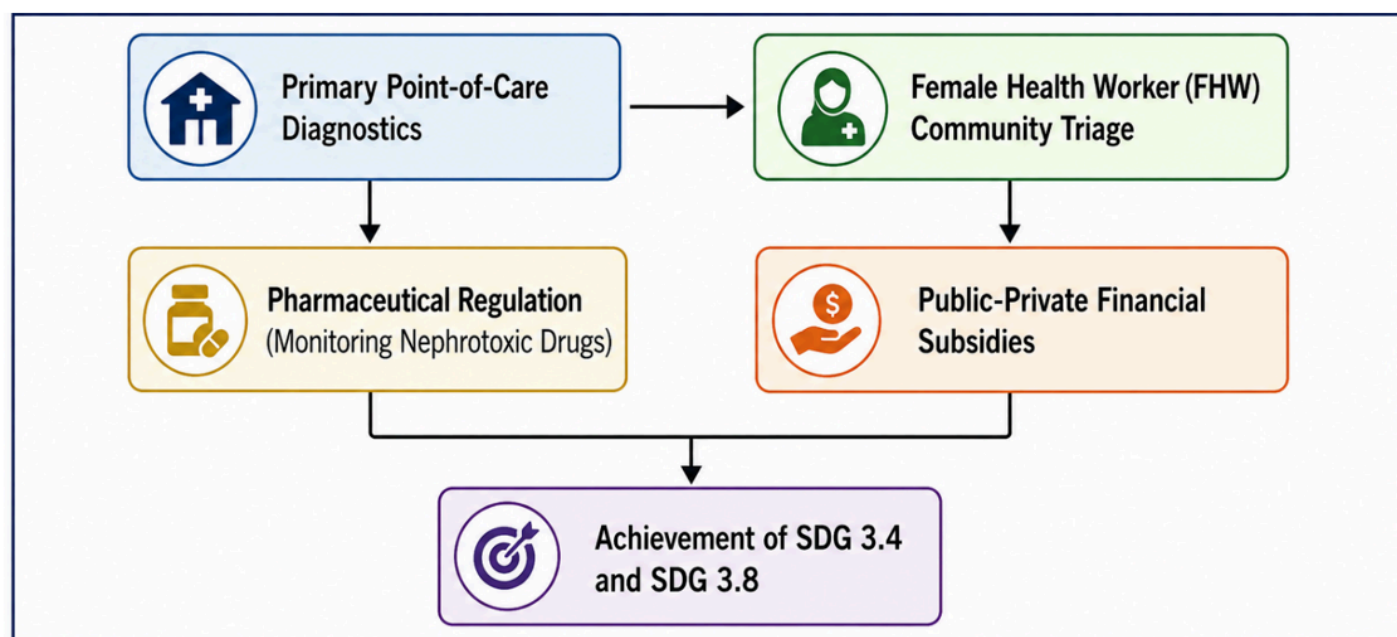


Figure 3

Health System Policy Integration Framework under Somalia's UHC Roadmap and EPHS 2020 Architecture.

Legend: Operational model detailing the alignment of primary point-of-care diagnostics, Female Health Worker (FHW) community triage, pharmaceutical regulation, and public-private financial subsidies to achieve SDG 3.4 and 3.8.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [AdditionalFile1SupplementaryAppendixS1.pdf](#)