

The Role of Patient Creatinine Level in the Prevalence of Chronic Kidney Disease in Critically Ill Patients in South Africa: A Retrospective Analysis of ICU Admissions

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Abstract

Chronic kidney disease is escalating public health concern in South Africa, however; data concerning its burden and risk factors are scant among critically ill patients due to lack of a national renal registry. The aim was to identify CKD predictors amongst critically ill patients admitted at the multi-disciplinary ICU in South Africa with emphasis on the contribution of the patient's creatinine level. A binary logistic regression analysis of 848 ICU admissions from the prospectively collected, publicly available, cohort dataset (LIVAKI), comprising data from 2017, was used to ascertain contribution of patient's peak creatinine value, age, gender and race to the burden of CKD. The analysis revealed that both age and patient creatinine level were statistically significant predictors of CKD ($p < 0.001$), while gender and race showed no significant effect. The likelihood ratio chi-square of 88.02 ($p < 0.001$) indicated that the model as a whole fit significantly. The results found are concordant with the growing evidence from sub-Saharan Africa showing that major contributors to burden of CKD in this region are chronic diseases like hypertension and diabetes mellitus; infectious diseases namely HIV and TB add to the problem. This points to the role for systematic CKD screening in acutely ill patients and that peak creatinine level upon ICU admission could serve as a prognostic indicator for CKD. The study provided additional evidence to the limited body of literature describing CKD in the acutely ill South African setting, suggesting that proactive strategies to enhance screening, diagnosis and integration into the national health service delivery should be considered.

Keywords: Chronic Kidney Disease, Creatinine, Critical Illness, Intensive Care Unit, South Africa, Acute Kidney Injury, Risk Factors, Logistic Regression

INTRODUCTION

Chronic kidney disease (CKD) is a new epidemic in South Africa that reflects the co-existence of communicable and non-communicable diseases (Tshivhase & Ngobeni, 2025). With the prevalence of kidney disease affecting over 10% of South Africans (Lutaaya, 2025), the nation has reached an silent epidemic stage which is commonly undiagnosed and not widely discussed (Lutaaya, 2025). 6 to 17 % of the adult South African population is affected by CKD but there is less data at the national level because there isn't a renal registry. (Tshivhase & Ngobeni, 2025). Hypertension is present in up to 55% of kidney disease patients in South Africa. (Lutaaya, 2025). The primary causes of CKD are Hypertension, diabetes mellitus, Human Immunodeficiency Virus (HIV) and inherited genetics and affects resource limited areas the most (Tshivhase & Ngobeni, 2025). In Black Africans there is a genetic predisposition with the carriage of APOL1 variants which makes them more prone to non-diabetic kidney disease. (Tshivhase & Ngobeni, 2025). There are no improved outcomes at the CKD stage, and poor access to renal replacement therapy, late diagnosis, and health inequalities at state and private levels are exacerbated. State dialysis services are still unchanged since 1994 but have rapidly expanded in the private sector thus creating disparity amongst provinces and across income groups. (Tshivhase & Ngobeni, 2025). Chronic kidney disease (CKD) is a common condition reported in critically ill patients admitted into Intensive care units (ICU). Acute kidney injury (AKI) has often been reported as a complication in Critically ill patients (with reported prevalence of 58.5 % in a South African multidisciplinary ICU cohort) (Aylward et al., 2019). Several reports have suggested that there might be a causal relation between AKI and subsequent progression to CKD with parameters such as the number, magnitude and duration of AKI insults playing a key role (Zarbock et al., 2025). Elderly patients were found to be at a risk for CKD after AKI (1 year increase in age meant a 3% increased chance for transition) in one study (Khairallah et al., 2024), 21 % of AKI patients who received renal replacement therapy in the ICU were later found to have severe long-term CKD, where the length of renal replacement therapy was identified as a novel predictor for future severe CKD (Khairallah et al., 2024).

There is very little data about the progression of AKI to CKD in sub-Saharan Africa due to the large burden of Trauma and HIV (Aylward et al., 2019). Our study therefore aims to investigate the causes of CKD in critically ill patients in South Africa by using existing prospective cohort dataset (LIVAKI) collected from all critically ill patients admitted into a multidisciplinary ICU in South Africa during the year 2017 (Aylward et al., 2019). We then examine the role of a patient's creatinine (a marker for the health of the kidney) in the prevalence of CKD in critically ill patients whilst accounting for patient characteristics such as age, gender, and ethnicity.

METHODS

Study Design and Data Source

This study used a prospective cohort study design and drew data from the publicly available LIVAKI data from all admitted patients in a multi-disciplinary ICU in South Africa during the whole of 2017 (Aylward et al., 2019). Data contained details on 849 admissions who had mean age of 42.5 years and SAPS 3 of 48.1 (Aylward et al., 2019) with comorbidities, including hypertension (30.5%), HIV (32.6%), diabetes (13.3%), CKD (7.8%), active TB (6.2%), trauma being most common indication (26%) (Aylward et al., 2019). AKI (58.5%) occurring in 497 (Aylward et al., 2019).

Variables

The dependent variable for this investigation was CKD as recorded on the data set. The independent variables were age (continuous), sex (male/female - categorical) race (categorical) and peak creatinine

level (continuous). Creatinine levels, with elevation in value showing impaired renal function are crucial predictors (Brennan et al., 2023).

Statistical analysis

Logistic regression was used for the investigation of age, sex, race and peak creatinine value on the presence of chronic kidney disease since dependent variable (CKD) was dichotomous, since it converged at 5 iterations yielding a log likelihood ratio statistic of-182.88881. The fit of the model as a whole was analyzed using the likelihood ratio chi-square test. Wald test statistics provided the information regarding the individual variables in the study, Odds ratio values and confidence intervals of 95% for all predictors were presented, and all studies were carried out in standard software; p values<0.05 indicated significance level.

RESULTS

Total observations used in the analysis: 848 The iteration log for the model indicated the model was stable, with the log-likelihood ratio of -182.88881 converged by the 5th iteration. The likelihood ratio chi sq (88.02 with a p-value of p<0.001) indicated that the model as a whole fit significantly with all predictors combined. This indicates that factors of age, gender, race and peak creatinine level all contribute significantly to the prediction of CKD for the patient sample. Individual Predictor Effects The table below shows the predictor coefficients, standard error, z -statistic, and p-value as well as the 95% confidence interval of the predictor coefficients.

Table 1: Logistic Regression Results Predicting Chronic Kidney Disease

Predictor	Coefficient	Standard Error	z-statistic	p-value	95% CI Lower	95% CI Upper
Age	0.045	0.012	3.75	<0.001	0.022	0.068
Peak Creatinine Level	0.089	0.021	4.24	<0.001	0.048	0.130
Gender (Male)	0.156	0.234	0.67	0.503	-0.302	0.614
Race	0.067	0.091	0.74	0.459	-0.111	0.245

For the assessment of CKD prediction model 6 is presented in the table table6: CKD prediction model. As shown in the table, both age and patient creatinine were statistically significant predictors of CKD (p<0.001). Both age and Cr coefficients were positive (0.045 and 0.089 respectively) implying increased CKD with increased age and increased cr respectively. The odds ratios for age and cr respectively were 1.046 (1.022, 1.070) and 1.093 (1.049, 1.139) implying that a one-year increase in age would imply a 4.6% increase in odds of CKD. Also, a unit increase in cr implies a 9.3% increase in the odds of CKD.

Gender (p=0.503) and Race (p=0.459) are not statistically significant predictors of CKD. Hence, these results are the same with those of other local and international studies. A study on the prevalence of CKD among hospital admission in kwaZulu-Natal 25% was observed in 45–59-year-old and mean age of all studied cases was 47.5 years while in the age group 4564 years was more while infection was the main cause of admission followed by cardiovascular disease (Mokhosi & Tlou, 2026). In 2016, a study among those living with HIV in a rural population of Limpopo Province reported a significant association of age with CKD [odds ratio of 1.078, p=0.039] (Choshi et al., 2024).

DISCUSSION

Summary of Key Findings

This study investigated risk factors for CKD in critically ill patients admitted to a multi-disciplinary ICU in South Africa. In our retrospective cohort of 848 ICU admissions over 2017, age and patient creatinine level were identified as statistically significant risks, whereas gender and race were not. This finding that age is a significant risk factor for CKD is consistent with the wide-ranging literature on the subject. Old age has previously been identified as a risk factor for CKD after AKI, with a 3% increased risk of progressing from AKI to CKD with each 1-year increase in patient age (Khairallah et al., 2024).

It has also been shown that 21% of ICU survivors who received renal replacement therapy for AKI had long-term severe CKD, and here the duration of renal replacement therapy was a new risk factor for severe long-term CKD (Khairallah et al., 2024). The strong correlation between creatinine level and CKD is consistent with the primary function of creatinine as a biomarker for renal function. Several studies have shown that serum creatinine was a significant predictor of a reliable estimated GFR, indicating its paramount role in the diagnosis and classification of CKD (Brennan et al., 2023). Other investigations found that both the baseline and 72-h serum creatinine level of the patients were significantly higher in the non-CKD group, indicating the critical role of creatinine in the prognostication of disease progression to CKD (Khairallah et al., 2024). In addition, serum creatinine has been validated as the most precise biochemical marker for CKD stage with an AUC of 0.933(95% CI: 0.876~0.969), which was significantly better than that of other biochemical markers (Korean Journal of Clinical Laboratory Science, 2025).

Non-Significant Demographic Factors

The fact that gender and race were not statistically significant predictors of CKD in the data set is noteworthy but should be interpreted cautiously. While studies have described male gender as a risk factor for CKD (Tshivhase & Ngobeni, 2025), some studies have shown no significant gender difference (Choshi et al., 2024). The non-significance of race may have been due to sample composition or heterogeneity between races may not be adequately captured by the categories and cannot account for the complex relationships between genetic, social, and environmental factors, as in high risk APOL1 variants in Black African people (Tshivhase & Ngobeni, 2025).

Clinical Implications

The results of the study emphasize on systematic surveillance of renal function in acute care settings (Tshivhase & Ngobeni, 2025). Although CKD was high among hospitalized patients, mainly admitted with infectious disease or critical illness, there is also a need for systematic surveillance of renal function in acute care settings (Mokhosi & Tlou, 2026). Creatinine levels being an easy and cheap way to assess renal function, it can be measured to predict risk of CKD (Brennan et al., 2023). Our results show that there needs to be increased screening for early detection of CKD in South Africans, the underdiagnosed and underreported disease (Lutaaya, 2025). Globally, only 6% of the general population and 10% of high-risk individuals are aware of their kidney disease (Lutaaya, 2025). In 2025, the WHO global non-communicable disease resolution calls for a comprehensive inclusion of kidney health strategies in all nations, focused on prevention, early detection and management, strengthened primary healthcare systems, and addressing the social determinants of health (especially low-income countries) (Tshivhase & Ngobeni, 2025).

Public Health Significance

Implications of Findings The findings described above are particularly impactful in the context of the increased burden of CKD in South Africa as well as the ongoing systemic barriers to kidney care in this country. CKD is a major and inequitable contributor to disease burden in South Africa (Tshivhase &

Ngobeni, 2025). In the absence of urgent reforms, CKD will continue to be a major public health threat (Tshivhase & Ngobeni, 2025). The 2025 Roadmap for Kidney Health in South Africa highlights that strengthening national surveillance, screening for CKD at primary levels, increasing capacity for dialysis and kidney transplantation, raising public awareness and increasing rural healthcare infrastructure are ongoing focal points (Wearne et al., 2025).

Limitations

This study has several limitations. First, we performed a secondary analysis of a dataset that was collected for a primary study, and some variables may not have been optimally labeled for the purposes of our study question. The lack of information pertaining to comorbidity profiles, medication history and long-term follow-up data available from our dataset limited the ability to fully characterize the CKD population and evaluate the implications of prognostic data (Aylward et al., 2019). Second, although the model was statistically significant, the logistic regression may not have accounted for all relevant predictor variables of CKD. Known risk factors of CKD include comorbidities (e.g., diabetes mellitus, HIV disease), medication history and genetic predispositions (Tshivhase & Ngobeni, 2025). Third, although the study was adequately powered, it was a single-centre study on a unique patient group (ICU patients), which reduces the extent to which conclusions can be applied elsewhere. Moreover, the small sample size of related studies and the fact that this was a single-centre study limit the extent to which the findings can be generalized to other clinical settings (Choshi et al., 2024). Fourth, the cross-sectional nature of our underlying dataset meant that causality between CKD predictors and the condition itself could not be conclusively determined. In many instances, the ability to distinguish CKD from AKI was limited given the absence of baseline renal parameters and longitudinal measurements of serum creatinine (Aylward et al., 2019). Fifth, the study was performed using data from 2017, and the trends in CKD burden may have changed since this time (Lutaaya, 2025).

CONCLUSION

The current study investigated factors associated with chronic kidney disease among critically ill patients admitted to a South African multi-disciplinary intensive care unit based on prospective cohort data analysis was used to determine the impact of various variables in predicting CKD prevalence. The study demonstrated that patient age and creatinine level have a predictive effect on CKD prevalence while no significant impact can be attributed to sociodemographic variables such as gender or race. The evidence generated by this study confirms the accumulating evidence coming from the sub-Saharan Africa that CKD is predominantly driven by traditional risk factors (e.g., age and high creatinine level) while the effects of sociodemographic factors may be mediated by other variables. It emphasizes the importance of systematic surveillance of renal function in acute care and suggests that the maximum creatinine level during ICU stay may be a useful clinical marker of CKD.

This study adds to the sub-Saharan African literature on CKD among critically ill patients and supports the rationale for further screening and early detection of CKD and integration of kidney health into the public health policy agenda, especially in light of the WHO 2025 non-communicable disease resolution framework that focuses on prevention, early detection, and treatment, while strengthening primary care and addressing social determinants of health (Tshivhase & Ngobeni, 2025). The domestic capacity for the management of CKD in South Africa has however not kept pace with the epidemic (Tshivhase & Ngobeni, 2025). Without urgent reform, preventable kidney disease will continue to be the main driver of preventable morbidity, early death and spiraling costs. Future research should conduct multicenter, longitudinal studies to confirm these findings and establish a national kidney disease registry for monitoring trend analysis, evaluating interventions, and formulating policies for optimal prevention and

management (Wearne et al., 2025). Additional research should describe the differential impact of HIV and other infectious diseases on CKD in South Africa (Choshi et al., 2024) and elucidate the contribution of genetic determinants such as APOL1 risk variants (Tshivhase & Ngobeni, 2025). Interventions should address both clinical management (e.g., screening, early detection) and health policy (expanded capacity for dialysis, investment in rural infrastructure, and public education) (Wearne et al., 2025).

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