ORIGINAL ARTICLE

Clinical and Laboratory Characterization of Hemodialysis Patients in Relation to Survival Outcomes at a Tertiary Referral Hospital in Indonesia

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ABSTRACT

Introduction: Despite advancements in hemodialysis care, disease progression and outcomes in adults with various comorbidities, particularly in Indonesia's overburdened tertiary hospitals, remain poorly characterized, limiting tailored care strategies. This study analyzed clinical characteristics and laboratory parameters among hemodialysis patients at Sulianti Saroso Infectious Disease Hospital, Jakarta, Indonesia, with stratification by survival outcomes.
Methods: We conducted a retrospective cohort study of adults (>18 years) undergoing hemodialysis at Sulianti Saroso Infectious Disease Hospital between March and July 2024. Using purposive sampling, we analyzed 27 cases with documented laboratory parameters (i.e., blood urea nitrogen (BUN), serum creatinine, and estimated glomerular filtration rate (eGFR)) and clinical outcomes. Associations between outcomes and laboratory/clinical variables were assessed using Fisher's exact test and logistic regression ($p<0.05$).
Results: Mortality was reported in 25.9% of patients, including one who passed away due to complications related to coronavirus disease 2019 (COVID-19) shortly after being discharged. The leading indication for hemodialysis was hyperuricemia (85.2%), followed by chronic kidney disease. Nearly half of the patients (48.1%) had comorbid diabetes mellitus. Diabetic nephropathy was a key contributor to elevated urea levels. Prevalent complications reported among the patients included sepsis (70.4%) and glomerular disease (40.7%).
Conclusion: This study found an association between diabetes mellitus and mortality in chronic kidney disease patients who underwent hemodialysis. Severe uremia, marked by elevated BUN levels, and symptomatic complications such as shortness of breath were observed, indicative of advanced disease progression. Earlier detection and optimized management are necessary to mitigate preventable morbidity in high-risk populations.

Keywords: Diabetes; hemodialysis; patients; sepsis

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Highlights:
1. This study examined undercharacterized hemodialysis patients at an Indonesian tertiary hospital, focusing on high comorbidity burdens and outcomes.
2. Severe kidney disease and high mortality were observed, driven by comorbidities such as diabetes mellitus, hypertension, coronavirus disease 2019 (COVID-19), and infectious diseases (drug-resistant tuberculosis and hepatitis B/C).
3. The findings underscore the importance of optimized risk stratification and early intervention for end-stage renal failure in patients with both communicable and non-communicable disease comorbidities.

Article history: •Received 13 March 2025 •Revised 10 June 2025 •Accepted 30 July 2025 •Published 31 August 2025

Available at https://e-journal.unair.ac.id/CIMRJ; DOI: 10.20473/cimrj.v6i2.70810

INTRODUCTION

Chronic kidney disease represents a considerable health challenge worldwide. The occurrence and frequency of chronic kidney disease differ significantly across countries, primarily because of variations in the prevalence of underlying health conditions and the accessibility of medical treatments (Kovesdy, 2022). Although its prevalence varies by country, the incidence of chronic kidney disease has increased to 200 cases per million people annually in numerous countries. There are approximately 400 instances per million people in the United States, Taiwan, and some parts of Mexico (Hustrini et al., 2022). In the United States, specifically, the prevalence rate of chronic kidney disease was approximately 11.5% between 1996 and 2006. Globally, the prevalence rate of chronic kidney disease ranged from 8.5% to 9.8% in 2017. Remarkably, China and India accounted for one-third of all global chronic kidney disease cases (Bikbov et al., 2020).

Similar to other regions around the world, Indonesia faces a significant burden of chronic kidney disease. However, data on chronic kidney disease epidemiology in the country is limited and often unreliable. Based on the National Basic Health Research, the prevalence of chronic kidney disease, as indicated by an estimated glomerular filtration rate (eGFR) below 60 mL/min/1.73 m², was 3.8 per thousand (‰) in 2018, suggesting an increase from 2.0 per thousand (‰) in 2013 (Ministry of Health of the Republic of Indonesia, 2019). However, these figures may not fully reflect the actual number of chronic kidney disease patients, as the screening for the illness is widely known to be challenging (De Broe et al., 2017).

Non-communicable diseases are the leading cause of death globally, with chronic kidney disease, diabetes, and hypertension being major contributors. The impact of this epidemic is particularly severe in low- and middle-income countries, where health facilities for screening and treatment are limited. Accurately estimating the prevalence of chronic kidney disease, diabetes, and hypertension in such areas is crucial for reducing the burden of these diseases (Ploth et al., 2018). This information aligns closely with global research regarding the prevalence and impact of chronic kidney disease (Bikbov et al., 2020).

Along with the occurrence rate and distribution of chronic kidney disease in Indonesia, its etiological factors are also poorly documented. The country is currently dealing with a triple burden of disease. The first factor is the inadequate management of infectious diseases, including those that are re-emerging and newly emerging. The other factor stems from the growing prevalence of chronic diseases, which have entered the top five most severe health conditions due to demographic shifts and nutritional changes. Finally, there is a continuous rise in trauma and injury incidents (World Health Organization & Alliance for Health Policy and Systems Research, 2017). Furthermore, environmental factors should also be taken into account in relation to the progression of chronic kidney disease. Access to clean water is critical, as the lack of it can lead to waterborne diseases and digestive disorders, which may result in acute kidney injury. Conditions such as schistosomiasis can contribute to the incidence of chronic kidney disease, and water pollution can exacerbate the risk of developing this disease (Luyckx et al., 2018; Botheju et al., 2021).

The distinct characteristics of the Indonesian population have raised concerns about how its diversity might affect the etiology of chronic kidney disease. Additionally, recent data may highlight the need to identify specific causative factors for chronic kidney disease within the population (Hustrini et al., 2023). It is essential to consider whether these factors have evolved in recent years and how significantly they might impact strategies aimed at reducing the prevalence of chronic kidney disease among our people. This study was conducted at Sulianti Saroso Infectious Disease Hospital in Jakarta, which serves as a referral center for patients with chronic kidney disease in Indonesia, providing a representative sample of hemodialysis cases with diverse clinical and laboratory profiles. Consequently, this research aimed to analyze the clinical characteristics and laboratory parameters of hemodialysis patients at the referral hospital, with a survival outcome stratification.

METHODS

This retrospective cohort study examined clinical characteristics, laboratory parameters, and their associations with outcomes among hemodialysis patients at Sulianti Saroso Infectious Disease Hospital, Jakarta, Indonesia (Chopra et al., 2023). The presentation of the cases included a description of the patients' sociodemographic characteristics, as well as details of history, physical examination findings, investigations, therapeutic interventions, and both expected and actual outcomes. The study period spanned from March to July 2024, during which we analyzed the medical records of 27 adult patients (aged ≥18 years) who underwent hemodialysis at the referral hospital. Participants were selected through purposive sampling based on the availability of complete laboratory data, including blood urea nitrogen (BUN), serum creatinine, and eGFR. Pregnant women were excluded from the analysis.

Data were extracted from the electronic medical records of patients receiving treatment in the hospital's Hemodialysis Unit, providing information on sociodemographic characteristics (age and sex), comorbidities, presenting symptoms, clinical signs, laboratory results, ultrasonography findings, course of treatment after admission, prognosis, and outcomes. The collected data were organized using Microsoft Excel for Windows, version 2504 (Microsoft Inc., Redmond, WA, USA, 2025) and analyzed using IBM SPSS Statistics for Windows, version 24.0 (IBM Corp., Armonk, NY, USA, 2016). We employed Fisher's exact test and logistic regression, with results reported as odds ratios (OR) with 95% confidence intervals (Gomez-Rojas & Nair, 2025). A p-value of less than 0.05 was considered statistically significant. In the descriptive analysis, continuous variables were presented as mean ± standard deviation (SD), while categorical variables were shown as frequency (percentages) (Mishra et al., 2019).

RESULTS

The sociodemographic characteristics of the hemodialysis patients are presented in Table 1. The analysis revealed that most hemodialysis patients, including those who survived and those who died, were male (16, 60%). In addition, this study indicated a predominance of older adults among the deceased hemodialysis patients, as non-survivors mainly belonged to the ≥60 years age group (13, 26%).

Table 1. Sociodemographic characteristics of hemodialysis patients, stratified by outcomes

Characteristics	Outcomes: Survival n (%)	Outcomes: Mortality n (%)	p	OR (95% CI)
Sex			1.000	1.13 (0.20–6.43)
Male	12 (60)	4 (57.1)		
Female	8 (40)	3 (42.9)		
Age (years)			0.209	3.75 (0.58–24.28)
<60	12 (60)	2 (28.6)		
≥60	8 (40)	5 (71.4)		

Note: The data were derived from an analysis using Fisher's exact test, with p<0.05 considered significant. OR=odds ratio; CI=confidence interval.

The comorbidity patterns were quite different between patients with survival and mortality outcomes, as detailed in Table 2. Anemia was observed in all patients (27, 100%), making it the most prevalent comorbidity, followed by vascular diseases, diabetes mellitus, and sepsis. Notably, anemia and vascular diseases were the predominant comorbid conditions in the deceased hemodialysis patients.

Table 2. Comorbidities of hemodialysis patients, stratified by outcomes

Comorbidities	Outcomes: Survival n (%)	Outcomes: Mortality n (%)	p	OR (95% CI)
Diabetes mellitus			0.033*	11.14 (1.11–112.01)
No	13 (65)	1 (14.3)		
Yes	7 (35)	6 (85.7)		
Anemia			-	-
No	0 (0)	0 (0)		
Yes	20 (100)	7 (100)		
HIV			1.000	-
No	18 (90)	7 (100)		
Yes	2 (10)	0 (0)		
Hepatitis B			0.060	-
No	20 (100)	5 (71.4)		
Yes	0 (0)	2 (28.6)		
Hepatitis C			1.000	-
No	18 (90)	7 (100)		
Yes	2 (10)	0 (0)		
DR-TB			1.000	-
No	19 (95)	7 (100)		
Yes	1 (5)	0 (0)		
DS-TB			0.633	0.39 (0.04–3.97)
No	14 (70)	6 (85.7)		
Yes	6 (30)	1 (14.3)		
Sepsis			1.000	1.07 (0.16–7.15)
No	6 (30)	2 (28.6)		
Yes	14 (70)	5 (71.4)		
Glomerulonephritis			1.000	-
No	12 (60)	4 (57.1)		
Yes	8 (40)	3 (42.9)		
Vascular diseases			0.283	-
No	5 (25)	0 (0)		
Yes	15 (75)	7 (100)		

Notes: An asterisk (*) denotes statistical significance (p<0.05) as determined by Fisher's exact test. OR=odds ratio; CI=confidence interval; HIV=human immunodeficiency virus infection; DR-TB=drug-resistant tuberculosis; DS-TB=drug-sensitive tuberculosis.

Table 3 shows the data on presenting symptoms, revealing that all patients reported shortness of breath (27, 100%). Other common symptoms observed among the total patients included weakness and oliguria (26, 96.3%). Meanwhile, the prevalent symptoms noted in the non-survivors comprised shortness of breath (7, 100%), weakness (7, 100%), and oliguria (4, 57.1%).

The clinical manifestations and prognosis shown in Table 4 demonstrated that the majority of the patients fell outside normal weight ranges, with the highest proportion (8, 29.6%) classified as underweight or overweight. Hypertension was commonly observed, with 14 survivors (70%) and 6 non-survivors (85.7%) presenting with elevated systolic/diastolic blood pressure (≥130 and/or ≥85 mmHg). Hyperuricemia was the primary indication for hemodialysis in 23 cases (85.1%). Furthermore, 13 patients (48%) required prolonged hospitalization for eleven days or longer.

Table 3. Presenting symptoms of hemodialysis patients, stratified by outcomes

Symptoms	Outcomes: Survival n (%)	Outcomes: Mortality n (%)	p	OR (95% CI)
Nausea/ vomiting			0.678	0.60 (0.09–3.89)
No	12 (60)	5 (71.4)		
Yes	8 (40)	2 (28.6)		
Hand swelling			0.459	3.17 (0.17–58.70)
No	19 (95)	6 (85.7)		
Yes	1 (5)	1 (14.3)		
Shortness of breath			-	-
Yes	20 (100)	7 (100)		
No	0 (0)	0 (0)		
Weakness			1.000	-
No	1 (5)	0 (0)		
Yes	19 (95)	7 (100)		
Oliguria			0.653	-
No	6 (30)	3 (42.9)		
Yes	14 (70)	4 (57.1)		

Note: The data were derived from an analysis using Fisher's exact test, with p<0.05 considered significant. OR=odds ratio; CI=confidence interval.

Table 4. Clinical manifestations and prognosis of hemodialysis patients, stratified by outcomes

Variables	Outcomes: Surv. n (%)	Outcomes: Mort. n (%)	p	OR (95% CI)
Clinical signs				
BMI			0.633	0.44 (0.73–2.70)
Normal	5 (25)	3 (42.9)		
Underweight/ overweight	15 (75)	4 (57.1)		
Systolic/ diastolic BP (mmHg)			0.633	2.57 (0.25–26.25)
<130 and/or <85	6 (30)	1 (14.3)		
≥130 and/or ≥85	14 (70)	6 (85.7)		
Indications for hemodialysis				
Malaria-induced nephropathy	1 (5)	0 (0)	Ref.	-
CKD	3 (15)	0 (0)	1.000	-
Hyperuricemia	16 (80)	7 (100)	1.000	-
Prognosis				
LoS (days)			0.385	0.33 (0.05–2.11)
1–10	9 (45)	5 (71.4)		
≥11	11 (55)	2 (28.6)		

Note: The data were derived from an analysis using Fisher's exact test, with p<0.05 considered significant. Surv.=survival; Mort.=mortality; OR=odds ratio; CI=confidence interval; BMI=body mass index; BP=blood pressure; Ref.=reference; CKD=chronic kidney disease; LoS=length of stay.

Table 5 summarizes the laboratory and ultrasonographic findings of the hemodialysis patients. All patients (100%), regardless of survival outcome, had elevated urea (182.22±69.63 mg/dL) and creatinine (7.25±4.10 mg/dL) levels, accompanied by reduced eGFR (9.96±7.10 mL/min/1.73 m²). Among the non-survivors, other abnormalities were also common, with BUN and natrium (85.10±32.52 mEq/L) levels outside normal ranges in 100% and 57.1% of them, respectively. The ultrasonography revealed parenchymal renal disease in nine survivors (33.3%) and the only one non-survivor (3.7%) who underwent the imaging.

Our analysis concluded that diabetes mellitus was related to mortality in end-stage chronic kidney disease patients who underwent hemodialysis (p<0.03, OR=11.14, 95% CI=1.11–112.01). While hepatitis B infection showed a similar pattern toward increased mortality risk, this association did not reach statistical significance.

Table 5. Laboratory and ultrasonographic findings of hemodialysis patients, stratified by outcomes

Variables	Outcomes: Surv. n (%)	Outcomes: Mort. n (%)	p	OR (95% CI)
Laboratory findings				
Urea levels			-	-
Normal (male: 8–24 mg/dL; female: 6–21 mg/dL)	0 (0)	0 (0)		
Abnormal	20 (100)	7 (100)		
Creatinine levels			-	-
Normal (male: 0.7–1.3 mg/dL; female: 0.6–1.1 mg/dL)	0 (0)	0 (0)		
Abnormal	20 (100)	7 (100)		
Natrium levels			0.365*	3.11 (0.53–18.38)
Normal (135–145 mEq/L)	14 (70)	3 (42.9)		
Abnormal	6 (30)	4 (57.1)		
Potassium levels			1.000*	0.75 (0.13–4.25)
Normal (3.5–5.2 mmol/L)	10 (50)	4 (57.1)		
Abnormal	10 (50)	3 (42.9)		
eGFR			-	-
Normal (male: 93–139; female: 84–126)	0 (0)	0 (0)		
Abnormal	20 (100)	7 (100)		
BUN levels			1.000*	-
Normal (6–20 mg/dL)	1 (5)	0 (0)		
Abnormal (<6 or >20 mg/dL)	19 (95)	7 (100)		
USG findings				
Normal	4 (20)	0 (0)	Ref.	-
Not performed	7 (35)	6 (85.7)	0.999**	-
Parenchymal renal disease	9 (45)	1 (14.3)	0.999**	-

Notes: An asterisk (*) indicates p-values from Fisher's exact test, while double asterisks (**) indicate those derived from logistic regression. Statistical significance was defined as p<0.05. Surv.=survival; Mort.=mortality; OR=odds ratio; CI=confidence interval; eGFR=estimated glomerular filtration rate; BUN=blood urea nitrogen; Ref.=reference; USG=ultrasonography.

DISCUSSION

This study revealed that the majority of deceased hemodialysis patients at Sulianti Saroso Infectious Disease Hospital, Jakarta, Indonesia, were male older adults aged ≥60 years, with an average age of 55.56 years. On the other hand, the survivors in this study were predominantly younger than 60 years. These findings align partially with prior research reporting an average age of over 60 years among hemodialysis patients (Foote et al., 2016; Masakane et al., 2018). The findings of this study are also quite consistent with those of a previous study conducted by Chaudhari et al. (2017) at a tertiary care hospital, where most patients were between 51 and 60 years old (23%). Their study further revealed a greater proportion of male patients (64%) compared to female patients (36%). In addition, Hustrini et al. (2023) reported a similar average age of 52 years among patients at a tertiary hospital in Jakarta.

A separate study by Rajbhandari et al. (2022) observed that among 96 hemodialysis patients, 83 (86.45%) had end-stage renal disease and required twice-weekly maintenance dialysis, while 13 (13.55%) necessitated emergency dialysis. The 83 patients with end-stage renal disease exhibited an average age of 54.16 years, with a range of 20 to 88 years. Similar observations were reported from other studies conducted in Nepal and India, where middle-aged patients predominated over elderly individuals (Chaudhari et al., 2017; Dhungana et al., 2020). These findings suggest that chronic kidney disease requiring hemodialysis can affect individuals across all age groups, from young adults to the elderly. The emerging trend of kidney disease among younger working-age individuals highlights the need for early preventive strategies to halt progression to end-stage renal disease.

All patients in this study underwent hemodialysis as their primary treatment. Among these patients, 74.07% survived, whereas 25.93% died, predominantly from septic shock. The elevated mortality rate reflects the role of Sulianti Saroso Infectious Disease Hospital as a national referral center for infectious diseases, where patients often present with severe infections and end-stage renal failure complicated by various comorbidities, including anemia, vascular diseases, diabetes mellitus, and sepsis. These findings align with existing evidence that acute kidney injury worsens outcomes in patients who experience septic shock, with mortality rates remaining high regardless of resuscitation protocols (Kellum et al., 2016; Cecconi et al., 2018).

The average hemoglobin level in this study was 9.15±2.10 g/dL, consistent with the well-documented prevalence of anemia in end-stage renal disease populations. Almost 90% of 863 patients with anemia and end-stage renal disease exhibited hemoglobin levels below 10 g/dL (Park et al., 2018; Toft et al., 2020). A longitudinal study further indicated that only 38% of more than 65,000 dialysis patients could maintain hemoglobin levels within the ideal range of 10 to 12 g/dL (Guedes et al., 2020). Anemia has been commonly observed in patients with end-stage renal disease (Winkelmayer et al., 2014; Kim et al., 2016). This condition can result from bleeding or deficiencies in vitamin B12, iron, folate, or erythropoietin (Jalalzadeh, 2021). Regular erythropoietin administration is recommended for end-stage renal disease patients as a part of anemia management during hemodialysis (Fishbane & Spinowitz, 2018).

Shortness of breath was the most prevalent symptom among hemodialysis patients in this study, followed by weakness and oliguria. These findings partially align with prior studies, including those conducted by He et al. (2020) and Rajbhandari et al. (2022), who reported oliguria as the most common systemic symptom, followed by muscle weakness, pedal edema, and breathlessness. Similarly, Chaudhari et al. (2017) found that the most frequently observed symptoms were shortness of breath, oliguria, hypertension, loss of appetite, and fatigue.

The observed oliguria prevalence likely resulted from reduced renal mass in end-stage renal disease patients. Clinical management should emphasize strict salt and fluid restrictions to minimize the risk of fluid overload. Fluid overload complications can manifest as pedal edema, a condition associated with cardiovascular risk factors, such as advanced age and left ventricular hypertrophy. Muscle weakness and exhaustion reported in this study and others might stem from uremic myopathy (Kaltsatou et al., 2015; Serrano et al., 2022). These conditions can contribute to a sedentary lifestyle, which exacerbates physical deconditioning and raises morbidity and mortality. However, physical exercises may help mitigate these effects. Furthermore, the high prevalence of shortness of breath might arise from multiple etiologies, including anemia, dialyzer bio-incompatibility, congestive heart failure, undiagnosed chronic lung illness, or sodium and fluid overload (Salerno et al., 2017).

Hemodialysis patients in this study had an average hospital stay of 11.30 days. All patients exhibited characteristic renal disease markers, including elevated urea and creatinine levels, reduced eGFR, and abnormal BUN and natrium levels. The findings of this study are consistent with those of Rajbhandari et al. (2022), who reported electrolyte imbalances in pre-dialysis patients, including hyperkalemia (serum potassium levels > 5.5 mmol/L) in 45.78% and hyponatremia in 50.60% of cases.

The observed electrolyte imbalances likely indicated a progression of chronic kidney disease. Hyperkalemia may result from multiple factors: diminished potassium excretion due to declining kidney function, metabolic acidosis inducing potassium shift to extracellular space, high-potassium diets, and medications such as beta-adrenergic blockers, cardiac glycosides, and renin-angiotensin-aldosterone system inhibitors (Morales et al., 2021; Sumida et al., 2023). In contrast, hyponatremia often develops from fluid excess or diuretic use (Lim et al., 2016; Arzhan et al., 2021). Clinically, potassium levels exceeding 6.0 mmol/L are concerning, as they are associated with increased hospitalization and mortality risks compared to levels below 5 mmol/L (Horne et al., 2019).

The ultrasonography revealed chronic renal parenchymal disease in 37.04% of the hemodialysis patients, while 48.15% did not undergo the examination. Among those scanned, the observed patterns align with findings from prior research by Chaudhari et al. (2017), who reported a reduction in kidney size in 80% of cases and an increase in 2%. The abnormalities were attributable to diabetic nephropathy, chronic pyelonephritis, autosomal dominant polycystic kidney disease, and unknown causes.

This study provides a clinical and laboratory characterization of hemodialysis patients, stratified by survival outcomes. All diagnoses were confirmed through both clinical evaluation and supporting examination, with detailed analysis of key renal parameters such as BUN, creatinine, and e-GFR. However, several limitations in this investigation must be acknowledged. First, as a single-center study with a small sample size, our findings may lack generalizability to broader populations. Second, while the retrospective approach enabled detailed parameter analysis, this research was unable to determine significant associations between prognostic factors and survival outcomes. These constraints highlight the need for future multicenter investigations with larger sample sizes to better characterize hemodialysis patients and elucidate disease prevalence, underlying etiologies, and clinical presentations.

CONCLUSION

This study identified diabetes mellitus as a significant predictor of mortality in end-stage renal disease patients undergoing hemodialysis at Sulianti Saroso Infectious Disease Hospital, Jakarta, Indonesia. Severe uremia, marked by elevated BUN levels, was a predominant clinical manifestation among the hemodialysis patients. Shortness of breath and weakness were the most prevalent symptoms, potentially indicating complications such as renal osteodystrophy and hyperphosphatemia, though the absence of phosphate testing restricted definitive assessment. The high prevalence of anemia and vascular diseases aligns with established patterns in patients with end-stage renal disease. It is recommended to include serum phosphate and ionized calcium testing for a more objective assessment in the clinical management of hemodialysis patients. Additionally, the general public is advised to undergo medical checkups to assess kidney function and degenerative diseases such as diabetes and hypertension, which are the leading etiological factors for renal failure in Indonesia. These measures are particularly important as kidney disease often progresses without significant early symptoms, making individuals unaware of their condition.

ACKNOWLEDGEMENT

We express our gratitude to the president director and the director of human resources, education, and research of Sulianti Saroso Infectious Disease Hospital, Jakarta, Indonesia, for granting permission for this research.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

ETHICS CONSIDERATION

This study received approval from the Health Research Ethics Committee of Sulianti Saroso Infectious Disease Hospital, Jakarta, Indonesia, under reference number PP.07.01/D.XXXIX.14/50/2024 on September 5, 2024.

FUNDING DISCLOSURE

None.

AUTHOR CONTRIBUTION

ES and SM conceptualized and designed the study as well as analyzed and interpreted the data. R drafted the article and provided administrative and technical support. GSB, A, and ADW provided logistic support in addition to collecting and assembling the data. RS and SOW conceptualized and designed the study, analyzed and interpreted the data, drafted the article, critically revised it for important intellectual content, provided study materials, and gave final approval. IWN and Y contributed to the critical revision of the article for important intellectual content and provided final approval.

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