STATISTICAL ASSESSMENT OF CHRONIC AND ACUTE KIDNEY DISEASE TRENDS IN A NIGERIAN TERTIARY HOSPITAL (2019–2024)

Alfred Ayo Ayenigba[1], Moses Sunday Afariogun[2] and Victoria Ayomide Adesoji[3]
1. Department of Mathematical Sciences, Ajayi Crowther University, Oyo, Nigeria.
2. Department of Biological Sciences, Ajayi Crowther University, Oyo, Nigeria
3. Department of Medical Laboratory Science, Ajayi Crowther University, Oyo, Nigeria

ARTICLE INFO

Corresponding author:
Alfred Ayo Ayenigba: Department of Mathematical Sciences, Ajayi Crowther University, Oyo, Nigeria,
Email:
aa.ayenigba@acu.edu.ng

Vol: 4 | Issue: 1
ISSN Print: 2960-2580
ISSN Online: 2960-2599

Publisher:
Medical Research and Statistical Consultancy Training Centre (SMC-PRIVATE) Limited
CONTRIBUTION
Ayenigba1 AA: Conceptualization, methodology, formal analysis, investigation, and original draft preparation
Afariogun MS: Critical review and manuscript editing
Adesoji VA: Review, visualization, and data verification
Keywords: Kidney disease; Seasonal variation; Temporal trends; Sex differences; Acute kidney injury; chronic kidney disease; Nigeria

ORIGINAL ARTICLE

ABSTRACT

Introduction: Kidney disease is a global public health burden, and it is especially serious in low-resource settings like Nigeria. Epidemiology of diseases are dictated by temporal, seasonal as well as demographic factors but longitudinal studies from a tertiary hospital in Nigeria are limited. **Objective:** The objectives of this study are to: describe the temporal seasonal patterns in the monthly incidence of kidney disease at the University College Hospital (UCH) Ibadan, January 2019- December 2024 and to ascertain if there is a statistically significant association between the sex of the patient and type of kidney disease chronic kidney disease (CKD) or acute kidney injury (AKI). **Methods:** Retrospective longitudinal ecological research was conducted using measured aggregate secondary data on 7038 kidney diseases that were reported to the UCH from January 2019 to December 2024. Trends and seasonality were separated using additive time series decomposition. Statistical significance of monotonic temporal trends was assessed using the Mann–Kendall test while the association of patient sex and type of disease was evaluated. **Results**: The average monthly observation over 72 months indicated 52.57 ($\pm$ 27.76) cases. According to the Mann–Kendall test, total monthly cases show a statistically significant declining trend ($Z = -3.403$; $p = 0.0007$). The same is true for all subgroups except female CKD ($Z = -1.225$; $p = 0.2206$). We observed a yearly cycle with peaks in Q1 and troughs in Q2. Among the total 7,038 cases, there were 3,989 (56.7%) male and 3,049 (43.3%) female. AKA was seen in 3,575 (50.8%) cases and CKD in 3,463 (49.2%). The association between sex and type of disease was noted to be significant ($\chi^2 = 6.004, DF = 1, p = 0.014$; $\varphi = 0.029$) with a predominance in males for AKA and females for CKD. **Conclusion:** Over a period of six years at SUCH Ibadan, there has been a significant overall decline in the incidence of kidney diseases. Also, we observed seasonal and sex differences in disease type. These findings warrant planning for targeted surveillance, sex-stratified prevention and resource planning during high-risk seasons.

INTRODUCTION

Kidney disease is among the leading causes of morbidity and mortality worldwide, significantly contributing to global non-communicable disease burden. Internationally, chronic kidney disease (CKD) and acute kidney injury (AKI) affect hundreds of millions of people, with a clear trend of increasing age-standardized disability-adjusted life-years in recent decades[1]. In sub-Saharan Africa (SSA), the prevalence of CKD based on community-based studies ranges from 2 to 41%, however there is wide variation due to difference in methodology, risk factor profile and access to health care[2]. Nigeria, as the most populous country in Africa, bears a disproportional burden, compounded by small capacity for renal replacement therapy, late patient presentation and resource limitation across the health care continuum[3]. CKD hospital admissions in tertiary hospitals in Nigeria increased from 47 per facility in 2015 to 147 per facility in 2020, though there was a plateau during the COVID-19 pandemic period.[4] Estimated CKD prevalence among medical outpatients stands at 9.7% with most of the diagnosed cases at an advanced stage (stages 4 and 5) accounting for about 58.0% of the cases diagnosed.[5] AKI occurs in 31.8% of CKD cases admitted into intensive care units. Mortality can be as high as 68% for cases with AKI.[6] In Nigerian adults, the commonest causes of CKD are hypertension (39.5%), diabetes mellitus (30.3%), chronic glomerulonephritis (25.0%), and so on.[7]

Longitudinal studies of incidence trends in tertiary hospitals in Nigeria remain under-researched, despite the known burden of kidney disease. Many existing studies provide only single time-point prevalence estimates and do not account for temporal variation or post-pandemic changes in disease patterns[3,5]. In particular, the post-pandemic period (2020–2024) has received limited attention, despite the potential influence of the direct nephrotoxic effects of SARS-CoV-2 and the indirect impact of healthcare disruptions[8]. Furthermore, sex differences in the epidemiology of CKD have not been adequately examined in the Nigerian literature, and the relationship between patient sex and disease type has not been rigorously assessed using inferential methods based on longitudinal datasets from southwestern Nigeria, although male-to-female ratios as high as 2.3:1 have been reported[9]. Recent empirical evidence underscores the importance of longitudinal hospital-based data in capturing disease dynamics over time and improving clinical inference in resource-constrained settings; for example, a retrospective analysis of hospital length of stay among typhoid fever patients at Lagos State University Teaching Hospital demonstrates how such data can reveal temporal patterns and support more robust, data-driven healthcare decision-making[25].

The University College Hospital (UCH), Ibadan, a primary referral centre in the South West Nigeria, offers specialist renal services to patients in the region. By assessing patient data with at least six months longitudinal follow-up from 2019 to 2024, provides an opportunity to capture disease dynamics during pre-pandemic, pandemic, and post-pandemic states. The use of the time series method on this data allows for measurement of the size of trends, identification of seasonal patterns, and assessment of specific subgroup trends. All of which will help in planning renal care better with the evidence in hand and preventive interventions targeting the neediest subgroup. The research investigates whether there is a monotonic increasing trend in the monthly incidences (total, CKD and AKI) from January 2019 to December 2024, using the Mann–Kendall trend test of 2022. This test will use the monthly incidence rates as the dataset. 2021, the study will use the Chi-square independence test to explore whether sex (female, male) is independent of disease type (CKD and AKI).

MATERIALS and METHODS

Study Design: This research used a retrospective longitudinal ecological design. Databases of secondary aggregate monthly cases of kidney disease were extracted from hospital record generated by the doctors and analyzed using time series methods and some inferential statistics. Even though the data comes from the retrospective medical records, the application of time series decomposition and trend analysis over 72 monthly consecutive observations adopts an ecological longitudinal approach rather than a cross-sectional one. The study was reported, and conducted in accordance with the STROBE guidelines for Strengthening the Reporting of Observational Studies in Epidemiology.

Study Setting: The University College Hospital (UCH), Ibadan, Oyo State in Nigeria is where the study was conducted. The UCH is a third-degree institution owned by the federal government and one of the leading referral centres in the south west Nigeria. It offers specialized service of nephrology, gets feedback from various states and is representative of the regional burden of advanced kidney disease.

Study Period: The analysis covered a six-year period from January 2019 to December 2024 (72 months) which is before pandemic (2019), pandemic (2020–2021) and post pandemic (2022–2024) Nigerian healthcare system analysis.

Data Source, Collection, and Management: We secured formal institutional approval to gather monthly aggregate counts of CKD and AKI cases from the Medical Records Department of UCH, disaggregated by sex of patient. Before extraction, all data were de-identified. The KDIGO clinical practice guidelines were used to classify cases according to the kidney disease, as was done in routine clinical documentation at UCH. Before conducting the analysis, the dataset had been verified and cleaned. In cases where monthly records contain missing values (represented as dashes in the source register), values have been coded as zero to ensure they are timely

Eligibility Criteria

Inclusion criteria: Between January 2019 and December 2024 all the cases of CKD and AKI seen at UCH were included. Records that were eligible had information on sex, the month and year when the diagnosis was made and the type of kidney disease.

Exclusion criteria: Records found to be lacking demographic or diagnostic information, duplicate entries, entries made outside the study period, and non-renal urological cases were excluded.

Sample: A total of 7038 cases (3463 CKD and 3575 AKI) were identified using a census approach which included all eligible cases available in the study time frame. Rather than aggregate yearly counts, we ditched case-counts by month as our unit of analysis for time series regression (n = 72 monthly observations). Chi-square analysis took places at the individual-level using case-counts.

Statistical Methods

Time Series Decomposition

To uncover the underlying trend and seasonal components of monthly kidney disease incidence, we applied an additive time series decomposition model to the 72-month series. The additive specification was chosen because the amplitude of the seasonal fluctuations in the observed data remained relatively constant and didn't increase in the same proportion as the level of the series. The trend component estimation involved the application of a centered moving average and the seasonal indices was derived by taking monthly averages of the detrended series over the years. The time series data was examined for stationarity visually, and the trend component obtained from the decomposed series was also used before applying the trend tests.

Mann–Kendall Trend Test

The Mann-Kendall non-parametric test evaluates if a significant monotonic trend exists in the monthly time series data. The test was chosen because of its strong performance in non-normality and its ability to detect monotonic trends in time series. The underlying method of the test was applied first to total monthly cases and then to disaggregated subgroups – CKD, AKI, male, female, male CKD, female CKD, male AKI, and female AKI. For each test, the null hypothesis was that there was no significant temporal trend. The computed values were of standardized test statistic Z and associated two-tailed p value. The threshold of significance applied throughout was $\alpha = 0.05$.

Chi-Square Test of Independence

To determine if there was a significant difference in the distribution of disease type (CKD versus AKI) between male and female patients, a Pearson chi-square test of independence was used. The null hypothesis stated independence between patient sex and disease type. It means that cell frequencies of each participant were estimated as $\frac{Row\ Total \times Column\ Total}{Grand\ Total}$. The degree of freedom was therefore set to one (df=1). Supplementary checks were conducted for Yates' continuity correction and the likelihood ratio chi-square. The effect size measure was represented by phi (φ). The value of significance level was $\alpha=0.05$.

Ethical Considerations

Data accessed and reported on was anonymous and aggregated, with no patient identifiers used or reported. Thus, consent was not required. The Medical Records Department of UCH granted us the access with written permission.

RESULTS

A cumulative total of 7,038 kidney disease cases were documented at University College Hospital Ibadan over the 72-month period from January 2019 to December 2024, comprising 3,463 cases (49.2%) of CKD and 3,575 cases (50.8%) of AKI. The sex distribution indicates a higher burden among males, who accounted for 3,989 cases (56.7%), compared to 3,049 cases (43.3%) among females. Monthly descriptive statistics, as presented in Table 1, show that the mean total caseload was 52.57 cases, with the mean monthly CKD count (28.76, SD = 15.69) slightly exceeding that of AKI (23.81, SD = 12.45). The relatively high coefficients of variation observed across total cases (52.8%), CKD (54.5%), and AKI (52.3%) suggest substantial month-to-month fluctuations, reflecting notable temporal variability in kidney disease presentations over the study period.

Temporal Trends in Monthly Kidney Disease Incidence

Figure 1 traces the monthly kidney disease caseload at University College Hospital Ibadan from January 2019 to December 2024, and the pattern is quite revealing. There is clear month-to-month fluctuation, but beyond that, a broader movement emerge cases begin to rise from around 2020, build steadily, and then reach a noticeable peak between late 2021 and mid-2022, with a maximum of 126 cases in a single month. After this point, the trend eases off, giving way to a gradual and sustained decline through 2023 and 2024. The 12-month centred moving average smooths out the short-term noise and confirms this overall rise–then–fall trajectory. When disaggregated by sex, males consistently account for higher monthly counts than females, yet both series move almost in tandem and peak at the same time, suggesting that the underlying dynamics are not sex-specific. Looking at disease type, CKD cases are generally more frequent than AKI across most months, which aligns with expectations in a tertiary care setting. Still, both CKD and AKI follow remarkably similar paths, peaking together in 2022 and declining thereafter a pattern that hints at a shared external or systemic influence during that period.

Seasonal Component and Trend Decomposition

Figure 2 summarizes the additive time series decomposition and gives a clearer sense of what is driving the observed patterns. Panel A shows the average monthly seasonal component, and a fairly stable annual rhythm becomes apparent… higher incidence in Q1 (January–March), a distinct dip around mid-year (June–July), followed by some recovery in Q3 and relatively lower levels again in Q4. The seasonal swings, typically about 10–15 cases above or below the long-run level, are noticeable and clinically relevant, though they do not dominate the overall variation. Panel B, which isolates the underlying trend after removing seasonal and irregular movements, tells a more structural story. The baseline rises from roughly 40 cases per month in early 2019 to about 85–90 cases by mid-2022, then gradually declines, settling around 30–40 cases per month by late 2024… indicating a clear rise followed by a sustained reduction over the study period.

Mann–Kendall Trend Analysis

The results of the Mann–Kendall trend test, as reported in Table 2, indicate a consistent pattern of decline across most series. Total monthly cases exhibited a statistically significant downward trend ($Z = -3.403$, $p = 0.0007$). Similar declining trends were observed for male cases ($Z = -3.816$, $p = 0.0001$) and female cases ($Z = -2.037$, $p = 0.0417$). By disease category, both CKD ($Z = -2.494$, $p = 0.0126$) and AKI ($Z = -3.422$, $p = 0.0006$) showed significant reductions over time. When further disaggregated, male CKD ($Z = -3.204$, $p = 0.0014$), male AKI ($Z = -3.607$, $p = 0.0003$), and female AKI ($Z = -1.983$, $p = 0.0473$) all followed similar declining trajectories. The only exception was female CKD ($Z = -1.225$, $p = 0.2206$), which remained relatively stable throughout the study period, suggesting a weaker or non-significant temporal change in that subgroup.

Association between Patient Sex and Kidney Disease Type

The sex distribution of CKD and AKI cases, together with the chi-square test results presented in Table 3, points to a subtle but statistically meaningful pattern. Among AKI cases (n = 3,575), 2,083 (58.3%) were male and 1,492 (41.7%) were female, while for CKD (n = 3,463), 1,906 (55.0%) were male and 1,557 (45.0%) were female. Under the assumption of independence, the expected counts were 2,023.9 (male AKI), 1,551.1 (female AKI), 1,965.1 (male CKD), and 1,497.9 (female CKD). The Pearson chi-square statistic ($\chi^2 = 6.004$, df = 1, $p = 0.014$) indicates a statistically significant association between sex and disease type. Looking a bit closer, male AKI cases slightly exceeded expectation (2,083 vs 2,023.9), whereas female CKD cases were also higher than expected (1,557 vs 1,497.9), suggesting a modest shift in how disease types are distributed across sexes. That said, the effect size remains small, as reflected by the phi coefficient ($\varphi = 0.029$). The agreement across Pearson, Yates' continuity correction, and likelihood ratio chi-square tests reinforces the stability of this result.

Table 1: Descriptive Statistics for Monthly Kidney Disease Cases by Disease Type (2019–2024)

Statistic	**Total Cases (CKD + AKI)**	**CKD Cases**	**AKI Cases**
Count (Months)	72	72	72
Mean (cases/month)	52.57	28.76	23.81
Standard Deviation	27.76	15.69	12.45
Minimum	1	1	0
25th Percentile (Q1)	30.25	16.00	13.00
Median (Q2)	50.50	27.50	22.00
75th Percentile (Q3)	69.75	39.75	30.75
Maximum	126	67	59
Range	125	66	59
Interquartile Range (IQR)	39.50	23.75	17.75
Coefficient of Variation (%)	52.8%	54.5%	52.3%

SD = Standard Deviation; IQR = Interquartile Range.

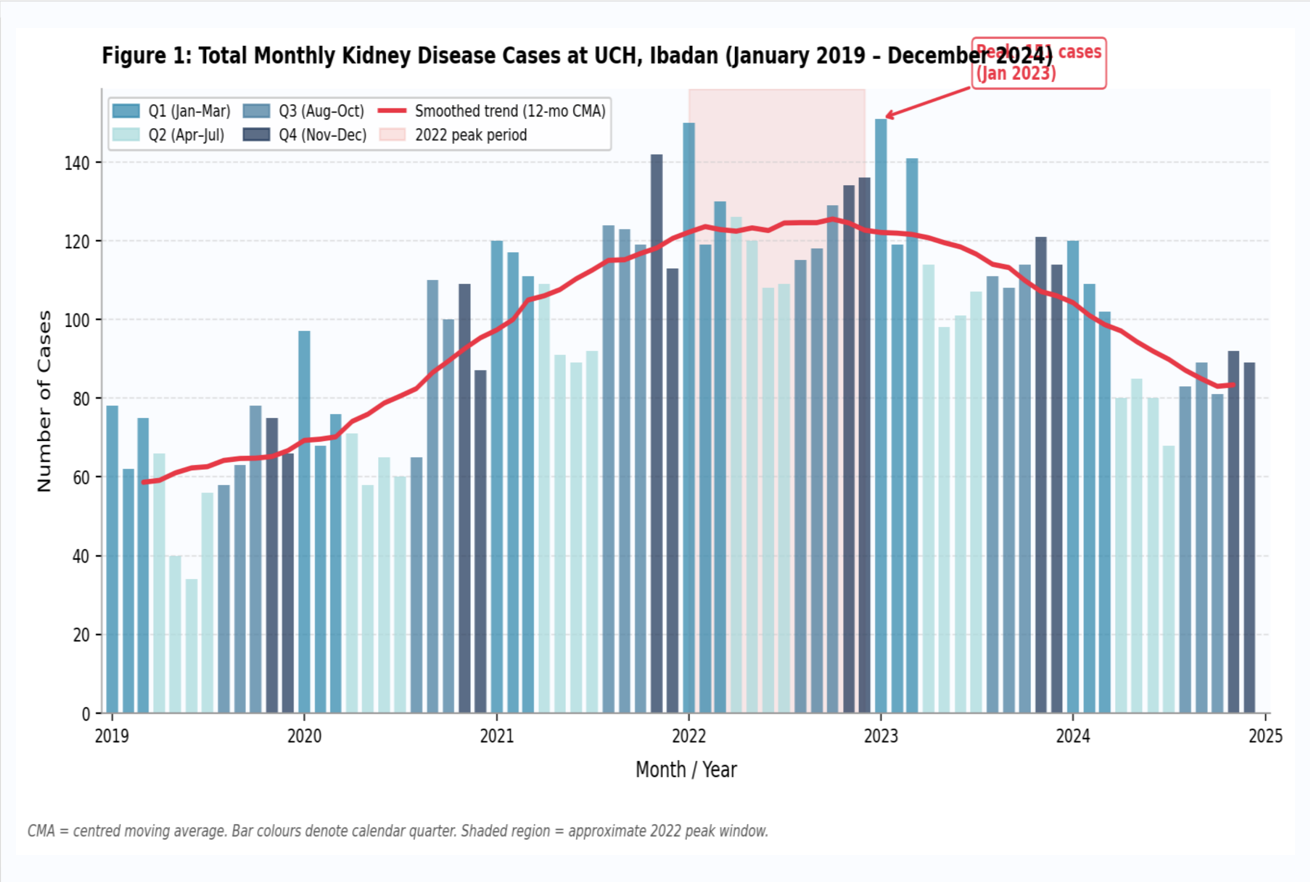

Figure 1: Total Monthly Kidney Disease Cases at UCH, Ibadan (January 2019 – December 2024).

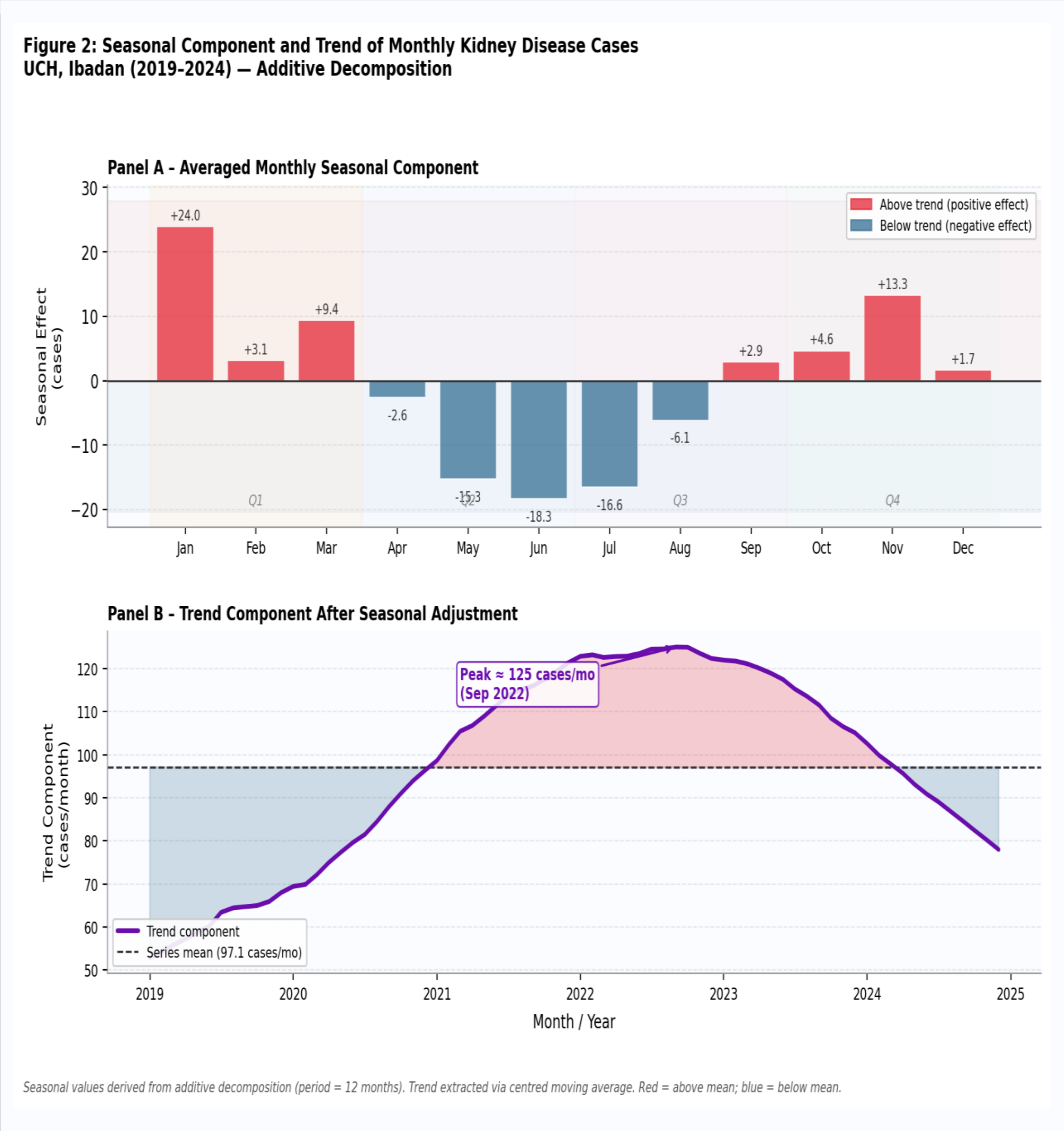

Figure 2: Seasonal Component and Trend of Monthly Kidney Disease

Table 2: Mann–Kendall Trend Test Results for Monthly Kidney Disease Cases (2019–2024)

Subgroup	**Z-Statistic**	**p-Value**	**Trend Direction**	**Significant (α = 0.05)**
Total Cases	−3.403	0.0007	Decreasing	**Yes**
Male Cases	−3.816	0.0001	Decreasing	**Yes**
Female Cases	−2.037	0.0417	Decreasing	**Yes**

CKD Cases	−2.494	0.0126	Decreasing	**Yes**
AKI Cases	−3.422	0.0006	Decreasing	**Yes**
Male CKD	−3.204	0.0014	Decreasing	**Yes**
Female CKD	−1.225	0.2206	Decreasing	**No**
Male AKI	−3.607	0.0003	Decreasing	**Yes**
Female AKI	−1.983	0.0473	Decreasing	**Yes**

Table 3: Distribution of Kidney Disease Cases by Type and Patient Sex, with Chi-Square Test Results (UCH, 2019–2024)

Disease Type	**Male n (%)**	**Female n (%)**	**Total n**	**% Male**
Acute Kidney Injury (AKI)	2,083 (58.3%)	1,492 (41.7%)	3,575	58.3%
Chronic Kidney Disease (CKD)	1,906 (55.0%)	1,557 (45.0%)	3,463	55.0%
Total	**3,989 (56.7%)**	**3,049 (43.3%)**	**7,038**	**56.7%**
Chi-Square Test of Independence Results				
Test	**χ^2 Value**	**df**	**p-Value**	**Effect Size**
Pearson Chi-Square	6.004	1	0.014	φ = 0.029
Yates' Continuity Correction	5.678	1	0.017	—
Likelihood Ratio	6.011	1	0.014	—
N of Valid Cases	**7,038**	—	—	—

φ = Phi coefficient. Statistically significant at α = 0.05.

DISCUSSION

This study documents a statistically significant overall decline in the monthly incidence of kidney disease at UCH, Ibadan, over the six-year period from 2019 to 2024. The Mann–Kendall test confirmed this trend for total cases (Z = −3.403, p = 0.0007) and for all disaggregated subgroups with the exception of female CKD (p = 0.2206). The declining pattern, particularly pronounced after the 2022 peak, mirrors findings from other Nigerian tertiary institutions. Ovwasa and colleagues[4] reported a comparable plateau and modest decline in CKD admissions at a semi-urban Nigerian hospital following a period of rising incidence, attributed in part to the gradual scale-up of hypertension and diabetes management programmes. Similarly, Akpan et al.[19] documented a slow initial rise in CKD admissions from 2020 at a tertiary centre in the Niger Delta region.

Caution is warranted in attributing the observed decline to any single cause, given that ecological study designs preclude the inference of mechanisms from aggregate data. Plausible contributing factors include improved outpatient management of hypertension and diabetes, expanded community screening in the post-COVID-19 period, and enhanced nephrology-specific referral triage. Conversely, financial barriers that restrict access to tertiary care may reduce recorded admissions without reflecting genuine population-level reductions in disease burden.[3] The exceptional stability of female CKD ($Z = -1.225$, $p = 0.2206$) is noteworthy; it may point to a persistent and subgroup-specific disease burden that individual-level data and covariate-adjusted analyses are better positioned to characterized.

The additive decomposition revealed a consistent seasonal cycle across all six study years, with Q1 peaks and Q2 troughs of approximately 10–15 cases in amplitude (Figure 2, Panel A). Comparable seasonal fluctuations have been described in other sub-Saharan African settings.[18,21] In south-western Nigeria, the harmattan dry season (December–February) may increase AKI risk through prerenal mechanisms, including dehydration and volume depletion. The mid-year trough coincides with the rainy season peak, during which certain infectious triggers of AKI may be less prevalent in urban tertiary settings. These explanatory hypotheses remain speculative in the absence of individual-level exposure data and will require prospective evaluation incorporating environmental and behavioural covariates.

The chi-square test identified a statistically significant association between patient sex and kidney disease type ($\chi^2 = 6.004$, $p = 0.014$). Male patients were disproportionately represented among AKI cases (58.3%), whereas females were proportionally more prevalent in CKD cases (45.0%). Neugarten and colleagues[22] found a male predominance in AKI requiring renal replacement therapy across multiple international datasets, attributing this to greater exposure to nephrotoxic medications, occupational hazards, and sepsis-related AKI. In a Nigerian two-centre study, Uduagbamen et al.[18] observed sex-specific differences in CKD stage at presentation, with women disproportionately represented among advanced CKD cases — consistent with patterns of delayed healthcare-seeking and longer disease duration at first tertiary presentation.

The overall male predominance (56.7%) across the combined dataset aligns with findings from northern and south-eastern Nigeria[3,9] and likely reflects a combination of biological factors, including hormonal nephroprotection in premenopausal women, and socioeconomic determinants of health-seeking behaviour. Aggregate data do not permit disentanglement of biological from access-related contributors. Adjusted analyses using individual-level logistic regression, with appropriate control for age, comorbidity burden, and socioeconomic status, would be required to isolate the independent effect of sex on disease type.

The total case volume of 7,038 over six years (mean 52.57 per month) is consistent with comparable Nigerian tertiary centres. Chukwuonye et al.[17] estimated the prevalence of CKD in adult Nigerian hospital populations at between 8% and 10%, aligning with the case volumes observed at UCH. The 2022 peak most likely reflects the post-pandemic recovery period, during which deferred presentations and accumulated hospital backlogs temporarily elevated caseloads. Guo and colleagues[23] demonstrated, using Global Burden of Disease 2021 data, that sub-Saharan Africa carries the fastest-growing share of CKD burden globally — providing broader context for the patterns observed at UCH.

STUDY LIMITATIONS

Several limitations should be noted. The use of aggregate data from a single center limits generalizability, while the retrospective ecological design precludes adjustment for key confounders such as Hypertension and Diabetes. Coding missing values as zero may introduce bias, and a sample size discrepancy required reconciliation. In addition, the assumption of stable seasonality and the very small effect size ($\varphi = 0.029$), though statistically significant, limit clinical interpretability without detailed patient-level data.

CONCLUSION

Analysis of disease incidence shows that across kidney disease, there is a clear temporal pattern. Each disease type shows variation in the temporal pattern. The association between the sex of patients and the disease classification appears to be statistically significant. However, in practical terms, this association is weak. When the results are evaluated together, they suggest that the observed patterns are likely shaped more by underlying population and reporting dynamics rather than strong differential effects across subgroups. While no causal claims are made, the analyses support meaningful trends and point towards the need for further patient-level work to determine clinical relevance and inform contextualized health policies.

DATA AVAILABILITY

Based on request

REFERENCES

1. Ferrari AJ, Santomauro D, Aali A, Global incidence, prevalence, years lived with disability (YLDs), disability-adjusted life-years (DALYs), and healthy life expectancy (HALE) for 371 diseases and injuries in 204 countries and territories and 811 subnational locations, 1990–2021: a systematic analysis for the Global Burden of Disease Study 2021. Lancet. 2024;404(10757):615–722.
2. Abd ElHafeez S, Bolignano D, D'Arrigo G, Dounousi E, Tripepi G, Zoccali C. Prevalence and burden of chronic kidney disease among the general population and high-risk groups in Africa: a systematic review. BMJ Open. 2018;8(1):e015069.
3. Abdulrasheed M, Armiyau MB, Abdullahi YN, Nuhu MK. Demographic and clinical profile of haemodialysis patients with end-stage renal disease in a Northern Nigerian hospital: a retrospective analysis of patterns and outcomes. Niger Med J. 2025;66(1): 165-173
4. Ovwasa H, Aiwuyo H, Okoye OC, Unuigbe E, Rajora N. Epidemiology trend of chronic kidney disease in a semi-urban tertiary hospital in Sub-Saharan Africa. Cureus. 2023;15(3):e36912

5. Ibrahim AH, Aikawa HM, Ladan MA, Iliya RS, Mohammed A, Ibrahim U. Chronic Kidney Disease in Jigawa State, Nigeria; A silently Emerging Epidemic?. REAL in Nursing Journal. 2023 Aug 11;6(2):135-41.
6. Ajite A, Ogundare E, Subulade AA, Adebisi AO. Aetiology, clinical profile and outcome of acute kidney disease in children presenting in a tertiary health institution in Southwest Nigeria. Br J Healthc Med Res. 2025;12(1): 287-95
7. Adejumo OA, Okaka EI, Madumezia G, Okwuonu C, Ojogwu LI. Assessment of some cardiovascular risk factors in predialysis chronic kidney disease patients in Southern Nigeria. Ann Afr Med. 2015;14(1):20–27.
8. Deng Y, Li N, Wu Y, et al. Global, regional, and national burden of diabetes-related chronic kidney disease from 1990 to 2019. Front Endocrinol. 2021;12:672350.
9. Achigbu KI, Ohiri JU. Sociodemographics-based assessment on urine albumin-to-creatinine ratio and creatinine levels among kidney disease patients at Federal Teaching Hospital, Owerri, Nigeria. J Adv Health Sci Med. 2024;485.
10. Mayne KJ, Sullivan M, Lees J. Sex and gender differences in the management of chronic kidney disease and hypertension. J Hum Hypertens. 2023;37(8):649–653.
11. Iyawe IO, Adejumo OA, Iyawe LI, Oviasu E. Assessment of iron status in predialysis chronic kidney disease patients in a Nigerian tertiary hospital. Saudi J Kidney Dis Transpl. 2018;29(6):1333–1341.
12. Adejumo OA, Akinbodewa A, Ogunleye A, Enikuomehin A, Lawal O. Cost implication of inpatient care of chronic kidney disease patients in a tertiary hospital in Southwest Nigeria. Saudi J Kidney Dis Transpl. 2020;31(1):207–213.
13. Ekrikpo UE, Udo AI, Ikpeme EE, Effa E. Haemodialysis in an emerging centre in a developing country: a two-year review and predictors of mortality. BMC Nephrol. 2011;12:50.
14. Bakare O, Agaba E, Gimba Z, et al. Assessing renal function in chronic kidney disease: a comparative evaluation of glomerular filtration rate prediction equations in the North-Central region of Nigeria. Cureus. 2025;17(5):e84577.
15. Biesiadecki Ł, Jacuska J, Tomecka P, Bruciak A, Musiał K. Pediatric chronic kidney disease during pandemic conditions—a single-center experience. J Clin Med. 2025;14(5):1608.
16. Adibe M, Ewelum PC, Amorha K. Evaluation of drug-drug interactions among patients with chronic kidney disease in a South-Eastern Nigeria tertiary hospital: a retrospective study. Pan Afr Med J. 2017;28:199.
17. Chukwuonye II, Ogah OS, Anyabolu EN, et al. Prevalence of chronic kidney disease in Nigeria: systematic review of population-based studies. Int J Nephrol Renovasc Dis. 2018;11:165–172.
18. Uduagbamen P, Adebola Yusuf AO, Ahmed SI, Thompson M, Alalade B, et al. Gender differences in chronic kidney disease: findings from a two-center study in Nigeria. Arch Pharm Pract 2022; 13(2): 69-77
19. Akpan EE, Udo AIA, Umoh IO, Ekrikpo UE, Umoh VA. Pattern of admission and outcomes for chronic kidney disease in a Nigerian tertiary institution: a five-year retrospective study. J Adv Med Med Res. 2024; 36(11): 117-127
20. Ibrahim UM, Karkarna MZ, Babura SM, Matazu MA, Jibo AM, Umar ML, Aliyu MH. Correlates of food contamination by heavy metals in Northwest Nigeria. Environmental health insights. 2024; 18:11786302241301700.
21. Hauwanga W, Alphonse B, Akram I, Djeagou A, Pessôa BL, et al. Decadal analysis of age-adjusted mortality rates for acute and chronic kidney disease in Brazil, Cureus 2024; 16(6): 2000–2021

22. Neugarten J, Golestaneh L, Kolhe N. Sex differences in acute kidney injury requiring dialysis. BMC Nephrol. 2018;19(1):314.
23. Guo J, Liu Z, Wang P, Wu H, Fan K, et al. Global, regional, and national burden inequality of chronic kidney disease, 1990–2021: a systematic analysis for the Global Burden of Disease Study 2021. Front Med. 2025;12:1439863.
24. Ladi-Akinyemi T, Ajayi I. Risk factors for chronic kidney disease among patients at Olabisi Onabanjo University Teaching Hospital in Sagamu, Nigeria: a retrospective cohort study. Malawi Med J. 2017;29(4):281–286.
25. Ayenigba, AA, Shittu, RO. Length of Hospital Stay in Typhoid Fever Patients: A Retrospective Study from Lagos State University Teaching Hospital. J. Stat. Sci. Comput. Intell. 2026, 2, 162-172.