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Comparative Survival Analysis of HIV-Infected Patients across Gombe, Borno, and Taraba States, North-Eastern Nigeria

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ABSTRACT
HIV remains a major public-health concern in Nigeria, with survival outcomes potentially varying across states because of differences in access to care, treatment adherence, and follow-up services. However, limited evidence exists on comparative HIV/AIDS survival in Borno, Gombe, and Taraba States, North-Eastern Nigeria. This study assessed survival duration among patients with confirmed HIV/AIDS-related deaths across the three states and identified factors associated with earlier mortality.
A retrospective study was conducted using health-facility records of 1,423 patients, comprising 461 from Borno, 590 from Gombe, and 372 from Taraba. Kaplan–Meier survival estimates, log-rank tests, and multivariable Cox proportional-hazards models were employed to estimate survival, compare survival patterns across states, and assess the effects of age, sex, financial status, residence, religion, and education.
Median survival times were 42.8 months in Borno, 42.5 months in Gombe, and 37.1 months in Taraba. Survival differed significantly among the three states ($p < 0.001$). In Borno, male patients had a significantly higher risk of death than females ($p = 0.004$). In Gombe, patients with secondary education had a significantly higher risk of death than those with tertiary education ($p = 0.010$). None of the variables included in the model significantly predicted survival in Taraba.
The findings demonstrate substantial differences in HIV/AIDS survival across the three states. State-specific interventions are recommended, including strengthened ART-adherence support in Taraba, targeted support for vulnerable groups, and improved documentation of patient outcomes to enhance HIV care and survival in North-Eastern Nigeria. These measures may help reduce preventable mortality and improve treatment outcomes.

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INTRODUCTION

Human immunodeficiency virus (HIV) remains a major public-health challenge worldwide, despite many years of prevention and treatment efforts. The virus attacks CD4 cells, which help the body fight infection. As the immune system becomes weaker, a person is more likely to develop serious infections and illnesses. Without treatment, HIV can progress to acquired immunodeficiency syndrome (AIDS), the most advanced stage of infection. However, antiretroviral therapy (ART) has changed HIV care significantly. By reducing the amount of virus in the body, ART helps people living with HIV stay healthier for longer and lowers the risk of AIDS-related death (Sieleunou et al. 2019; UNAIDS, 2023; Mohammed et al. 2026).

Even with these advances, survival outcomes are not the same everywhere. In many low- and middle-income countries, people may still face late diagnosis, limited access to healthcare, difficulty staying on treatment, and poor follow-up care. These challenges can affect how well people respond to treatment and how long they live (Maria et al., 2001; Sieleunou et al. 2019).

Sub-Saharan Africa carries the largest share of the global HIV burden. While access to treatment has improved, many people still experience barriers such as poverty, stigma, weak healthcare systems, and inconsistent follow-up care. Nigeria is among the countries most affected by HIV and continues to face challenges in ensuring that people can access and remain on effective treatment. In North-Eastern Nigeria, Gombe, Borno, and Taraba States differ in the availability and quality of health services. These differences may affect the survival of people living with HIV. However, few studies have compared survival outcomes across these three states using rigorous statistical methods (Mohammed et al. 2026).

Survival analysis is useful in HIV research because it examines how long it takes for an event, such as death, to occur. It can also account for patients who leave a study, transfer to another facility, or are still alive when the study ends. This makes it more suitable than many conventional statistical methods for studying patient outcomes over time. In this study, the Kaplan–Meier estimator, log-rank test, and Cox proportional-hazards model are used to compare survival outcomes among patients with confirmed HIV/AIDS-related deaths in Gombe, Borno, and Taraba States (Mohammed et al. 2026).

Although ART has improved HIV management, HIV-related mortality remains a concern in Nigeria, especially in settings with limited resources. Delayed diagnosis, poor adherence to treatment, loss to follow-up, and unequal access to quality healthcare can all contribute to poorer outcomes. Many Nigerian studies have examined HIV prevalence, treatment

coverage, and clinical outcomes, but fewer have used formal survival-analysis methods to compare outcomes across several states. As a result, there is still limited evidence on whether survival differs significantly among patients in Gombe, Borno, and Taraba States, or on the factors that may explain these differences (Mohammed et al. 2026; Eguzo et al., 2014).

Survival-analysis methods have been widely used in medical research for many years. The Kaplan–Meier estimator is used to estimate the probability of survival over time, while the log-rank test compares survival patterns between groups. The Cox proportional-hazards model makes it possible to assess how several factors, such as age, sex, education, and financial status, are related to the risk of death (Hosmer, Lemeshow, & May, 2008; Collett, 2015).

Previous research has shown that survival among people living with HIV can be influenced by several factors, including age, sex, education, stage of disease, adherence to treatment, CD4 count, and tuberculosis co-infection. Nigerian studies have also linked mortality among patients receiving ART to factors such as sex, low educational attainment, and tuberculosis co-infection. This study adds to the available evidence by comparing survival outcomes in Gombe, Borno, and Taraba States using independently extracted patient-level data.

The aim of this study is to compare the survival experiences of patients with confirmed HIV/AIDS-related deaths in Gombe, Borno, and Taraba States. Specifically, the study seeks to estimate survival probabilities, compare survival patterns across the three states, identify factors associated with survival, and assess how these factors affect the risk of death.

MATERIALS AND METHODS

Study Design and Population

This study reviewed existing hospital records to compare the time between HIV diagnosis and death among patients with confirmed HIV/AIDS-related deaths in Gombe, Borno, and Taraba States in North-Eastern Nigeria. The three states were chosen because they are important HIV-care settings in the region and differ in healthcare facilities and treatment delivery (Mohammed et al. 2026).

The study included HIV-infected patients whose treatment and outcome records were available at the participating health facilities. Rather than selecting a sample, all records that met the study criteria during the study period were included. This ensured that the analysis used all available eligible records. However, the findings reflect the patients and facilities included in the study and may not represent every person living with HIV in the three states.

To be included, a record had to show a confirmed HIV-positive diagnosis, a clear diagnosis date, a recorded date of death, and complete information on the study variables. Records were excluded if dates were missing or inconsistent, entries were duplicated, or key information was incomplete. The selection and reporting of records followed the principles of the STROBE guideline for observational studies.

After applying these criteria, 1,423 records were included in the analysis: 461 from Borno, 590 from Gombe, and 372 from Taraba. One important limitation was that the available records included only patients with confirmed deaths. Records for patients who were still alive, had transferred to another facility, or had been lost to follow-up were not available. Therefore, every patient included in the analysis had experienced the event of interest, which was death.

Time to death was calculated as the number of days between the date of HIV diagnosis and the date of death, converted to months. The study therefore describes how long patients who died lived after diagnosis in each state. Since there were no censored records, the findings should not be interpreted as survival probabilities for all people living with HIV. Instead, they show patterns in the timing of death among the confirmed fatalities included in the study. This is different from conventional survival analysis, which usually includes both patients who experience the event and those whose outcomes are not observed during follow-up.

Source of Data and Variables

The study used secondary data from clinical and administrative records kept by the participating health facilities in Gombe, Borno, and Taraba States. Information was collected by reviewing patient case files and treatment registers. No patients were contacted, and no questionnaire or other primary data-collection tool was used. Personal identifiers were removed during data extraction, and the data were used only for academic and research purposes.

The main outcome was time to death, measured in months from the date of HIV diagnosis to the date of death. The factors examined were state of treatment or residence, age, sex, financial status, location, religion, and educational level. State was grouped as Borno, Gombe, or Taraba; sex as male or female; financial status as rich, average, or poor; location as urban or rural; religion as Islam, Christianity, or other; and education as tertiary, secondary, primary, or other.

These factors were included because they were available in the records and may influence HIV-related outcomes. Their relationship with time to death was examined using the Kaplan–Meier estimator, log-rank test, and Cox proportional-hazards model.

Statistical Methods

The analysis began with simple descriptive statistics. Frequencies and percentages were used to describe the socio-demographic characteristics of patients with confirmed HIV/AIDS-related deaths in each state.

Three methods were then used to examine the time from HIV diagnosis to death: the Kaplan–Meier estimator, the log-rank test, and Cox proportional-hazards regression. Each analysis was carried out first for Gombe, Borno, and Taraba separately, and then for the three states combined.

Kaplan–Meier estimator. The Kaplan–Meier method was used to describe the pattern of time to death and to estimate the median time from HIV diagnosis to death in each state. The estimator is written as:

$$\hat{S}(t_j)=\hat{S}(t_{j-1})\left(1-\frac{d_j}{n_j}\right) \quad (1)$$

Here, $\hat{S}(t_j)$ represents the estimated proportion of patients who had not died by timet_j; n_j is the number of patients still at risk immediately before timet_j; and d_j is the number of deaths recorded at that time. Median time to death was the point at which the estimated survival curve first reached 0.50 or below (Kaplan & Meier, 1958; Kleinbaum & Klein, 2012).

The log-rank test was used to determine whether the pattern of time to death differed significantly between groups. It was used to compare categories of each explanatory variable within a state and to compare the three states in the pooled analysis. For the comparison across states, the null hypothesis was:

$$H_0: S^G(t) = S^B(t) = S_T(t) \quad (2)$$

This means that the time-to-death patterns in Gombe, Borno, and Taraba were assumed to be the same. The alternative hypothesis was that at least one state had a different pattern. The test compares the number of deaths actually observed in each group with the number expected if there were no

difference between the groups. A result was considered statistically significant when the p-value was less than 0.05.

Cox proportional-hazards regression. Cox regression was used to examine the combined effects of age, sex, financial status, location, religion, and educational attainment on time to death. Separate models were fitted for each state. The model is expressed as:

$$h(t \mid X) = h_0(t)\exp(\beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_p X_p) \quad (3)$$

In this model, $h(t \mid X)$ is the hazard function, which express the rate of death at time t for a patient with a particular set of characteristics (Cox, 1972). The term $h_0(t)$ represents the baseline rate of death, while the β values show how the explanatory variables are related to the rate of death. The hazard ratio for each variable was calculated as:

$$\text{HR} = \exp(\beta_j) \quad (4)$$

A hazard ration greater than 1, HR > 1, means that a group had a higher rate of death than the reference group. A hazard ratio below 1, HR < 1, means a lower rate of death, while a hazard ratio of 1, HR = 1, means there was no difference. Statistical significance was assessed at the 5% level, and 95% confidence intervals were reported for all hazard ratios. Before fitting the Cox models, the proportional-hazards assumption was checked visually using the state-specific Kaplan–Meier curves. The curves were examined for major crossing or clear differences in pattern over time, which could suggest that the relative risk of death did not remain constant (Cox, 1972). All analyses were performed using SPSS version 26.0.

RESULTS AND DISCUSSION

Descriptive Statistics of Confirmed HIV/AIDS Deaths by State

A total of 1,423 confirmed HIV/AIDS deaths with complete records were analyzed: 461 in Borno State, 590 in Gombe State, and 372 in Taraba State. Table 1 presents the socio-demographic characteristics of the patients and the median survival time, in months, for each category by state.

In Borno State, most confirmed deaths occurred among females (56.2%), individuals of average financial status (44.0%), urban residents (51.6%), Christians (52.5%), and those with tertiary education (50.5%). In Gombe State, the majority were males (55.4%), individuals of average financial status (41.0%), urban residents (63.7%), Muslims (54.8%), and those with tertiary education (42.7%). In Taraba State, confirmed deaths were equally distributed between males and females (50.0% each); most individuals were of average financial status (42.7%), lived in urban areas (52.7%), were Muslim (50.5%), and had tertiary education (39.5%).

Table 1: Socio-Demographic Distribution and Median Survival Time of Confirmed HIV/AIDS Deaths, by State

Variable	Category	Borno n (%)	Gombe n (%)	Taraba n (%)	Median Survival (months) B / G / T
Sex	Female	259 (56.18)	263 (44.58)	186 (50.00)	44.8 / 40.2 / 40.1
	Male	202 (43.82)	327 (55.42)	186 (50.00)	40.2 / 43.0 / 36.1
Financial Status	Rich	137 (29.72)	191 (32.37)	111 (29.84)	45.6 / 43.9 / 36.0
	Average	203 (44.03)	242 (41.02)	159 (42.74)	40.8 / 45.2 / 37.1
	Poor	109 (23.64)	150 (25.42)	80 (21.51)	45.4 / 40.4 / 42.3
	Unknown	12 (2.60)	7 (1.19)	22 (5.91)	37.5 / 31.0 / 36.0
Location	Urban	238 (51.63)	376 (63.73)	196 (52.69)	44.5 / 41.6 / 40.7
	Rural	223 (48.37)	210 (35.59)	176 (47.31)	41.0 / 43.5 / 36.4
Religion	Islam	216 (46.85)	323 (54.75)	188 (50.54)	41.9 / 43.9 / 37.7
	Christianity	242 (52.49)	267 (45.25)	180 (48.39)	43.9 / 41.6 / 36.8
	Other	3 (0.65)	—	4 (1.08)	61.9 / — / 49.2
Level of Education	Tertiary	233 (50.54)	252 (42.71)	147 (39.52)	40.8 / 43.9 / 36.1
	Secondary	164 (35.57)	231 (39.15)	115 (30.91)	44.3 / 40.9 / 34.0
	Primary	51 (11.06)	70 (11.86)	71 (19.09)	44.7 / 40.4 / 39.0
	Other	13 (2.82)	33 (5.59)	39 (10.48)	35.5 / 58.7 / 55.8
Total		461 (100)	590 (100)	372 (100)	42.8 / 42.5 / 37.1

Note: B = Borno; G = Gombe; T = Taraba. Percentages are within-state column percentages and may not sum exactly to 100 due to rounding.

State-Specific Kaplan–Meier Estimates and Log-Rank Tests

State-specific Kaplan–Meier analyses showed median survival times among confirmed deaths of 42.8 months in Borno State, 42.5 months in Gombe State, and 37.1 months in Taraba State, which had the shortest median survival time of the three states. Within each state, log-rank tests were conducted to determine whether survival times differed significantly across categories of each risk factor. The results are presented in Table 2.

Table 2: Within-State Log-Rank Tests of the Association between Risk Factors and Survival Time

Factor	Borno χ^2 (df, p)	Gombe χ^2 (df, p)	Taraba χ^2 (df, p)
Sex	7.962 (1, 0.005)*	0.411 (1, 0.521)	1.376 (1, 0.241)
Financial Status	3.109 (3, 0.375)	5.436 (3, 0.143)	1.229 (3, 0.746)
Location	0.633 (1, 0.426)	2.820 (2, 0.244)	0.349 (1, 0.555)
Religion	1.236 (2, 0.539)	0.430 (1, 0.512)	1.083 (2, 0.582)
Level of Education	0.779 (3, 0.854)	7.693 (4, 0.104)	5.936 (3, 0.115)

*Statistically significant at $p < 0.05$.

Table 2 indicates that, in Borno State, sex was the only factor significantly associated with survival time among confirmed deaths ($\chi^2 = 7.962$, df = 1, p-value = 0.005). Financial status, location, religion, and educational level showed no statistically significant associations within the state ($p > 0.05$).

In Gombe and Taraba States, none of the five risk factors was significantly associated with survival time in the log-rank tests. However, educational level showed the strongest, albeit non-significant, association in both states (Gombe: $\chi^2 = 7.693$, df = 4, p = 0.104; Taraba: $\chi^2 = 5.936$, df = 3, p = 0.115).

State-Specific Multivariable Cox Proportional Hazards Regression

Separate multivariable Cox proportional hazards models were fitted for each state, with age, sex, financial status, location, religion, and educational level included as covariates. Table 3 presents the hazard ratios (HRs), 95% confidence intervals, and p-values for each state.

Table 3: State-Specific Multivariable Cox Proportional Hazards Regression Analyses

Covariate (reference category)	Borno HR (95% CI), p	Gombe HR (95% CI), p	Taraba HR (95% CI), p
Age (years)	0.9995 (0.992–1.007), 0.884	0.996 (0.989–1.003), 0.233	0.993 (0.984–1.001), 0.093
Sex: Male (Female)	1.322 (1.093–1.599), 0.004*	0.968 (0.818–1.144), 0.701	1.147 (0.924–1.424), 0.215
Financial: Average (Rich)	1.221 (0.972–1.535), 0.086	0.973 (0.800–1.184), 0.786	1.114 (0.866–1.432), 0.400
Financial: Poor (Rich)	1.017 (0.784–1.320), 0.898	1.125 (0.900–1.407), 0.299	1.004 (0.738–1.366), 0.981
Location: Rural (Urban)	1.170 (0.965–1.419), 0.111	1.023 (0.844–1.241), 0.814	1.019 (0.822–1.264), 0.861
Religion: Christianity (Islam)	0.877 (0.724–1.061), 0.175	1.078 (0.911–1.277), 0.382	0.859 (0.688–1.072), 0.179
Religion: Other (Islam)	0.861 (0.265–2.796), 0.803	—	0.718 (0.260–1.987), 0.524
Education: Secondary (Tertiary)	0.999 (0.812–1.230), 0.996	1.273 (1.059–1.530), 0.010*	1.121 (0.866–1.450), 0.386
Education: Primary (Tertiary)	0.869 (0.629–1.200), 0.393	0.999 (0.754–1.324), 0.996	0.985 (0.723–1.342), 0.925
Education: Other (Tertiary)	0.912 (0.496–1.674), 0.765	0.836 (0.552–1.265), 0.396	0.715 (0.487–1.049), 0.086

*Statistically significant at $p < 0.05$.

Table 3 shows that, in Borno State, sex was the only statistically significant predictor of the hazard of earlier death. Male patients had a significantly higher hazard than female patients (HR = 1.322; 95% CI: 1.093–1.599; p = 0.004). In Gombe State, educational level was the only significant predictor: patients with secondary education had a significantly higher hazard of earlier death than those with tertiary education (HR = 1.273; 95% CI: 1.059–1.530; p = 0.010). In Taraba State, none of the covariates reached conventional statistical significance. However, age (HR = 0.993; p = 0.093) and the "other" education category (HR = 0.715; p = 0.086) showed borderline associations. Overall, these findings suggest that predictors of the hazard of death vary across states, sex in Borno, educational level in Gombe, and no significant individual-level predictor in Taraba supporting the state-specific analytical approach used in this study.

Cross-State Comparison of Survival Experience

Median survival time among confirmed deaths was similar in Borno State (42.8 months) and Gombe State (42.5 months) but shorter in Taraba State (37.1 months). A multi-group log-rank test, with state as the grouping variable, was conducted using the full dataset of 1,423 patients to assess differences in overall survival experience across the three states. The test yielded a chi-square statistic of 22.868 with 2 degrees of freedom ($p < 0.001$), indicating a statistically significant difference in survival time among confirmed deaths across Borno, Gombe, and Taraba States. Table 4 summarizes the comparison.

Table 4: Comparison of Median Survival Times and the Between-State Log-Rank Test

State	n (confirmed deaths)	Median survival (months)
Borno	461	42.8
Gombe	590	42.5
Taraba	372	37.1
Total / Between-state log-rank test	1,423	$\chi^2 = 22.868$, df = 2, p-value < 0.001

This study comparatively examined the survival experiences of patients with confirmed HIV/AIDS deaths in Gombe, Borno, and Taraba States, Nigeria, using Kaplan–Meier estimation, log-rank testing, and Cox proportional hazards regression. The between-state log-rank test showed a highly significant difference in survival experience across the three states (p-value < 0.001). Among confirmed deaths, patients in Taraba State experienced the shortest time to death, whereas those in Borno and Gombe States had broadly similar and relatively longer survival times.

This finding is consistent with a broader published study of the same three states, which reported significant state-level differences in HIV/AIDS mortality using chi-square and log-rank tests and identified Gombe as having the highest overall mortality rate, followed by Taraba and Borno (Mohammed et al., 2026). It also agrees with earlier evidence showing that survival outcomes may vary substantially by treatment centre and geographical location because of differences in healthcare access and quality of care (Sieleunou et al., 2009).

In the state-specific Cox regression analyses, educational level emerged as a significant predictor of the hazard of death in Gombe State. Patients with secondary education had a significantly higher hazard of earlier death than those with tertiary education (p-value = 0.010). This finding is consistent with evidence from Fortaleza, Brazil, where university-educated patients with HIV/AIDS had a markedly lower risk of death than those without university education (Maria et al., 2001). It also aligns with broader evidence that higher educational attainment is often associated with better treatment adherence and health-seeking behaviour (Udoh et al., 2025).

In Borno State, sex was the only significant predictor of the hazard of death. Male patients had a significantly higher hazard of earlier death than female patients (p-value = 0.004). This result is consistent with the male mortality disadvantage reported in the published benchmark study of the same three states (Mohammed et al., 2026), as well as with sex-related mortality differences reported among patients receiving ART

in Ethiopia and other parts of sub-Saharan Africa (Eguzo et al., 2014).

By contrast, financial status, location, and religion were not statistically significant predictors of survival time or the hazard of death in any of the three states. In Taraba State, none of the covariates reached statistical significance. This finding is partly attributable to the nature of the dataset: the records included only patients with a confirmed and dated death outcome. Consequently, the analysis assessed the timing of death among patients who died, rather than the overall probability of death or survival among all enrolled patients.

This distinction likely explains why the present findings are more limited in scope than those of the published benchmark study, which included both censored observations and deaths. That broader study was therefore able to identify statistically significant associations between overall survival status and sex, financial status, and educational level (Mohammed et al., 2026). The median survival times reported in this study, 37.1 to 42.8 months, or approximately 3.1 to 3.6 years among confirmed deaths, should thus be interpreted as the time to death among fatal cases, rather than the expected survival time of a typical diagnosed patient. Estimating the latter requires the inclusion of censored observations. The benchmark study estimated survival durations of up to approximately 16.5 years in the same three states, broadly consistent with ART-era survival durations of 9 to 15 years reported in Uganda and China, respectively (Todd et al., 2006; Mohammed et al., 2026).

Overall, the findings from the record-level data are broadly consistent with and complementary to the wider evidence on HIV survival in Gombe, Borno, and Taraba States. They also highlight an important methodological consideration for future HIV survival research in the region: meaningful assessment of overall survival probabilities requires data on both deaths and censored outcomes, including patients who remain alive, are transferred, or are lost to follow-up. This requirement was only partially met by the dataset used in the present study.

CONCLUSION

This study compared the survival experiences of 1,423 patients with confirmed HIV/AIDS-related deaths in Gombe, Borno, and Taraba States, Nigeria, using Kaplan–Meier estimation, log-rank testing, and multivariable Cox proportional-hazards regression. The results revealed significant differences in survival time across the three states, with Taraba State recording the shortest median survival time of 37.1 months, while Borno State recorded the longest at 42.8 months. These findings indicate substantial variation in the timing of HIV/AIDS-related mortality across North-Eastern Nigeria and suggest that differences in healthcare access, treatment adherence, follow-up services, and other state-specific conditions may contribute to varying survival experiences. The analysis further showed that the factors associated with mortality differed between states. Sex was a significant predictor of the hazard of death in Borno State, whereas educational level was a significant predictor in Gombe State. In contrast, none of the covariates examined was statistically significant in Taraba State. Financial status, residential location, and religion were not significant predictors of mortality in any of the three states. Overall, the findings demonstrate that demographic factors associated with the timing of HIV/AIDS-related death are not uniform across the study areas, highlighting the importance of context-specific HIV prevention, treatment, and support strategies. The study concludes that state of residence, sex, and educational level are important factors associated with HIV/AIDS mortality patterns in North-Eastern Nigeria. However, the restriction of the dataset to patients with confirmed HIV/AIDS-related deaths limits the estimation and interpretation of overall survival probabilities among the broader population of people living with HIV. Future studies should therefore incorporate both surviving and deceased patients, where appropriate, to provide more comprehensive estimates of survival and identify modifiable factors influencing mortality. Strengthening state-specific interventions, particularly adherence support, continuity of care, and accurate patient outcome documentation, may improve HIV treatment outcomes and reduce preventable mortality across the region.

Based on these findings, the following recommendations are made:

i. Taraba State health authorities and HIV treatment partners should strengthen ART adherence support, patient tracking, and early clinical intervention, given the shorter survival time observed among confirmed deaths in the state.
ii. Health education and treatment-literacy programmes should be strengthened in Gombe State, particularly for patients with secondary education, who had a significantly higher hazard of earlier death than those with tertiary education.
iii. Health facilities and state HIV/AIDS control programmes should improve patient-outcome documentation by consistently recording whether enrolled patients are dead, alive, transferred, or lost to follow-up. This would support more comprehensive survival analyses that include censored observations.
iv. Policymakers should adopt state-specific HIV programme planning and resource allocation strategies across North-Eastern Nigeria, rather than relying on uniform interventions, in recognition of the survival differences identified across states.
v. Future data systems should capture key clinical variables, including CD4 count, WHO clinical stage, ART regimen, and adherence level, as these are established predictors of HIV survival but were unavailable in the present dataset.

This study contributes to existing knowledge by providing state-specific, patient-level evidence on HIV/AIDS survival among confirmed deaths in Gombe, Borno, and Taraba States—an area of North-Eastern Nigeria that remains underrepresented in comparative survival research. It also demonstrates the combined use of Kaplan–Meier estimation, log-rank testing, and Cox proportional hazards regression within a comparative framework across three states. In addition, it highlights the practical data-quality challenge of conducting survival analysis without complete records for censored patients, an issue of direct relevance to HIV data management and survival research in resource-limited settings.

Future studies should use complete cohort data that include censored observations to enable fully specified Kaplan–Meier and Cox regression analyses of survival probability. They should also incorporate clinical indicators such as CD4 count and WHO clinical stage, extend the analysis to all six North-Eastern Nigerian states, and formally assess the proportional hazards assumption using Schoenfeld residuals when complete cohort data become available.

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