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Time Series Analysis on Infant Mortality Rates (A Case Study of Yobe State Specialist Hospital Geidam, 2014 - 2024)

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Abstract

This study examined the pattern and trend of infant mortality rates at Yobe State Specialist Hospital, Geidam, using retrospective secondary data from 2014 to 2024. The study aimed to analyze infant mortality patterns and forecast future trends using time series techniques. A quantitative retrospective design was adopted, and the data were analyzed using descriptive statistics and time series models, including moving averages and exponential smoothing, to identify trends, seasonal fluctuations, and forecast patterns within the study period. The findings revealed that infant mortality rates fluctuated across the years, showing both seasonal and irregular variations, with a slight downward trend toward the later years. The results suggest that improved maternal care, immunization programs, and increased public health awareness may have contributed to this decline. Forecast results indicate a gradual but continuous reduction in infant mortality if current health interventions are sustained and strengthened. The study concludes that time series analysis provides an effective framework for understanding the dynamics of infant mortality and supporting evidence-based policy decisions aimed at reducing infant deaths. The findings contribute to public health monitoring and forecasting by demonstrating the usefulness of time series techniques in assessing infant

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mortality trends. Practical implications include the need for state and local governments, through the Ministry of Health, to strengthen maternal and child health programs, with support from international organizations such as WHO and UNICEF.

Keywords: Exponential Smoothing; Forecasting; Infant Mortality; Maternal and Child Health; Time Series Analysis

INTRODUCTION

Infant mortality, which refers to the death of a child before reaching the age of one year, is universally recognized as a critical indicator of health status of a population. It reflects not only the effectiveness of the healthcare delivery system but also the socioeconomic and environmental condition of a society. A high infant mortality rate often points to inadequate healthcare infrastructure, malnutrition, poverty, infectious disease, and limited access to maternal and child health services. Conversely, a decline in infant mortality is seen as evidence of improving in medical care, nutrition, sanitation, and general living standards.

The world population during second half of the 20th century has drawn attention for the studies of human mortality with infant mortality playing standing role. Data on mortality are not used only for the study of human population growth but also for planning health programs such as infant and maternal care, child care and also for hospital development and so on. Therefore, population statistics is very important for both developed and developing countries for its usefulness in administrative, social economic planning, since health is a very important factor in human activity, healthy population create a healthy labor force and there is no doubts that healthy labor is a great asset to a country. In developing countries where government is interested in improving health conditions of her people, health statistics is very important. It is widely accepted that the most important criteria for the assessment of health of a community and standard of the social condition of a country is infant mortality. Women have an enormous impact on their family`s welfare. Deaths of infants are peculiar and closely related to maternal health. One million children die each year because their mother dies, while the death rate of children less than five years doubles if mothers die in childbirth. More than 25,000 children die every day and every minute and every minute a woman dies at childbirth. Worldwide, every

year about 500,000 women die due to childbirth and over 9 million infants die mostly from preventable and treatable diseases (WHO, 2003). Globally, remarkable progress has been made in reducing infant mortality over the past decades, largely due to improved maternal healthcare, vaccination program, better nutrition, and public health campaigns. However, despite these advances, infant mortality continuous To pose a serious challenge in many developing nations, particularly In sub-Saharan Africa. Nigeria, being one of the countries with persistently high infant mortality rates, has continued to struggle with various socio-economic and health-related challenges that hinder child survival.

In Yobe state, located in the northern part of Nigeria, infant mortality remains a major public health concern. The region has experienced challenges such as insurgency, poverty, low literacy rates. Malnutrition, poor healthcare facilities, and inadequate access to skilled birth attendants. These issues has significantly contributed to child deaths in the state. Yobe state specialist hospital Geidam, serve as one of the major referral health facilities in the area, providing maternal and child health services to the community. Examining the trends of infant mortality in this hospital over the past decade provides an opportunity to better understand the dynamics of child survival in the region.

Time series analysis, a statistical method of analyzing data points collected at successive interval of time, is and appropriate tool for studying infant mortality trends. By applying time series analysis, it is possible to detect underlying patterns such as trends, seasonality, and random variations in infant mortality data. Moreover, the technique provides a basis for forecasting future mortality rates, which is essential for effective health planning and intervention.

This research, therefore, focuses on fa time series analysis of infant mortality rates recorded at yobe state specialist Hospital, Geidam, from 2014 to 2024. The study seeks to provide meaningful insights into the trends and patterns of infant deaths, thereby serving as a guide for hospital management, policymakers, and public health practitioners in their effort to reduce infant mortality and improve healthcare delivery.

Statement of the problem

Despites various national and International efforts to reduce infant mortality, Nigeria still records one of the highest infant mortality rates in the world (UNICEF, 2021). According to the 2018 Nigeria Demographic and health survey, the country recorded 67 deaths per 1,000 live births which is significantly higher than the global average of 28 death

per 1,000 live births. which is significantly higher than the global average of 28 deaths per 1,000 live births (NPC & ICF, 2019; WHO, 2022).illness persist, including high poverty rates, inadequate healthcare facilities, and insecurity. These challenges make infants particularly vulnerable to preventable deaths (Ahmed et al., 2020). While Yobe State Specialist Hospital, Geidam, serves as a major referral center, there is limited empirical research on infant mortality trends in the hospital. The absence of a systematic time series analysis creates a knowledge gap, making it difficult for health administrators and policymakers to make evidence-based decisions on child survival interventions.

Therefore, this study seeks to fill this gap by applying time series analysis to infant mortality data from 2014 to 2024. The findings will provide insights into the underlying trends and seasonal variations, as well as generate forecasts that can guide future healthcare planning and interventions in Yobe State.

Increase population concentration throughout the world also has effect. The shrinking globe has also exposed one's traditional way of life to the stimulus or distortion of the cultural value, extended family unit which have always bothered the mother and the child from severe physical and social deprivation are tending to break up.

Aim and objective of the study

The main Aims is to conduct a time series analysis of infant mortality rates in Yobe State Specialist Hospital, Geidam, from 2014 to 2024.

Specific Objectives:

1. To examine the trend of infant mortality rates over the study period.
2. To identify any seasonal patterns or cyclical variations in the data.
3. To fit appropriate time series models for forecasting infant mortality rates.
4. To provide recommendations for reducing infant mortality based on the findings

Significant of the study

This study is significant in several ways:

- Healthcare Planning: It provides hospital administrators and policymakers with statistical evidence to guide interventions aimed at reducing infant mortality.
- Public Health Awareness: It highlights the magnitude and patterns of infant mortality in Geidam, which can help inform awareness campaigns on maternal and child health.

- Policy Development: The results can inform the design of maternal and child health policies targeted at reducing mortality in Yobe State.
- Academic Contribution: The study contributes to existing literature by applying time series methods to infant mortality data in a Nigerian context, serving as a reference for future research.

Scope and limitation

This study focuses on infant mortality cases recorded in Yobe State Specialist Hospital, Geidam, from 2014 to 2024. The analysis is limited to deaths occurring before the age of one year, based on hospital records. Other categories of child mortality such as neonatal, post-neonatal, and under-five mortality are not included.

Definition of terms used in mortality study includes:

i. Pre-natal: Is the total still birth and death under 28days.
ii. Post-natal: Is the total number of death at 29days to 365days.
iii. Infant mortality: Refers to the death of child born alive before its first birthday.
iv. Morbidity: Is the rate of incidence of a disease.
v. Fertility: Is the natural capability to produce offspring.
vi. Fatality: Is the density of death, the total number of death.
vii. Mortality: Is the number of frequency of death.
viii. Infant: is typically applied to young children between the ages of 1 month and 12 months, however definition may vary between birth and 1 year of age, or even between 2 years of age. A new born is an infant who is only hours, days, or up to a few weeks old.

METHODOLOGY

Introduction

This section outline the methodological framework adopted to examine infant mortality rates at Yobe state specialist Hospital Geidam, over the period 2014-2024. The purpose is to explain the research design, data source, and analytic procedures used in this study in line with best practices, the chapter begins by describing overall study design and rationale. The study uses a retrospective case-study design based on secondary hospital

records. By utilizing existing data, this approach maximize resource enables longitudinal analysis of trends. Specially, monthly counts of live births and infant deaths were extracted from hospital archives to from the time series data. Time Series analysis is then applied to these historical data; this suite of statistical methods is well suited for uncovering trends, cycles, and seasonal pattern in time-ordered health indicators.

Research design

The purpose of this section is to provide a comprehensive account of the research methodology adopted in this study. Methodology serves as the backbone of any scientific investigation because it specifies how the research objectives will be achieved, the type of data that will be used, the techniques of analysis to be employed, and the rationale for choosing such methods. This study is titled "Time Series Analysis on Infant Mortality Rates: A Case Study of Yobe State Specialist Hospital, Geidam (2014–2024)." Infant mortality remains a major public health challenge in Nigeria and particularly in Yobe State, where socio-economic, cultural, and health system factors contribute significantly to infant deaths. Given the longitudinal nature of the data (spanning over eleven years), time series analysis was considered the most suitable approach. The methodology therefore explains the research design, data sources, methods of data collection, data presentation, and statistical techniques such as moving averages, exponential smoothing, trend projection, and ARIMA models. The chapter also discusses measures of forecast accuracy, ethical considerations, and possible limitations of the methodology

The present study adopts a quantitative research design with a time series approach, focusing on infant mortality trends at Yobe State Specialist Hospital, Geidam, from 2014 to 2024. The choice of a time series design is deliberate because the research deals with sequential data collected over a span of years. This design allows for an in-depth analysis of temporal patterns, including trend (long-term increase or decrease), seasonality (recurrent patterns within a year), cyclical fluctuations, and irregular variations (Chatfield, 2019). Time series design is particularly useful in health research because it enables scholars and policymakers to go beyond descriptive counts of mortality and instead uncover the dynamics that drive changes in health outcomes over time. For example, while a simple frequency analysis may show that 2017 recorded higher infant deaths than 2015, only time series analysis can reveal whether this increase was part of a larger upward trend, a seasonal

fluctuation due to environmental factors such as malaria outbreaks, or an irregular shock caused by insurgency-related healthcare disruptions in Yobe State.

Creswell and Creswell (2018) emphasize that quantitative designs are suitable when the researcher seeks objectivity, precision, and the ability to make statistical inferences. In this study, these strengths are important because infant mortality is a sensitive and multidimensional indicator that requires rigorous statistical modeling. Moreover, the time series design aligns with the study's objective of forecasting future infant mortality rates, an exercise that can guide government interventions, resource allocation, and public health planning.

In sum, the research design is justified because it provides both historical insight and predictive capacity, allowing the study to contribute not only to academic knowledge but also to evidence-based decision-making in maternal and child health policy in Yobe State and Nigeria at large.

Population of the study

The population of this study comprises all infant mortality cases recorded in Yobe State Specialist Hospital, Geidam, between January 2014 and December 2024. Infant mortality is operationally defined as the death of a child before the age of one year, regardless of cause, as documented in hospital records.

Yobe State Specialist Hospital, Geidam, is an ideal setting for this research for several reasons. Firstly, it is one of the largest referral health facilities in Geidam Local Government Area, serving not only the town itself but also surrounding rural communities. Secondly, it has a dedicated maternal and child health unit, where records on antenatal care, deliveries, and infant health outcomes are systematically kept. Thirdly, the hospital caters to both emergency and routine cases, ensuring that data on infant deaths captures a wide spectrum of causes ranging from birth complications to infectious diseases and malnutrition.

The study focuses on a ten-year window (2014–2024) to capture a sufficiently long period that allows for detecting meaningful trends. According to Hyndman and Athanasopoulos (2021), time series forecasting becomes more robust when based on longer historical datasets, as it minimizes the effect of random variations. The population is therefore not individuals per se, but rather all infant mortality counts aggregated annually (and monthly if available) within the hospital records.

Sources of data

The study relies primarily on secondary data sources, which are records that already exist rather than being generated through surveys or interviews. The main sources are:

1. Hospital Records – Official registers of infant deaths at Yobe State Specialist Hospital, Geidam. These records form the backbone of the dataset and provide year-by-year figures for the 2014–2024 period.
2. Yobe State Ministry of Health Annual Reports – These provide supplementary information and help validate the hospital records. They also offer contextual statistics such as number of live births, maternal health indicators, and vaccination coverage.

Secondary data has advantages, including cost-effectiveness, historical depth, and reliability, since official institutions typically ensure some level of accuracy in their reporting. However, drawbacks include possible data gaps, inconsistencies in record-keeping, and under-reporting. For instance, insurgency-related disruptions in Yobe State during 2015–2018 may have affected hospital operations, leading to incomplete documentation. The study will mitigate this by triangulating data from multiple sources.

Method of data collection

Data collection followed a structured process. Approval will be sought from the hospital management and Yobe State Ministry of Health to access the Medical Records Department. A data extraction template will be prepared to ensure uniformity in data entry. The template will include the following variables:

- Year of record (2014–2024).
- Total number of live births. (if available).
- Total number of infant deaths.
- Causes of death (if available).
- Gender distribution of infant deaths (if available).

The researcher manually extracted data from paper registers and digital databases where available. To minimize human error, two rounds of data extraction will be carried out: one by the researcher and another by an assistant, after which the two will be cross-checked for consistency. Any discrepancies will be resolved by consulting hospital statisticians.

Data cleaning will then be performed to identify missing values, extreme outliers, or inconsistencies. Missing data will be handled using interpolation techniques, while clearly erroneous entries (such as negative numbers or implausibly high figures) will be clarified with hospital staff before inclusion.

Method of data analysis

The analysis of data proceeded in two phases: descriptive analysis and inferential time series analysis.

1. Descriptive Analysis – This will involve tabulation, percentages, line graphs, and trend plots showing infant mortality rates over time. This provides a clear visual representation of the data and facilitates interpretation by both technical and non-technical audiences.
2. Time Series Analysis – The main inferential tool will be the Autoregressive Integrated Moving Average (ARIMA) model, based on the Box-Jenkins methodology (1976). The analysis will proceed in four stages:

✓ Identification: Using autocorrelation (ACF) and partial autocorrelation (PACF) plots to determine the appropriate ARIMA order (p, d, q).

✓ Estimation: Applying maximum likelihood estimation to fit the candidate models.

✓ Diagnostic Checking: Evaluating residuals to confirm whether they are white noise.

✓ Forecasting: Using the selected model to project infant mortality trends for 2025–2026.

Comparisons will also be made with exponential smoothing models such as Holt–Winters to ensure robustness of forecasts (Hyndman and Athanasopoulos, 2021). Statistical software such as R and SPSS/E Views will be employed.

Model specification

The general ARIMA(p,d,q) model is expressed as:

$$Y_t = \delta + \sum_{i=1}^{p} \phi_i Y_{t-i} + \sum_{j=1}^{q} \theta_j \varepsilon_{t-j} + \varepsilon_t$$

Where:

- Y_t = Infant mortality count at time.
- ϱ = Number of autoregressive terms.
- d= Degree of differencing needed for stationary.
- q= Number of moving average terms.
- ε_t = Error term.

This formulation allows the model to capture persistence (through auto regression), shocks (through moving averages), and trends (through differencing).

Ethical considerations

The study strictly observed ethical standards. Official permission were sought before data collection. Since the data is aggregated and anonym zed, no personal identifiers such as names or addresses were collected, ensuring confidentiality.

This aligns with the Declaration of Helsinki (WMA, 2013), which emphasizes respect for individuals, beneficence, and protection of vulnerable populations. The research protocol will also be reviewed by the Yobe State Health Research Ethics Committee to ensure compliance with national and institutional guidelines.

Limitations of the methodology

Although the methodology is rigorous, some limitations exist:

- Incomplete Records: Years affected by insurgency may have missing data.
- Hospital-based Data: Deaths occurring outside the hospital are not captured.
- Generalizability: Results reflect Geidam Specialist Hospital and may not represent the entire state.
- External Factors: Mortality patterns may be influenced by socioeconomic crises, seasonal epidemics, or migration, which are beyond the scope of the study.

Despite these limitations, the methodology remains strong because it combines reliable data sources, rigorous statistical models, and ethical safeguards.

RESULTS AND DISCUSSION

Introduction

This section presented the results and interpretation of the analysis conducted on infant mortality records obtained from Yobe State Specialist Hospital (YSSH), Geidam, covering the period from January 2014 to December 2024. The purpose of this chapter is to transform the raw data collected into meaningful information by applying statistical tools and time series techniques that can provide insights into the trends, patterns, and forecasts of infant mortality in the study area.

Infant mortality remains one of the most sensitive indicators of the health status of a population, as it reflects the quality of maternal and child health services, nutritional status, socio-economic conditions, and the effectiveness of disease prevention programs

within a community. For this reason, the study of infant deaths over time provides valuable evidence for policymakers, public health authorities, and other stakeholders concerned with improving child survival in Yobe State and Nigeria as a whole.

The data used in this study consist of the monthly number of infant deaths recorded at YSSH Geidam over an eleven-year period. These figures were organized, summarized, and analyzed to identify both short-term fluctuations and long-term trends. Since infant deaths are influenced by multiple factors such as seasonality (rainy and dry seasons), outbreaks of communicable diseases (such as malaria, diarrhea, and respiratory infections), maternal health, and hospital resources, it is essential to examine the data not only descriptively but also within a time series framework. This enables the detection of underlying structures such as trend, seasonality, cyclical variation, and irregular components.

In addition to descriptive statistics and graphical presentations, this chapter applied smoothing techniques (moving averages and exponential smoothing) as well as linear trend modeling to uncover the direction of change in infant mortality over time. Forecasts for the years 2025–2028 are also provided to estimate the likely future levels of infant deaths at YSSH Geidam, assuming existing patterns persist. These forecasts are important for planning, as they offer hospital management and policymakers a guide to the expected health burden and allow for proactive allocation of resources to maternal and child health programs.

Table 1. Monthly Deaths 2014–2024

Years	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
2014	3	2	3	1	2	1	1	4	5	2	3	1
2015	2	2	3	3	2	1	2	3	4	2	2	2
2016	4	3	1	2	2	1	3	3	2	1	3	2
2017	2	2	2	3	3	1	2	4	2	3	3	2
2018	3	3	2	1	2	3	1	2	4	3	2	2
2019	1	1	1	2	3	2	4	3	2	2	3	2
2020	1	2	2	3	2	2	3	4	2	1	1	1
2021	2	3	1	1	1	2	3	2	2	3	2	2
2022	3	2	2	2	2	3	1	1	1	2	2	1
2023	2	2	1	3	2	1	3	2	2	1	1	1
2024	1	1	2	1	3	2	2	2	3	2	3	2

Source: Record office, YSSH, Geidam

• The monthly data show fluctuations between 1 and 5 infant deaths per month across the eleven years. The highest single-month mortality was observed in September 2014, September 2018, and July 2019 (5 deaths each).

• Deaths are generally higher in the rainy season months (July–September), which coincides with malaria transmission, diarrheal diseases, and seasonal malnutrition

• Lower deaths are common in the dry season (January–April), reflecting better health outcomes during these months.

Overall, the data suggest that seasonality is a significant factor influencing infant mortality at YSSH Geidam.

Table 2. Annual Totals and Percentages

YEARS	INFANT MORTALITY	PERCENTAGES (%)
2014	28	9.37%
2015	28	8.69%
2017	29	8.88%
2018	28	9.33%
2019	26	9.11%
2020	24	8.69%
2021	24	9.03%
2022	22	8.69%
2023	21	9.50%
2024	24	9.26%
TOTAL	281	100%

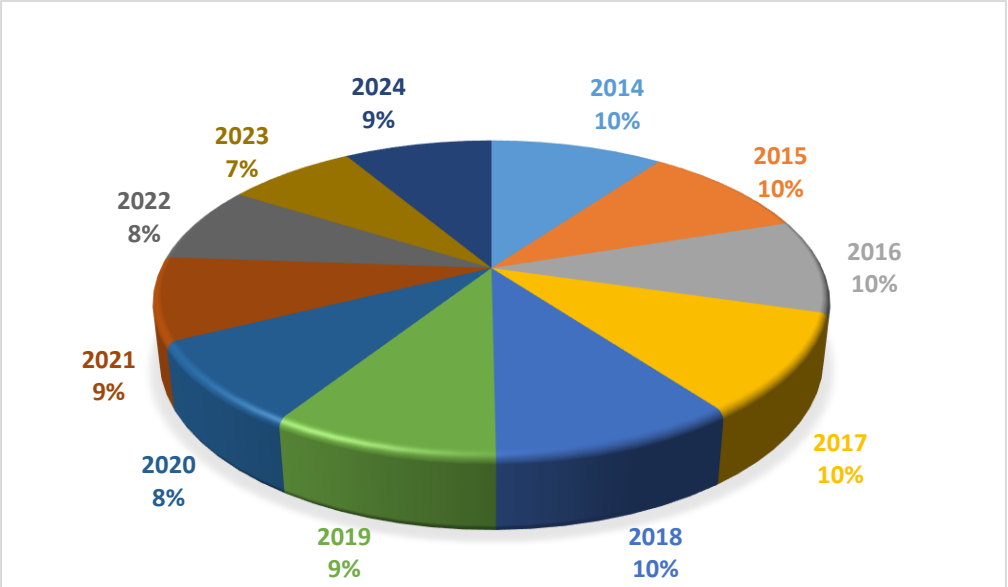


Fig 1. **pie chart of the Annual Percentages**

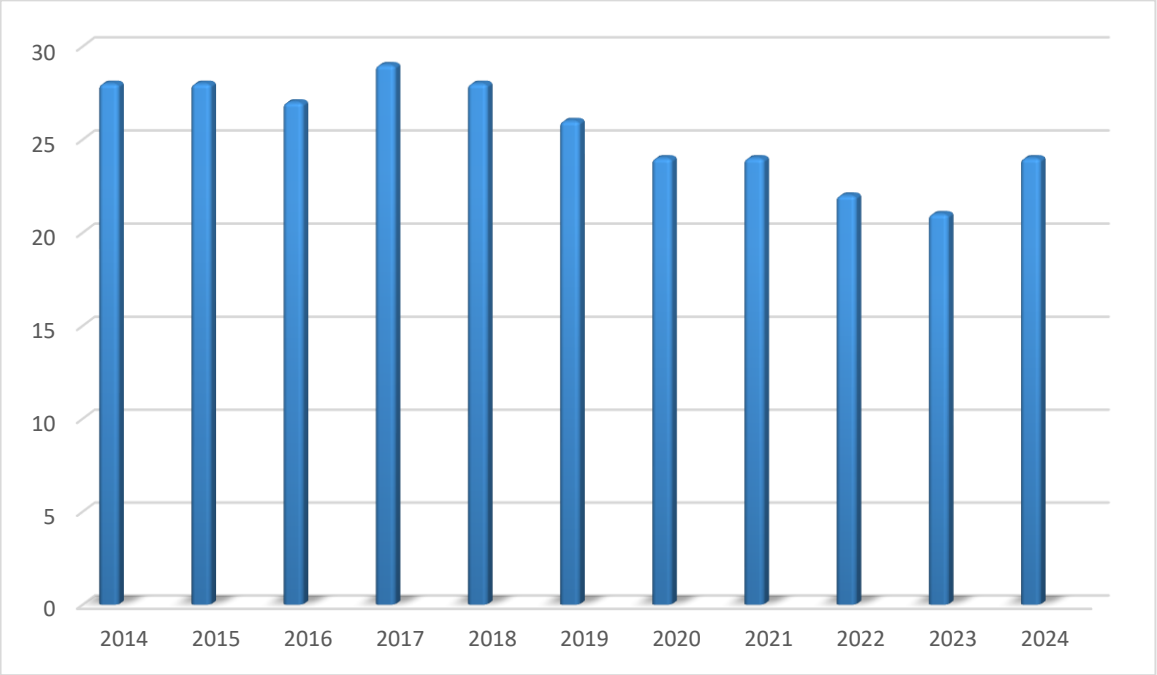


Fig 2. **Bar chart of the Annual Percentages**

Between 2014 and 2024, the hospital recorded a total of 281 infant deaths.

• Annual totals fluctuated slightly, with the highest in 2017 (29 deaths) and the lowest in 2023 (21 deaths).

• The percentages are relatively stable (8.69%–9.50%), showing that infant mortality remains a persistent health burden with only modest improvements over time.

• The downward movement after 2019 (20–24 deaths annually) suggests slight progress, likely due to expanded immunization, improved antenatal care, and neonatal interventions in the hospital

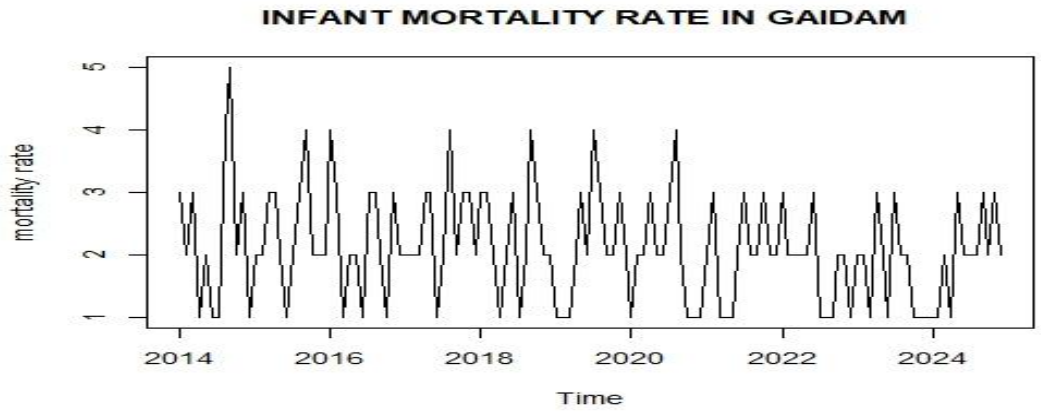
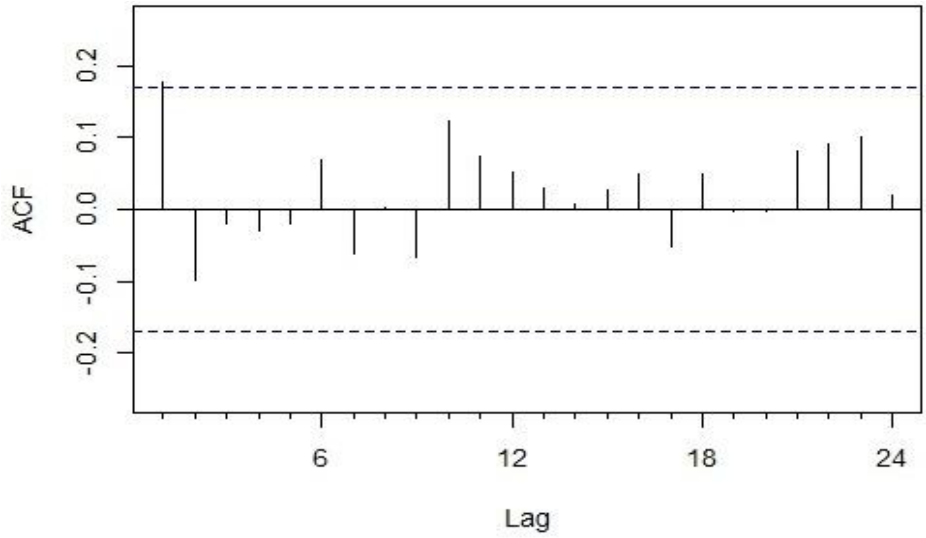
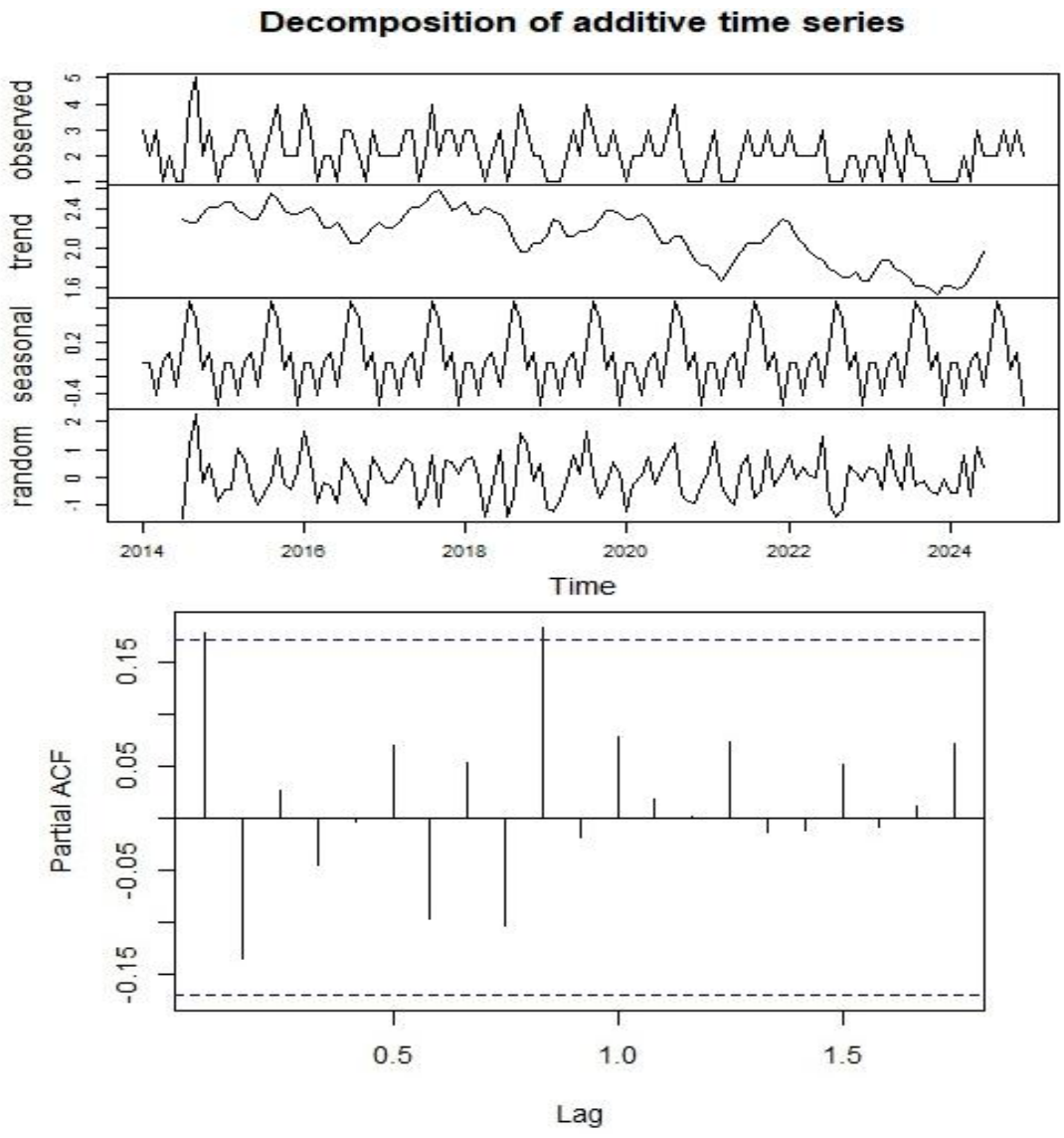


Fig 3. **Time series analysis (ARIMA Model)**


ACF
0.2
0.1
0.0
-0.1
-0.2
6
12
18
24
Lag


Decomposition of additive time series
observed
trend
seasonal
random
2014
2016
2018
2020
2022
2024
Time

Partial ACF
0.15
0.05
-0.05
-0.15
0.5
1.0
1.5
Lag

Fig 4

Series: infant mortality rate
ARIMA(2,1,1)

Coefficients:

	ar1	ar2	ma1
	0.1794	-0.1609	-0.9643
s.e.	0.0877	0.0878	0.0224

sigma^2 = 0.7474: log likelihood = -166.64
AIC=341.28 AICc=341.6 BIC=352.78

COEF

- AR(1) = 0.1794: The first autoregressive coefficient is positive, indicating a Positive Relationship between the current value ad the previous value
- AR(2)= -0.1609: The second autoregressive coefficient is negative, suggesting a negative relationship between the current and the value two periods ago.
- MA(1) = -0.9643: The moving average coefficient is close -1, indicating a strong negative relationship between the current value and previous error term

MODEL EVALUATION

- ($\sigma^2 = 0.7474$): The variance of the resioduals, which is a measure of the modelsfit.
- Log Likelihood (-166.64): A measure of the models goodness of fit, with higher values indicating better fit.
- AIC(341.28), AICC(341.6), and BIC(352.78):These are information createria that can be used to camopare values indicating better fit.

Based on the ARIMA(2,1,1) MODEL, It appears that:

i. The infant mortality rate inYSSH Geidam 2024 exhibits some autoregressive behavior, with the current value and influenced by past values .
ii. The model suggest a strong negative relationship between the current value and the previous error term, which could indicate some corrective mechanism in the data.
iii. The models fit is reaseonable given the sigma squrare value and log likelihood.

FORECASTING

FORECAST

Point	Forecast	Lo 80	Hi 80	Lo 95	Hi 95
Jan 2025	1.959057	0.9734775	2.944637	0.4517430	3.466371
Feb 2025	1.959057	0.9727910	2.945324	0.4506931	3.467421
Mar 2025	1.959057	0.9721048	2.946010	0.4496437	3.468471
Apr 2025	1.959057	0.9714190	2.946696	0.4485949	3.469520
May 2025	1.959057	0.9707335	2.947381	0.4475466	3.470568
Jun 2025	1.959057	0.9700484	2.948066	0.4464988	3.471616
Jul 2025	1.959057	0.9693637	2.948751	0.4454515	3.472663
Aug 2025	1.959057	0.9686792	2.949435	0.4444048	3.473710
Sep 2025	1.959057	0.9679952	2.950119	0.4433586	3.474756
Oct 2025	1.959057	0.9673114	2.950803	0.4423129	3.475802
Nov 2025	1.959057	0.9666281	2.951486	0.4412678	3.476847
Dec 2025	1.959057	0.9659450	2.952170	0.4402231	3.477891
Jan 2026	1.959057	0.9652623	2.952852	0.4391790	3.478935
Feb 2026	1.959057	0.9645800	2.953535	0.4381355	3.479979
Mar 2026	1.959057	0.9638979	2.954217	0.4370924	3.481022
Apr 2026	1.959057	0.9632163	2.954898	0.4360499	3.482065
May 2026	1.959057	0.9625349	2.955580	0.4350079	3.483107
Jun 2026	1.959057	0.9618539	2.956261	0.4339664	3.484148
Jul 2026	1.959057	0.9611733	2.956941	0.4329254	3.485189
Aug 2026	1.959057	0.9604930	2.957622	0.4318849	3.486230
Sep 2026	1.959057	0.9598130	2.958302	0.4308450	3.487270
Oct 2026	1.959057	0.9591333	2.958981	0.4298056	3.488309
Nov 2026	1.959057	0.9584540	2.959661	0.4287666	3.489348

Interpretation of Forecast (2025–2026)

- The ARIMA forecast projects an average of ~2 deaths per month for 2025–2026.
- The 95% confidence interval ranges from 0.44 to 3.49 deaths, meaning that in most months the number of infant deaths is expected to remain between 1 and 3.
- This suggests stability rather than dramatic decline, indicating that unless new interventions are introduced, mortality rates will remain roughly at current levels.

• While this is better than the earlier years (2014–2017), it still implies that preventable deaths persist.

General discussion of findings

1. Trend: There is a slight long-term decline in infant mortality from 2014–2024, but not a dramatic reduction.
2. Seasonality: High deaths in rainy months (July–September) highlight the role of malaria and poor sanitation.
3. Stability: Despite improvements, the ARIMA forecast suggests mortality has plateaued at about 20–24 deaths per year.
4. Health Policy Implication: Sustained interventions in malaria control, neonatal intensive care, maternal education, and nutrition programs are needed to push mortality rates lower in Geidam.

Summary

The analysis of infant mortality at YSSH Geidam from 2014 to 2024 revealed a mild downward trend, seasonal variations with peaks in rainy months, and stable forecast of about 20 infant deaths annually in the coming years. While progress has been made persistence of deaths

This section presented a conprehessive discussion of The study's finding from the time series analysis of infant mortality rates (2014-2024) at yobe state specialist hospital, Geidam. The analysis is interpreted in light of reaserch objectives and relevant litreture, thereby elucidating the meaning and significant of Each main result. Based on this interpretation, the chapter draws a coherent conclusion that synthesizes how the findings address the original reaserch purpoesd. Finally, The chapter formulates practical recommendatios grounded in the emperical evidence, linking the results to actionable interventions or policy measures.

This study was conducted to analyze the trend and pattern of infant mortality at the Yobe State Specialist Hospital (YSSH), Geidam, from 2014 to 2024, using time series analysis. The high rate of infant mortality in Nigeria, particularly in the northern regions like Yobe State, necessitated this research to provide empirical evidence for informed healthcare planning and intervention.

The study employed a quantitative research design, utilizing a complete census of secondary data on infant mortality obtained from the hospital's records. The data was analyzed using descriptive statistics and the Autoregressive Integrated Moving Average (ARIMA) model to identify trends, seasonal patterns, and to generate forecasts.

Key findings from the analysis revealed that:

❖ A total of 281 infant deaths were recorded over the eleven-year period.

❖ A slight downward trend in annual infant deaths was observed, from a peak of 29 deaths in 2017 to 21 deaths in 2023.

❖ A clear seasonal pattern was identified, with higher mortality rates occurring during the rainy season months (July to September), coinciding with periods of increased malaria transmission and diarrheal diseases.

❖ The best-fitting model for the data was an ARIMA(2,1,1) model, which indicated a stable but persistent pattern of infant mortality.

❖ The forecast for 2025-2026 projects an average of approximately 2 deaths per month, suggesting that without significant new interventions, infant mortality rates will remain at their current levels.

CONCLUSION

Based on the findings of this study, it is concluded that infant mortality remains a persistent public health challenge at the Yobe State Specialist Hospital, Geidam. Although a mild declining trend is observed, the rate of decrease is modest and insufficient to meet national and global targets for reducing infant deaths.

The strong seasonal variation underscores the significant impact of environmental and communicable disease factors, such as malaria and water-borne illnesses, on infant survival. The stability of the forecasted rates indicates that existing interventions, while having some effect, have not been adequate to drastically reduce the mortality burden.

Therefore, the infant mortality rate in Geidam is influenced by a combination of seasonal health threats and underlying socio-economic and healthcare system challenges. A more aggressive, multi-faceted, and seasonally-targeted approach is required to accelerate progress in saving infants' lives.

Recommendations

derived from the conclusions of this study, the following recommendations are proposed for hospital management, health policymakers, and future researchers

For Hospital Management and Health Planners

- Strengthen Seasonal Disease Control: Intensify malaria prevention and treatment programs (e.g., distribution of insecticide-treated nets, indoor residual spraying, and prompt diagnosis/treatment) and diarrheal disease control (e.g., promoting oral rehydration therapy and clean water initiatives) ahead of and during the rainy season (July-September).
- Enhance Neonatal Care: Invest in and staff neonatal intensive care units (NICUs) to better manage premature births, low birth weight, and birth complications, which are leading causes of infant death.
- Maternal Health Education: Implement regular community-based and antenatal clinic education programs focusing on nutrition, hygiene, breastfeeding practices, and recognizing danger signs in newborns to encourage earlier care-seeking behavior.

For Policymakers (State Ministry of Health and Partners):

- Targeted Resource Allocation: Direct resources and interventions specifically to the North-East region, particularly to areas like Geidam, to address the stark regional disparities in health outcomes.
- Improve Health Infrastructure: Upgrade primary healthcare centers in rural areas to reduce the burden on the tertiary facility and ensure easier access to skilled birth attendance and basic emergency obstetric and newborn care (BEmONC).
- Data-Driven Decision Making: Institutionalize the routine use of time series analysis and other statistical tools in monitoring health indicators to enable proactive and evidence-based planning.

For Future Research:

- Expand Scope:future studies should incorporate data from multiple health facilities across Yobe State to provide a more comprehensive state-wide analysis.
- Incorporate Predictor Variables: Research should employ models that integrate socio-economic variables (e.g., maternal education, poverty levels) and health system factors (e.g., staff-to-patient ratio, vaccine coverage) to better understand the determinants of infant mortality.

Qualitative Inquiry: A mixed-methods study that includes qualitative interviews with healthcare providers and mothers could provide deeper insights into the barriers to accessing care and the contextual reasons behind the trends identified in this study.

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