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A Time Series Analysis Of The Monthly Incidence Of Malaria Fever In Oshimili South Local Government Area, Delta State

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ABSTRACT

Malaria remains one of the most persistent public health challenges in tropical and subtropical regions, contributing significantly to morbidity and mortality rates, especially in developing countries. This study applies time series analysis to examine the monthly incidence of malaria fever with the aim of identifying patterns, trends, and seasonal variations in its occurrence. Monthly malaria data collected over a defined period from three Hospitals in Oshimili South Local Government Area of Delta State Asaba from January 2010 to December 2022 were analyzed using statistical time series models such as the Additive and Multiplicative decomposition and ARIMA models to determine the underlying components of trend, seasonality, and irregular fluctuations. The findings revealed a clear seasonal pattern in the incidence of malaria, corresponding with variations in climatic conditions such as rainfall and temperature. The trend analysis indicated periods of both rising and declining malaria cases, reflecting the combined influence of environmental changes, preventive measures, and healthcare interventions. Forecasts derived from the fitted time series model provide a basis for predicting future malaria incidence, offering valuable insights for State, Local Government, Communities and health authorities and policymakers in planning effective control strategies. The study underscores the usefulness of time series modeling as a reliable tool for disease surveillance and forecasting. By understanding the temporal dynamics of malaria transmission, Government and health institutions can better allocate resources, implement targeted preventive programs, and mitigate the impact of seasonal outbreaks. This research contributes to the growing body of knowledge on the application of statistical modeling techniques in epidemiological studies and supports data-driven decision-making in public health management.

Keywords: Time Series, Incidence, & Malaria Fever

INTRODUCTION

Malaria continues to be a significant global health challenges and a major public health issue in several countries, including Nigeria. The disease is transmitted in humans from one person to another through the bites of infected female mosquitoes of the anopheles. There are five (5) species of parasite belonging to the genus Plasmodium, that transmit malaria of which *P. falciparum* is the most prevalent (WHO, 2022). Globally, there were 247 million cases of malaria and 619,000 deaths in 2021 say (WHO, 2022). However, approximately 80% of all deaths due to malaria were concentrated in just 15 countries mainly in the Africa region. Despite frantic efforts and interventions targeted at its elimination, 48% of the World

population remains exposed to the risk of malaria, a figure substantially higher than the 40% widely cited. Malaria accounts for the highest number of hospitalizations and outpatient visits in Africa.

The prevalence of malaria infection among the adolescent patients varies from place to place, even within the same country, and may be due to differences in socio-demographic environmental and climatic factors. In Nigeria, malaria prevalence of 66.7%, 64.0% and 58.0% have been reported by previous studies.

Socio-demographic factors such as age, gender, education, occupations and income, which may directly affect human exposure and treatment, and climatic factors such as temperature, humidity and rainfall which may support rapid growth and development of mosquitoes vectors have been well reported in Urban and peri-urban centers. In Africa, malaria transmission is comparatively higher among the rural settings than the urban areas and may be due to the highest vector density, poor housing status and poor drainage systems in rural settings

Hematological profile may contribute to the clinical presentation of malaria, but not transmission of malaria infection. These changes may be related to the individuals packed cell volume, ABO blood grouping, and haemoglobin electrophoresis pattern. Anemia has been known to be the usual sign of the parasitic infection in endemic malaria areas with *Plasmodium. falciparum* being an important contributor to anemia in Children. Anemia is a condition characterized by a decrease in the number of red blood cells (RBCs) or a lower than normal amount of haemoglobin level of less than 12g/dl in non-pregnant women aged 15 and older, and less than 13 g/dl in men aged 15 and older.

RESEARCH METHODOLOGY

The study area for this work is Oshimili South Local Government area of Delta State Asaba which situated in the Niger Delta Region and the South-South geo-political zone. The study adopts a quantitative research design based on time series analysis. The population for this study comprises the entire inhabitants of Oshimili South Local Government Area (LGA) of Delta State, Nigeria. Data from City Population (2022) estimated the population of Oshimili South LGA to be about 205,600. Furthermore, the Delta State Government (2024–2027 Development Plan) projects the population to reach approximately 245,013 in 2024 and 251,492 in 2025. Therefore, for the purpose of this research, the estimated total population of Oshimili South Local Government Area is taken to be approximately 250,000 persons (as of 2025). For the purpose of this work, three main Hospitals were sampled, the first Hospital is Government own Hospital situated in urban area of Oshimili South, while the second Hospital is private Hospital equally situated in urban area of Oshimili South and the third Hospital is owned by State Government and situated in rural area of Delta State. Stratified Sampling Techniques was adopted to ensure that the sample accurately represents the population of Oshimili South Local Government Area, thereby improving the reliability and validity of the findings.

The malaria incidence data were extracted manually and electronically from the hospital's health records in the Department of Health Records and Information Management from the three Hospitals. The data were compiled, cleaned, and arranged chronologically to form a continuous time series suitable for statistical analysis.

Time Series Model

There are three most common models

- i. Auto-Regressive Moving Average Models (ARIMA) by Box-Jenkins: These can be considered as univariate models, it is used to better understand a single time-dependent variable, e.g temperature overtime, and to predict future data of variables. These work on the assumption there the data is stationery. They give analysts the opportunities to account for and remove as many differences and seasonalities in past data points as they can. These also includes terms to account for moving averages, seasonal difference operators, and autoregressive terms within the model.

ii. Multivariate Models

These are used to analyze more than one time-dependent variable, such as temperature and humidity over time.

iii. Holt-Winters Model: This is an exponential smoothing techniques. It is used to predict outcomes, provided that the data points include seasonality.

Auto Regressive Models (AR Model)

A stationary process X_t is said to be autoregressive process (model) of order P denoted by AR(P) it is satisfies differential equations $X_t + \theta_1 X_{t-1} + \theta_2 X_{t-2} + \dots + \theta_p X_{t-p} + \sum t$ with variance $\sigma^2 \sum t \psi(B) X_t = \epsilon t$ where $\Phi(B) = 1 - \Phi_1 B - \Phi_2 B^2 - \Phi_3 B^3 \dots \dots \Phi_p B^p$

Characteristics Equation for AR(I)

$$X_t = \Phi_1 X_{t-1} + \epsilon t$$

$$X_t = \Phi_1 X_t + \epsilon t$$

$$(1 - \Phi B) X_t = \epsilon t$$

Moving Average Model

In summary, the average model can be enumerated in these order to find the four quarter moving total. $Y_1 + Y_{1+1} + Y_{1+2} + Y_{1+3}$ and equate it to A_1 , then reset $Y_1 + Y_{1+1} + Y_{1+2} + Y_{1+3} + Y_{1+4}$ and equal it to A_2 , add A_1 and A_2 together and divide their sum by two (i.e averaging the sum) to give the four quarters moving average:

$$(i.e \frac{A_1 + A_2}{2})$$

Seasonal Variation

To calculate seasonal variation, divide the original data by the trend of the average and multiply the result by 100 i.e $S.V. = \frac{Y}{T} \times 100$

Cyclical Variation

This can also be adjusted for trend by simple division of the data by its corresponding trend value.

$$C.V = \frac{Y}{TS}$$

Where:

Y = Original data value

T = Trend Value and

S = Seasonal Variation

Irregular Variation

This can be calculated by dividing Y by cyclical variation value respectively

$$I.V = \frac{C.I}{C}$$

Deseasonalized Variation

To calculate the deseasonalized variation, the quarterly value (Y) is divided by seasonal variation and multiplied by 100

$$D.V = \frac{Y}{SV} \times 100$$

Forecasting and Exponential Smoothing

The fit of the exponential smoothing model to each time series is measured by the Forecast root Mean Square Error (RMSE), which equal to the square root of the average squared difference between the exponential smoothing model and the value of the time series.

$$\text{Forecast RMSE} = \sqrt{\frac{\sum_{t=1}^T (C_t - r_t)^2}{T}}$$

Where T = the number of time

C_t = The Fitted value from exponential smoothing

r_t = The Raw value of the time series at time t.

DATA ANALYSIS AND INTERPRETATION OF RESULTS

Analysis of Malaria Incidences Reported at FMC Asaba

ARIMA(0,1,1) Model for the Trends of Malaria cases in FMC Asaba

Model	ma1(a)	ma2(b)
Male trend coefficient	3.0291	-0.9346
Female trend coefficient	1.256	-0.5645
Children trend coefficient	6.4298	-0.5257
Aggregate trend coefficient	8.6169	-0.4624
Standard Error	0.0085	0.0087

Table 1

The model for the trends of malaria cases in FMC Asaba are established using the ARIMA (0,1,1) as follow: column 2 (ma1 a) represented y -intercept which is called initial value while column 3 (ma2 b) represented gradient value, therefore the general trend for malaria incidence in FMC Hospital is $Y = 8.6169 - 0.4624X$, where variable X is the independent or input variable that can be used to forecast the future occurrence of malaria incidence and Y is the dependent or output variable which is called the result of the incidence of malaria. Likewise, trend for Male is $Y = 3.0291 - 0.9346X$, trend for Female is $Y = 1.256 - 0.5645X$ and the trend for Children is $Y = 6.41298 - 0.5257X$

4.2 Irregular Variation (First Few Values – 2010) FMC Male

Month	Jan	Feb	Mar	Apr	May	Jun
2010	0.0770	18.1595	4.4073	43.1321	-21.2196	-19.2767

Irregular Variation (First Few Values – 2010) FMC Female

Month	Jan	Feb	Mar	Apr	May	Jun
2010	0.1590	-3.4347	53.6901	91.4122	-31.6291	-97.5604

Irregular Variation (First Few Values – 2010) FMC Children

Month	Jan	Feb	Mar	Apr	May	Jun
2010	0.3630	34.6119	82.1297	-126.4451	0.3244	-182.7099

Irregular Variation (First Few Values – 2010)

Month	Jan	Feb	Mar	Apr	May	Jun
2010	0.5990	45.5956	143.6869	23.7662	-71.4416	-288.2242

Table 2

The irregular variation occurred in 2010 between January and June, these are the noise, residuals or unpredictable and random fluctuations in the data collected that cannot be explained by trend. This is as a result of irregular cases of incidence of malaria recorded in the Hospitals used.

Forecast – Male Malaria Incidences (ARIMA(0,1,2))

Month	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
Apr 2022	217.2497	66.4235	368.0760	-13.4191	447.9186
May 2022	270.0390	99.3383	440.7398	8.9748	531.1033
Jun 2022	270.0390	93.7552	446.3228	0.9920	539.0861
Jul 2022	270.0390	89.4091	450.6688	-6.4782	546.5562
Aug 2022	270.0390	85.9998	454.0781	-11.7730	551.8510
Sep 2022	270.0390	83.2755	456.8025	-15.9121	555.9900
Oct 2022	270.0390	81.0625	459.0155	-19.3167	559.3946
Nov 2022	270.0390	79.2367	460.8413	-22.1949	562.2730
Dec 2022	270.0390	77.7080	462.3700	-24.6579	564.7360
Jan 2023	270.0390	76.4105	463.6675	-26.7726	566.8506
Feb 2023	270.0390	75.2954	464.7826	-28.5861	568.6641
Mar 2023	270.0390	74.3263	465.7517	-30.1333	570.2113

Forecast – Male Malaria Incidences (ARIMA(0,1,2))

Apr 2022 – Mar 2023

Month	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
Apr 2022	217.2497	66.4235	368.0760	-13.4191	447.9186
May 2022	270.0390	99.3383	440.7398	8.9748	531.1033
Jun 2022	270.0390	93.7552	446.3228	0.9920	539.0861
Jul 2022	270.0390	89.4091	450.6688	-6.4782	546.5562

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Month	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
Aug 2022	270.0390	85.9998	454.0781	-11.7730	551.8510
Sep 2022	270.0390	83.2755	456.8025	-15.9121	555.9900
Oct 2022	270.0390	81.0625	459.0155	-19.3167	559.3946
Nov 2022	270.0390	79.2367	460.8413	-22.1949	562.2730
Dec 2022	270.0390	77.7080	462.3700	-24.6579	564.7360
Jan 2023	270.0390	76.4105	463.6675	-26.7726	566.8506
Feb 2023	270.0390	75.2954	464.7826	-28.5861	568.6641
Mar 2023	270.0390	74.3263	465.7517	-30.1333	570.2113
Month	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
Apr 2023	270.0390	73.4745	466.6035	-31.4440	571.5220
May 2023	270.0390	72.7186	467.3594	-32.5441	572.6221
Jun 2023	270.0390	72.0428	468.0353	-33.4567	573.5347
Jul 2023	270.0390	71.4343	468.6438	-34.2025	574.2805
Aug 2023	270.0390	70.8820	469.1960	-34.8007	574.8787
Sep 2023	270.0390	70.3774	469.7006	-35.2684	575.3464
Oct 2023	270.0390	69.9133	470.1648	-35.6209	575.6989
Nov 2023	270.0390	69.4839	470.5942	-35.8718	575.9498
Dec 2023	270.0390	69.0842	470.9939	-36.0324	576.1104
Jan 2024	270.0390	68.7102	471.3678	-36.1124	576.1904

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Month	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
Feb 2024	270.0390	68.3584	471.7196	-36.1207	576.1987
Mar 2024	270.0390	68.0258	472.0522	-36.0655	576.1435

Forecast – Male Malaria Incidences (ARIMA(0,1,2))

Month	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
Apr 2024	270.0390	67.7100	472.3680	-35.9559	575.0339
May 2024	270.0390	67.4182	472.6598	-35.7994	574.8774
Jun 2024	270.0390	67.1477	472.9303	-35.6023	574.6803
Jul 2024	270.0390	66.8962	473.1818	-35.3702	574.4482
Aug 2024	270.0390	66.6620	473.4160	-35.1076	574.1856
Sep 2024	270.0390	66.4433	473.6347	-34.8184	573.8964
Oct 2024	270.0390	66.2387	473.8393	-34.5060	573.5840
Nov 2024	270.0390	66.0468	474.0312	-34.1733	573.2513
Dec 2024	270.0390	65.8666	474.2114	-33.8229	572.9009
Jan 2025	270.0390	65.6969	474.3811	-33.4567	572.5337
Feb 2025	270.0390	65.5367	474.5413	-33.0763	572.1533
Mar 2025	270.0390	65.3851	474.6929	-32.6830	571.7600

Month	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
Apr 2025	270.0390	65.2413	474.8367	-32.2783	571.3563
May 2025	270.0390	65.1046	474.9734	-31.8635	570.9415
Jun 2025	270.0390	64.9743	475.1037	-31.4394	570.5174

Month	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
Jul 2025	270.0390	64.8499	475.2281	-31.0071	570.0851
Aug 2025	270.0390	64.7309	475.3471	-30.5671	569.6451
Sep 2025	270.0390	64.6169	475.4611	-30.1199	569.1979
Oct 2025	270.0390	64.5074	475.5706	-29.6657	568.7437
Nov 2025	270.0390	64.4022	475.6758	-29.2050	568.2830
Dec 2025	270.0390	64.3009	475.7771	-28.7380	567.8160
Jan 2026	270.0390	64.2032	475.8748	-28.2651	567.3431
Feb 2026	270.0390	64.1090	475.9690	-27.7865	566.8645
Mar 2026	270.0390	64.0180	476.0600	-27.3025	566.3805

Forecast – Male Malaria Incidences (ARIMA(0,1,2))

Apr 2026 – Mar 2027

Month	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
Apr 2026	270.0390	63.9300	476.1480	-26.8134	565.8914
May 2026	270.0390	63.8448	476.2332	-26.3193	565.3973
Jun 2026	270.0390	63.7624	476.3156	-25.8203	564.8983
Jul 2026	270.0390	63.6825	476.3955	-25.3168	564.3948
Aug 2026	270.0390	63.6051	476.4729	-24.8089	563.8869
Sep 2026	270.0390	63.5299	476.5481	-24.2969	563.3749
Oct 2026	270.0390	63.4569	476.6211	-23.7810	562.8590
Nov 2026	270.0390	63.3860	476.6920	-23.2613	562.3393

Month	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
Dec 2026	270.0390	63.3170	476.7610	-22.7379	561.8159
Jan 2027	270.0390	63.2500	476.8280	-22.2109	561.2889
Feb 2027	270.0390	63.1847	476.8933	-21.6806	560.7586
Mar 2027	270.0390	63.1213	476.9567	-21.1469	560.2250

Apr 2027 – Mar 2028

Month	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
Apr 2027	270.0390	63.0594	477.0186	-20.6101	559.6881
May 2027	270.0390	62.9993	477.0787	-20.0701	559.1481
Jun 2027	270.0390	62.9406	477.1374	-19.5272	558.6052
Jul 2027	270.0390	62.8835	477.1945	-18.9814	558.0594
Aug 2027	270.0390	62.8277	477.2503	-18.4329	557.5109
Sep 2027	270.0390	62.7733	477.3047	-17.8817	556.9597
Oct 2027	270.0390	62.7202	477.3578	-17.3279	556.4059
Nov 2027	270.0390	62.6684	477.4096	-16.7715	555.8495
Dec 2027	270.0390	62.6178	477.4602	-16.2126	555.2906
Jan 2028	270.0390	62.5684	477.5096	-15.6513	554.7293
Feb 2028	270.0390	62.5201	477.5579	-15.0876	554.1656
Mar 2028	270.0390	62.4729	477.6051	-14.5216	553.5996

Apr 2028 – Mar 2029

Month	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
Apr 2028	270.0390	62.4268	477.6512	-13.9534	553.0314
May 2028	270.0390	62.3817	477.6963	-13.3830	552.4610

Month	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
Jun 2028	270.0390	62.3377	477.7403	-12.8105	551.8885
Jul 2028	270.0390	62.2946	477.7834	-12.2360	551.3140
Aug 2028	270.0390	62.2525	477.8255	-11.6596	550.7376
Sep 2028	270.0390	62.2113	477.8667	-11.0812	550.1592
Oct 2028	270.0390	62.1709	477.9071	-10.5011	549.5791
Nov 2028	270.0390	62.1314	477.9466	-9.9192	548.9972
Dec 2028	270.0390	62.0928	477.9852	-9.3355	548.4135
Jan 2029	270.0390	62.0549	478.0231	-8.7502	547.8282
Feb 2029	270.0390	62.0179	478.0601	-8.1632	547.2412
Mar 2029	270.0390	61.9816	478.0964	-7.5746	546.6526

Apr 2029 – Mar 2030

Month	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
Apr 2029	270.0390	61.9461	478.1319	-6.9844	546.0624
May 2029	270.0390	61.9112	478.1668	-6.3927	545.4707
Jun 2029	270.0390	61.8771	478.2009	-5.7995	544.8775
Jul 2029	270.0390	61.8437	478.2343	-5.2048	544.2828
Aug 2029	270.0390	61.8109	478.2671	-4.6087	543.6867
Sep 2029	270.0390	61.7787	478.2993	-4.0112	543.0892
Oct 2029	270.0390	61.7471	478.3309	-3.4123	542.4903

Month	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
Nov 2029	270.0390	61.7161	478.3619	-2.8121	541.8901
Dec 2029	270.0390	61.6856	478.3924	-2.2106	541.2886
Jan 2030	270.0390	61.6557	478.4223	-1.6077	540.6857
Feb 2030	270.0390	61.6263	478.4517	-1.0036	540.0816
Mar 2030	270.0390	61.5974	478.4806	-0.3983	539.4763

Table 3

From the forecast table of Male category above, column five(5) indicates the overview of the Male category forecast, this indicate negative trend in the incidence of malaria between year 2029 and 2030. This indicate that the efforts put in place by the Government and individual in combating incidence of Malaria in Oshimili Local Government Area have significant effect.

4.4 Female Malaria Forecasts in FMC

Apr 2022 – Mar 2023

Month	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
Apr 2022	217.2497	66.4235	368.0760	-13.4191	447.9186
May 2022	270.0390	99.3383	440.7398	8.9748	531.1033
Jun 2022	270.0390	95.8130	444.2651	3.6637	536.4143
Jul 2022	270.0390	92.7407	447.3373	-1.0592	541.1372
Aug 2022	270.0390	90.0060	450.0720	-5.9498	546.0279
Sep 2022	270.0390	87.5325	452.5455	-10.9301	551.0081
Oct 2022	270.0390	85.2706	454.8074	-15.9668	556.0448
Nov 2022	270.0390	83.1878	456.8903	-21.0374	561.1154
Dec 2022	270.0390	81.2605	458.8176	-26.1277	566.2057
Jan 2023	270.0390	79.4718	460.6062	-31.2288	571.3068
Feb 2023	270.0390	77.8081	462.2699	-36.3355	576.4145
Mar 2023	270.0390	76.2590	463.8190	-41.4445	581.5226

Apr 2023 – Mar 2024

Month	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
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Month	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
Apr 2023	270.0390	74.8167	465.2613	-46.5532	586.6312
May 2023	270.0390	73.4749	466.6031	-51.6598	591.7388
Jun 2023	270.0390	72.2289	467.8492	-56.7628	596.8410
Jul 2023	270.0390	71.0745	469.0035	-61.8610	601.9391
Aug 2023	270.0390	70.0078	470.0702	-66.9534	607.0315
Sep 2023	270.0390	69.0252	471.0528	-72.0391	612.1172
Oct 2023	270.0390	68.1234	471.9546	-77.1172	617.1952
Nov 2023	270.0390	67.2994	472.7786	-82.1870	622.2650
Dec 2023	270.0390	66.5503	473.5277	-87.2480	627.3270
Jan 2024	270.0390	65.8735	474.2045	-92.2997	632.3787
Feb 2024	270.0390	65.2667	474.8113	-97.3417	637.4207
Mar 2024	270.0390	64.7276	475.3505	-102.3738	642.4528

Month	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
Apr 2024	270.0390	64.2538	475.8242	-107.3959	647.4740
May 2024	270.0390	63.8432	476.2348	-112.4080	652.4861
Jun 2024	270.0390	63.4939	476.5841	-117.4099	657.4879
Jul 2024	270.0390	63.2039	476.8741	-122.4010	662.4799
Aug 2024	270.0390	62.9715	477.1065	-127.3810	667.4599
Sep 2024	270.0390	62.7949	477.2832	-132.3496	672.4285
Oct 2024	270.0390	62.6726	477.4055	-137.3066	677.3855
Nov 2024	270.0390	62.6030	477.4750	-142.2516	682.3296
Dec 2024	270.0390	62.5847	477.4933	-147.1846	687.2626
Jan 2025	270.0390	62.6163	477.4617	-152.1053	692.1833

Month	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
Feb 2025	270.0390	62.6964	477.3816	-157.0137	697.0927
Mar 2025	270.0390	62.8238	477.2542	-161.9097	701.9887

Apr 2025 – Mar 2026

Month	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
Apr 2025	270.0390	62.9975	477.0805	-166.7931	706.8711
May 2025	270.0390	63.2163	476.8617	-171.6640	711.7420
Jun 2025	270.0390	63.4793	476.5987	-176.5223	716.6003
Jul 2025	270.0390	63.7856	476.2924	-181.3680	721.4460
Aug 2025	270.0390	64.1343	475.9437	-186.2010	726.2790
Sep 2025	270.0390	64.5247	475.5533	-191.0215	731.0995
Oct 2025	270.0390	64.9560	475.1220	-195.8293	735.9073
Nov 2025	270.0390	65.4274	474.6506	-200.6246	740.7026
Dec 2025	270.0390	65.9384	474.1396	-205.4072	745.4852
Jan 2026	270.0390	66.4883	473.5897	-210.1773	750.2553
Feb 2026	270.0390	67.0766	473.0014	-214.9347	755.0127
Mar 2026	270.0390	67.7028	472.3752	-219.6795	759.7575

Apr 2026 – Mar 2027

Month	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
Apr 2026	270.0390	68.3665	471.7115	-224.4117	764.4897
May 2026	270.0390	69.0672	471.0108	-229.1312	769.2092

Month	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
Jun 2026	270.0390	69.8045	470.2735	-233.8382	773.9162
Jul 2026	270.0390	70.5779	469.5001	-238.5325	778.6105
Aug 2026	270.0390	71.3869	468.6911	-243.2142	783.2922
Sep 2026	270.0390	72.2312	467.8468	-247.8833	787.9613
Oct 2026	270.0390	73.1103	466.9677	-252.5398	792.6178
Nov 2026	270.0390	74.0238	466.0542	-257.1836	797.2616
Dec 2026	270.0390	74.9713	465.1067	-261.8149	801.8929
Jan 2027	270.0390	75.9525	464.1255	-266.4336	806.5116
Feb 2027	270.0390	76.9670	463.1110	-271.0396	811.1176
Mar 2027	270.0390	78.0144	462.0636	-275.6331	815.7111
Month	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
Apr 2027	270.0390	79.0944	460.9836	-280.2140	820.2920
May 2027	270.0390	80.2066	459.8714	-284.7823	824.8603
Jun 2027	270.0390	81.3506	458.7274	-289.3380	829.4160
Jul 2027	270.0390	82.5259	457.5521	-293.8811	833.9591
Aug 2027	270.0390	83.7322	456.3458	-298.4116	838.4896

Month	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
Sep 2027	270.0390	84.9690	455.1090	-302.9296	843.0076
Oct 2027	270.0390	86.2358	453.8422	-307.4350	847.5130
Nov 2027	270.0390	87.5322	452.5458	-311.9278	852.0058
Dec 2027	270.0390	88.8578	451.2202	-316.4081	856.4861
Jan 2028	270.0390	90.2122	449.8658	-320.8758	860.9538
Feb 2028	270.0390	91.5948	448.4832	-325.3310	865.4090
Mar 2028	270.0390	93.0054	447.0726	-329.7736	869.8516

Apr 2028 – Mar 2029

Month	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
Apr 2028	270.0390	94.4433	445.6347	-334.2037	874.2817
May 2028	270.0390	95.9083	444.1697	-338.6213	878.6993
Jun 2028	270.0390	97.3999	442.6781	-343.0263	883.1043
Jul 2028	270.0390	98.9176	441.1604	-347.4188	887.4968
Aug 2028	270.0390	100.4610	439.6170	-351.7987	891.8767
Sep 2028	270.0390	102.0298	438.0482	-356.1662	896.2442
Oct 2028	270.0390	103.6234	436.4546	-360.5211	900.5991
Nov 2028	270.0390	105.2414	434.8366	-364.8635	904.9415
Dec 2028	270.0390	106.8836	433.1944	-369.1933	909.2713
Jan 2029	270.0390	108.5493	431.5287	-373.5107	913.5887
Feb 2029	270.0390	110.2383	429.8397	-377.8156	917.8936
Mar 2029	270.0390	111.9502	428.1278	-382.1079	922.1859

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Apr 2029 – Mar 2030

Month	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
Apr 2029	270.0390	113.6847	426.3933	-386.3878	926.4658
May 2029	270.0390	115.4414	424.6366	-390.6552	930.7332
Jun 2029	270.0390	117.2200	422.8580	-394.9101	934.9881
Jul 2029	270.0390	119.0200	421.0580	-399.1525	939.2305
Aug 2029	270.0390	120.8412	419.2368	-403.3824	943.4604
Sep 2029	270.0390	122.6831	417.3949	-407.5998	947.6778
Oct 2029	270.0390	124.5455	415.5325	-411.8048	951.8828
Nov 2029	270.0390	126.4280	413.6500	-415.9973	956.0753
Dec 2029	270.0390	128.3303	411.7477	-420.1774	960.2554
Jan 2030	270.0390	130.2520	409.8260	-424.3450	964.4230
Feb 2030	270.0390	132.1929	407.8851	-428.5001	968.5781
Mar 2030	270.0390	134.1526	405.9254	-432.6428	972.7208

Trends 13 Graph of Forecast (FMC)

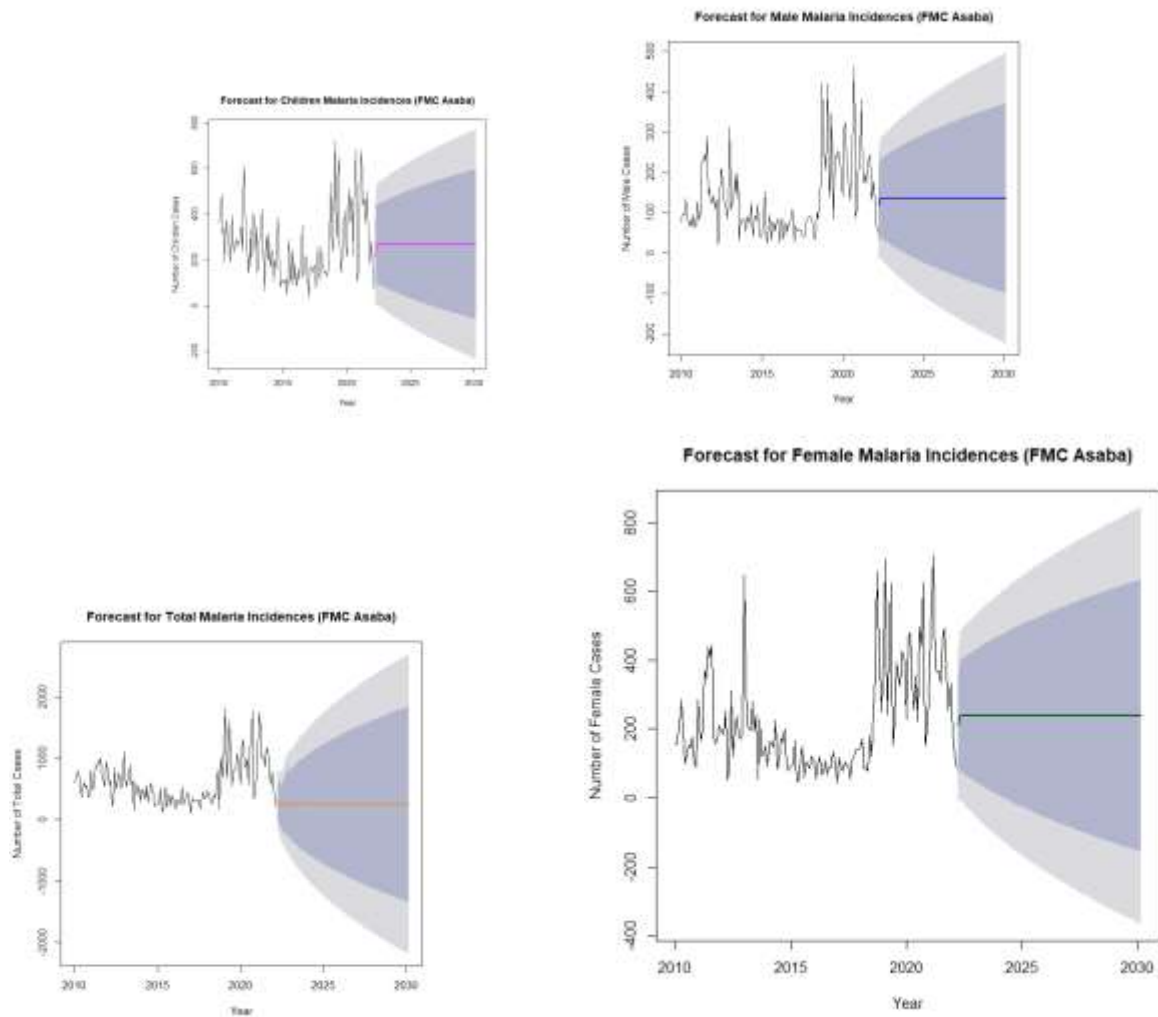


Figure 1-4

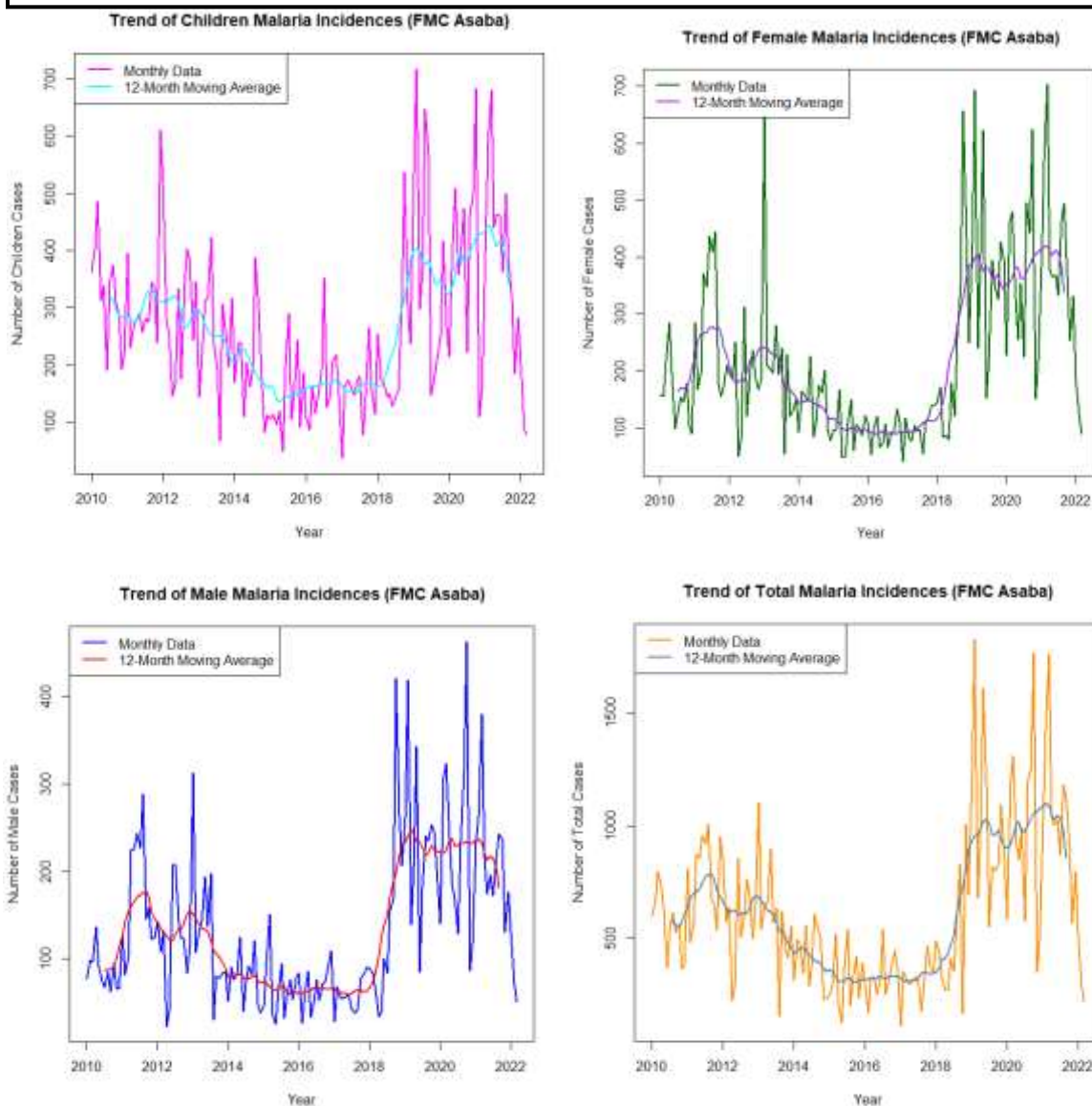


Figure 5-8

From the above graphs, the trends behaved in the same way, that is, they follow the same pattern, they are co-addicted, this shows that the Government's effort and individual's effort in controlling the incidence of malaria is effective, except between 2019 and 2020 where the trend increased as a result of covid 19 pandemic, but later came down between 2021 and 2022.

Analysis of Malaria Incidences Reported at General Hospital Okwe

Table 4.10.0 ARIMA(0,1,1) Model of the Trends for Malaria cases in Okwe Hospital Asaba

Analysis of Malaria Incidences Reported at General Hospital Okwe ARIMA(0,1,1) Model of the Trends for Malaria cases in Okwe Hospital Asaba

Model	ma1(a)	ma2(2)
Male trend coefficient	1.1635	-0.4566
Female trend coefficient	1.7588	-0.3430
Children trend coefficient	4.4442	0.4909
Aggregate trend coefficient	11.2142	-0.5463

Table 5

The model for the trend of malaria cases in Okwe General Hospital Asaba is established using the ARIMA (0,1,1) as follows: The general trend is $Y = 11.2142 - 0.5463X$, Male trend is $Y = 1.1635 - 0.4566X$, Female trend is $Y = 1.7588 - 0.3430X$ and Children trend is $Y = 4.4442 + 0.4909X$, why positive trend in the category of the children? This is as a result of inadequate attention of the Government in terms of awareness, provision of health facilities and posting of qualified hands to the rural areas.

Malaria Incidences Forecast Using ARIMA Models (2022–2030)

Male Malaria Forecast (ARIMA(0,1,2))

Apr 2022 – Mar 2023

Month	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
Apr 2022	217.2497	66.4235	368.0760	-13.4191	447.9186
May 2022	270.0390	99.3383	440.7398	8.9748	531.1033
Jun 2022	270.0390	93.7552	446.3228	0.9920	539.0861
Jul 2022	270.0390	89.4091	450.6688	-6.4782	546.5562
Aug 2022	270.0390	85.9998	454.0781	-11.7730	551.8510
Sep 2022	270.0390	83.2755	456.8025	-15.9121	555.9900
Oct 2022	270.0390	81.0625	459.0155	-19.3167	559.3946
Nov 2022	270.0390	79.2367	460.8413	-22.1949	562.2730
Dec 2022	270.0390	77.7080	462.3700	-24.6579	564.7360
Jan 2023	270.0390	76.4105	463.6675	-26.7726	566.8506
Feb 2023	270.0390	75.2954	464.7826	-28.5861	568.6641
Mar 2023	270.0390	74.3263	465.7517	-30.1333	570.2113

Apr 2023 – Mar 2024

Month	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
Apr 2023	270.0390	73.4654	466.6126	-31.4471	571.5251
May 2023	270.0390	72.6929	467.3851	-32.5531	572.6311

Month	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
Jun 2023	270.0390	71.9931	468.0849	-33.4714	573.5494
Jul 2023	270.0390	71.3533	468.7247	-34.2171	574.2951
Aug 2023	270.0390	70.7628	469.3152	-34.8023	574.8803
Sep 2023	270.0390	70.2133	469.8647	-35.2376	575.3156
Oct 2023	270.0390	69.6978	470.3802	-35.5329	575.6109
Nov 2023	270.0390	69.2107	470.8673	-35.6976	575.7756
Dec 2023	270.0390	68.7469	471.3311	-35.7407	575.8187
Jan 2024	270.0390	68.3027	471.7753	-35.6709	575.7489
Feb 2024	270.0390	67.8751	472.2029	-35.4964	575.5744
Mar 2024	270.0390	67.4616	472.6164	-35.2252	575.3032

Apr 2024 – Mar 2025

Month	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
Apr 2024	270.0390	67.0607	473.0173	-34.8649	574.9430
May 2024	270.0390	66.6709	473.4071	-34.4227	574.5010
Jun 2024	270.0390	66.2912	473.7868	-33.9056	573.9839
Jul 2024	270.0390	65.9206	474.1574	-33.3200	573.3983
Aug 2024	270.0390	65.5582	474.5198	-32.6722	572.7505
Sep 2024	270.0390	65.2035	474.8745	-31.9681	572.0464
Oct 2024	270.0390	64.8556	475.2224	-31.2129	571.2912
Nov 2024	270.0390	64.5139	475.5641	-30.4112	570.4895

Month	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
Dec 2024	270.0390	64.1778	475.9002	-29.5674	569.6467
Jan 2025	270.0390	63.8467	476.2313	-28.6857	568.7639
Feb 2025	270.0390	63.5202	476.5578	-27.7703	567.8483
Mar 2025	270.0390	63.1978	476.8802	-26.8251	566.9031

Apr 2025 – Mar 2026

Month	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
Apr 2025	270.0390	62.8789	477.1991	-25.8536	565.9316
May 2025	270.0390	62.5633	477.5147	-24.8591	564.9371
Jun 2025	270.0390	62.2505	477.8275	-23.8442	563.9222
Jul 2025	270.0390	61.9402	478.1378	-22.8115	562.8905
Aug 2025	270.0390	61.6321	478.4459	-21.7636	561.8426
Sep 2025	270.0390	61.3260	478.7520	-20.7029	560.7810
Oct 2025	270.0390	61.0215	479.0565	-19.6313	559.6993
Nov 2025	270.0390	60.7186	479.3594	-18.5507	558.6287
Dec 2025	270.0390	60.4170	479.6610	-17.4628	557.5408
Jan 2026	270.0390	60.1166	479.9614	-16.3692	556.4472
Feb 2026	270.0390	59.8173	480.2607	-15.2712	555.3492
Mar 2026	270.0390	59.5189	480.5591	-14.1701	554.2481

Apr 2026 – Mar 2027

Month	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
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Month	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
Apr 2026	270.0390	63.9300	476.1480	-26.8134	565.8914
May 2026	270.0390	63.8448	476.2332	-26.3193	565.3973
Jun 2026	270.0390	63.7624	476.3156	-25.8203	564.8983
Jul 2026	270.0390	63.6825	476.3955	-25.3168	564.3948
Aug 2026	270.0390	63.6051	476.4729	-24.8089	563.8869
Sep 2026	270.0390	63.5299	476.5481	-24.2969	563.3749
Oct 2026	270.0390	63.4569	476.6211	-23.7810	562.8590
Nov 2026	270.0390	63.3860	476.6920	-23.2613	562.3393
Dec 2026	270.0390	63.3170	476.7610	-22.7379	561.8159
Jan 2027	270.0390	63.2500	476.8280	-22.2109	561.2889
Feb 2027	270.0390	63.1847	476.8933	-21.6806	560.7586
Mar 2027	270.0390	63.1213	476.9567	-21.1469	560.2250

Table 6 Apr 2027 – Mar 2028

Month	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
Apr 2027	270.0390	63.0594	477.0186	-20.6101	559.6881
May 2027	270.0390	62.9993	477.0787	-20.0701	559.1481
Jun 2027	270.0390	62.9406	477.1374	-19.5272	558.6052
Jul 2027	270.0390	62.8835	477.1945	-18.9814	558.0594
Aug 2027	270.0390	62.8277	477.2503	-18.4329	557.5109

Month	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
Sep 2027	270.0390	62.7733	477.3047	-17.8817	556.9597
Oct 2027	270.0390	62.7202	477.3578	-17.3279	556.4059
Nov 2027	270.0390	62.6684	477.4096	-16.7715	555.8495
Dec 2027	270.0390	62.6178	477.4602	-16.2126	555.2906
Jan 2028	270.0390	62.5684	477.5096	-15.6513	554.7293
Feb 2028	270.0390	62.5201	477.5579	-15.0876	554.1656
Mar 2028	270.0390	62.4729	477.6051	-14.5216	553.5996

Children Malaria Forecasts (2022–2030)

Apr 2022 – Mar 2023

Month	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
Apr 2022	639.7922	404.0177	875.5668	279.2062	1000.378
May 2022	695.0266	431.7697	958.2834	292.4099	1097.643
Jun 2022	695.0266	428.3891	961.6641	285.4033	1104.650
Jul 2022	695.0266	425.2579	964.7953	278.6508	1111.402
Aug 2022	695.0266	422.3143	967.7390	272.0342	1118.019
Sep 2022	695.0266	419.5232	970.5299	265.4895	1124.564
Oct 2022	695.0266	416.8611	973.1921	258.9865	1131.067
Nov 2022	695.0266	414.3116	975.7416	252.5112	1137.542
Dec 2022	695.0266	411.8615	978.1917	246.0563	1143.997
Jan 2023	695.0266	409.5005	980.5526	239.6177	1150.435

Month	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
Feb 2023	695.0266	407.2200	982.8332	233.1932	1156.860
Mar 2023	695.0266	405.0125	985.0408	226.7803	1163.273

Apr 2023 – Mar 2024

Month	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
Apr 2023	695.0266	402.8730	987.1802	220.3777	1169.676
May 2023	695.0266	400.7966	989.2567	213.9841	1176.069
Jun 2023	695.0266	398.7797	991.2736	207.5986	1182.454
Jul 2023	695.0266	396.8187	993.2346	201.2206	1188.832
Aug 2023	695.0266	394.9102	995.1430	194.8490	1195.204
Sep 2023	695.0266	393.0512	997.0021	188.4830	1201.570
Oct 2023	695.0266	391.2390	998.8143	182.1219	1207.931
Nov 2023	695.0266	389.4712	1000.5821	175.7649	1214.288
Dec 2023	695.0266	387.7455	1002.3078	169.4116	1220.641
Jan 2024	695.0266	386.0599	1003.9933	163.0612	1226.992
Feb 2024	695.0266	384.4126	1005.6406	156.7133	1233.340
Mar 2024	695.0266	382.8017	1007.2515	150.3671	1239.686

From the forecast table of the Children Category in the above table, column five indicates overview of the forecast for Children Category, this indicates positive trend in the incidence of malaria fever in the Okwe General Hospital.

Total Malaria Forecasts (2022–2030)

Apr 2022 – Mar 2023

Month	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
Apr 2022	1132.592	890.213	1374.971	763.627	1501.557
May 2022	1210.066	931.799	1488.332	791.027	1629.105
Jun 2022	1210.066	928.100	1492.032	783.097	1637.036
Jul 2022	1210.066	924.601	1495.531	775.356	1644.776
Aug 2022	1210.066	921.255	1498.877	767.717	1652.415
Sep 2022	1210.066	918.027	1502.105	760.134	1660.000
Oct 2022	1210.066	914.892	1505.240	752.581	1667.552
Nov 2022	1210.066	911.832	1508.300	745.047	1675.085
Dec 2022	1210.066	908.833	1511.299	737.523	1682.610
Jan 2023	1210.066	905.885	1514.248	730.004	1690.129
Feb 2023	1210.066	902.980	1517.153	722.486	1697.647
Mar 2023	1210.066	900.111	1520.022	714.967	1705.166

Apr 2023 – Mar 2024

Month	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
Apr 2023	1210.066	897.275	1522.857	707.447	1712.685
May 2023	1210.066	894.467	1525.665	699.924	1720.208
Jun 2023	1210.066	891.685	1528.447	692.399	1727.733
Jul 2023	1210.066	888.927	1531.205	684.872	1735.260

Month	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
Aug 2023	1210.066	886.191	1533.941	677.344	1742.788
Sep 2023	1210.066	883.476	1536.656	669.815	1750.317
Oct 2023	1210.066	880.781	1539.351	662.285	1757.847
Nov 2023	1210.066	878.104	1542.028	654.756	1765.376
Dec 2023	1210.066	875.445	1544.687	647.226	1772.906
Jan 2024	1210.066	872.802	1547.330	639.696	1780.436
Feb 2024	1210.066	870.175	1549.957	632.166	1787.966
Mar 2024	1210.066	867.562	1552.570	624.636	1795.496

Table 7

Trend Graph Of Forecast

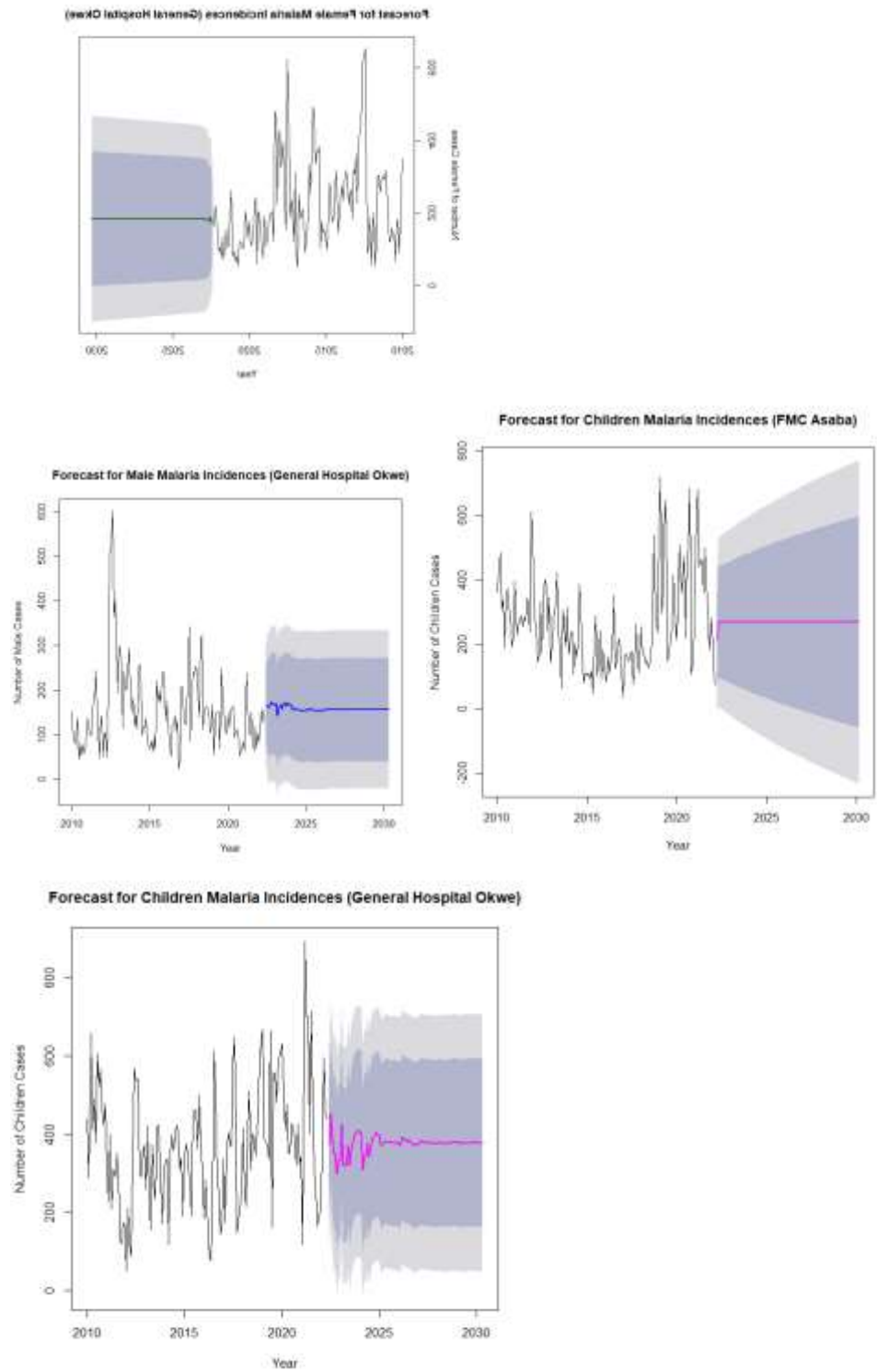


Table 9-12

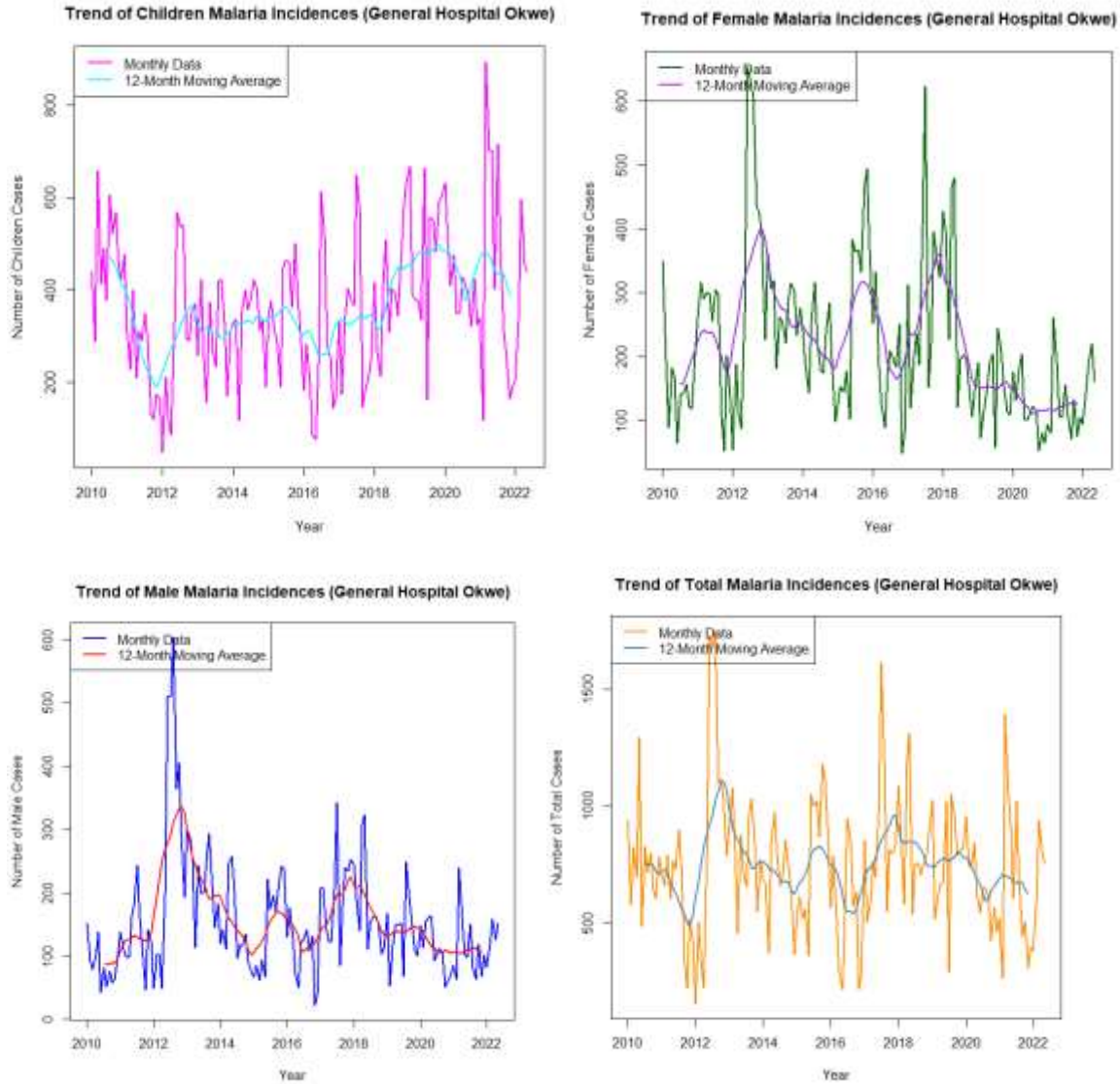


Table 13-16

Analysis of Malaria Incidences Reported at St. Joseph Catholic Hospital Asaba.

ARIMA (2,0,2) (1,0,0) [12] with non-zero mean Model for Male Malaria cases in St-Joseph Catholic Hospital Asaba

ARIMA(0,1,1) Model for Trend of Malaria cases in St-Joseph Hospital

Model	ma1(a)	ma2(b)
Male trend coefficient	1.1061	-0.3542
Female trend coefficient	2.0313	-0.8136
Children trend coefficient	2.1699	2.3874
Agregate trend coefficient	7.0695	-0.1492
Standard Error	0.0085	0.0087

Table 8

The model for the trend of malaria cases in St Joseph Hospital Asaba is established using the ARIMA (0,1,1) as follows:

The general trend is $Y = 7.0695 - 0.1492X$, Male trend is

$Y = 1.1061 - 0.3542X$, Female trend is $Y = 2.0313 - 0.8136X$ and Children trend is

$Y = 2.1699 + 2.3874X$.

The factor that responsible for the positive trend of children category in Okwe hospital is equally responsible in St Joseph hospital, just because the two hospitals are located in rural areas in Oshimili South Local Government of Delta State, this is calling on the Government to pay more attention to the rural areas concerning their health in order to curb the incidence of Malaria fever in those rural areas.

Irregular Variation (first few values) St Joseph Hospital

Month	Value
Jan 2010	0.4010
Feb 2010	-46.1459
Mar 2010	184.0690
Apr 2010	-131.4455
May 2010	34.9797
Jun 2010	-141.7222

Forecast for Male Incidences Forecast Horizon: 96 months

Forecast Table (first few rows)

Month	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
Jan 2023	107.0052	46.0541	167.9564	13.7884	200.2220
Feb 2023	124.9813	57.4859	192.4767	21.7559	228.2066
Mar 2023	117.0720	47.6816	186.4624	10.9486	223.1954
Apr 2023	126.9691	55.0003	198.9379	16.9023	237.0359
May 2023	128.6499	56.0131	201.2867	17.5614	239.7383
Jun 2023	136.2616	62.5347	209.9885	23.5061	249.0171
...

Table 10a Forecast for Female Incidences Forecast Horizon: 96 months

Forecast Table (first few rows)

Month	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
Jan 2023	239.1118	132.4956	345.7279	76.6609	401.5626
Feb 2023	224.6600	116.4202	332.8998	59.9122	389.4078
Mar 2023	249.7647	141.1794	358.3500	84.4378	415.0916
Apr 2023	215.9201	107.0739	324.7662	50.1831	381.6571
May 2023	221.6286	112.6636	330.5936	55.7365	387.5206
Jun 2023	225.8134	116.7340	334.8927	59.7102	391.9166
Jul 2023	236.0251	126.8312	345.2189	69.6908	402.3593
Aug 2023	237.8986	128.5890	347.2082	71.3901	404.4070
Sep 2023	230.9027	121.5926	340.2128	64.2690	397.5364
Oct 2023	238.7608	129.3340	348.1876	71.8973	405.6243
Nov 2023	239.5051	129.9647	349.0455	72.4657	406.5445
Dec 2023	242.1583	132.5099	351.8067	74.8850	409.4317

Table 11

Forecast for Children Incidences Forecast Horizon: 96 months

Forecast Table (first few rows)

Month	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
Jan 2023	344.1224	235.9490	452.2957	179.9273	508.3174
Feb 2023	356.1745	247.4175	464.9314	190.9415	521.4075
Jan 2029	365.9032	257.0555	474.7509	200.3689	531.4375
Feb 2029	356.9430	248.0465	465.8396	191.1863	522.6998
Mar 2029	362.6670	253.6824	471.6516	196.0061	529.3280
Jun 2023	368.4227	259.3498	477.4956	200.8471	536.0004

Month	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
Jul 2023	374.0143	264.8568	483.1718	205.4290	542.5996
Aug 2023	379.6772	270.4342	488.9202	210.0790	549.2755
Sep 2023	385.2670	275.9411	494.5930	214.6599	555.8741
Oct 2023	390.9280	281.5180	500.3380	219.3097	562.5462
Nov 2023	396.5152	287.0234	505.9870	223.8895	569.1408
Dec 2023	402.1754	292.5983	511.7524	228.5384	575.8124

Table 12. Forecast for Total Incidences Forecast Horizon: 96 months

Forecast Table (first few rows)

Month	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
Apr 2029	690.2630	510.8400	869.6859	416.9280	963.5981
May 2029	717.1137	537.5905	896.6369	443.6477	990.5797
Jun 2029	727.3817	547.8585	906.9049	453.9157	1000.8477
Jul 2029	718.0538	538.5306	897.5770	444.4699	991.6377
Aug 2029	731.0790	551.5487	910.6093	457.4692	1004.6888
Sep 2029	744.1256	564.5941	923.6570	470.5073	1017.7439
Oct 2029	757.0601	577.5298	936.5903	483.4309	1030.6893
Nov 2029	770.0800	590.5492	949.6108	496.4407	1043.7194
Dec 2029	783.0097	603.4799	962.5395	509.3611	1056.6583
Jan 2030	796.0193	616.4898	975.5489	522.3612	1069.6774
Feb 2030	808.9446	629.4152	988.4739	535.2791	1082.6102
Mrr 2030	821.9496	642.4203	1001.4789	548.2817	1095.6176

Table 13. Trend Graph for Forecast In St Joseph

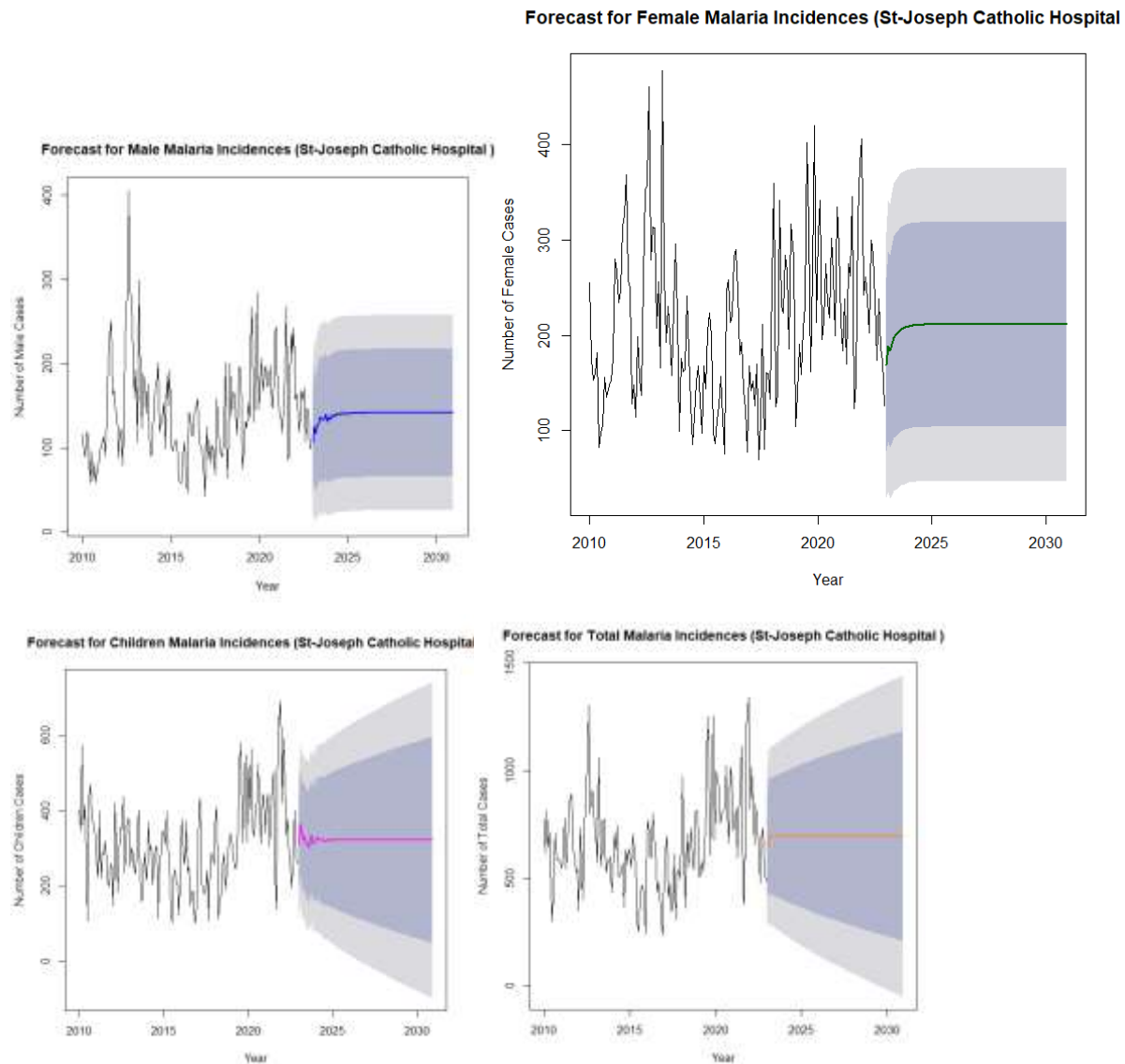


Figure 17-2

Summary

This study examined the **monthly incidence of malaria fever** at three Hospitals in Oshimili South Local Government Area Asaba, using **time series analysis** to identify patterns, trends, and seasonal variations and to forecast future malaria occurrences.

The study began by reviewing relevant literature on malaria epidemiology and the application of statistical models in health data analysis. Monthly malaria incidence data covering a thirteen-years period (2010–2022) were collected from hospital records and analyzed using **Additive, Multiplicative, and ARIMA** models.

The **Additive and Multiplicative decomposition** models identified the underlying trend and seasonal components of the data. The **ARIMA (1,1,1)(0,1,1)₁₂** model was found to be the best-fitting model, as it effectively captured both seasonal and non-seasonal variations in malaria incidence. Forecasts derived

from the model indicated that malaria cases would continue to exhibit seasonal peaks corresponding to climatic conditions.

Findings and Observations

- This work was able to establish trend on the incidence of malaria in Oshimili South Local Government area of Delta State.
- Descriptive and graphical analyses revealed significant fluctuations in malaria cases across the years, with a noticeable pattern of **higher incidences during the rainy season (June–September)** and **lower cases during the dry season (November–March)**.
- Isolation of cyclical and irregular variation was discovered in the year 2010.
- Forecasts derived from the model indicated that malaria cases would continue to exhibit seasonal peaks corresponding to climatic conditions.

RECOMMENDATIONS

Arising from this study, we hereby make the recommendations

- Government should give more attention to rural areas in awareness and provision of facilities by building more facilities and posting qualified hands to the rural areas.
- Government should clear both major and minor drainages before month of July which has the highest incidence rate of malaria in order to prevent stagnant water in both rural and urban areas.
- Both State and Local Government should ensure proper environmental sanitation during the raining season.
- There should be greater sensitization by Health Organization on the use of Mosquito nets in both rural and urban areas.

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