

The Pattern of Severe Malaria in Plateau State of Nigeria: A Five-Year Review of Severe Malaria Case-Based Surveillance Data from 2013 to 2017

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Abstract: There is a decline in the global incidence, morbidity, and mortality of malaria. However, approximately 20% of hospital admissions and 10% of hospital deaths in Nigeria have been attributed to malaria. This secondary data analysis was conducted to examine the pattern severe malaria in Plateau State in the face of declining global malaria infection. Severe malaria-specific Integrated Disease Surveillance and Response (IDRS) records of Plateau State of Nigeria over a five-year period were reviewed. A total of 38,467 cases of severe malaria were reported between January 2013 and December 2017. The highest number of cases 14098 (36.65%) was reported in 2016 and the least number of cases 950 (2.47%) were reported in 2014. A total of 362 severe malaria deaths was reported within the same period with a case fatality rate (CFR) of 0.94%. The highest CFR 1.43% was recorded in 2015 while the least CFR 0.00% was recorded in 2014. The 0-28 days age group had the highest CFR (3.13%). The comparative monthly trend of severe malaria cases did not follow any consistent pattern during the 5 years under review. However, as of 2017, the trends of total cases per year and CFRs were on the decline. In conclusion, the overall number of cases and deaths of severe malaria is declining in Plateau State but the CFR among neonates remains high. Therefore, prevention and control efforts should be intensified in Plateau State, in order to achieve malaria elimination in the State.

Keywords: Nigeria, Malaria, Tropical Medicine

1. Introduction

Malaria is a protozoan infection of the red blood cells transmitted by the bite of a blood-feeding female anopheline mosquito [1]. Five species of *Plasmodium* have been known to infect humans: *Plasmodium malariae*, *Plasmodium vivax*, *Plasmodium ovale* and *Plasmodium falciparum* and *Plasmodium knowlesi*. Ninety-five percent of malaria infections in Nigeria are caused by *Plasmodium falciparum* and five percent by *Plasmodium malariae* [2]. *P. falciparum* is responsible for the highest morbidity and mortality attributed to malaria infection. This parasite exhibits characteristics like cytoadherence, sequestration, resetting,

and aggregation, which leads to micro-circulatory obstruction in *falciparum* malaria [3, 4]. This obstruction in the micro-circulation ultimately leads to end-organ dysfunction [5-9].

The clinical manifestations of malaria are divided into uncomplicated malaria and severe malaria. The clinical features of uncomplicated malaria are non-specific and include fever, chills and rigors headache, malaise, muscular discomfort, lack of appetite and bitter taste in the mouth [1, 10]. Severe *falciparum* malaria has specific diagnostic criteria [1, 10]. These criteria are divided into clinical and laboratory criteria.

1. Clinical criteria

Prostration

Confusion or agitation (with Glasgow Coma Scale [GCS] >11)

Coma (GCS ≤11 or Blantyre Coma Scale <3 in children)

Respiratory distress (acidotic breathing)

Convulsions

Shock: prolonged capillary refill time (>2 s), with or without systolic blood pressure <80 mm Hg in adults (<70 in children)

Pulmonary edema (confirmed radiologically)

Abnormal bleeding

Jaundice

Anuria

Repeated vomiting

hyperpyrexia (temperature ≥41.5°C)

2. Laboratory criteria

Hemoglobin <7 g/dL in adults, <5 g/dL in children

Macroscopic hemoglobinuria

Hypoglycaemia (blood glucose <2.2 mmol/L or <40 mg/dL)

Acidosis (i.e. base deficit >8 meq/L or plasma bicarbonate <15 mmol/L or venous plasma lactate >5 mmol/L)

Acute kidney injury (creatinine >3 mg/dL or urea >20 mmol/L)

Asexual parasitemia >10% of infected red blood cells or >250,000/μL of blood

Adults living in areas of high transmission generally come down with uncomplicated malaria, while non-immune individuals and children below three years of age are more likely to suffer from severe malaria [1].

The incidence rate of malaria declined globally between 2010 and 2017, from 72 to 59 cases per 1000 population at risk [11]. In 2017, an estimated 219 million cases of malaria occurred worldwide compared with 239 million cases in 2010 and 217 million cases in 2016 [11]. Fifteen countries in sub-Saharan Africa and India carried almost 80% of the global malaria burden and Nigeria accounted for 25% of cases worldwide [11]. In 2017, there were an estimated 435 000 deaths from malaria globally, compared with 451,000 estimated deaths in 2016, and 607 000 in 2010 [11]. Children below 5 years accounted for 61% of all malaria deaths worldwide in 2017. Africa accounted for 93% of all malaria deaths in 2017 and Nigeria accounted for 19% of all global malaria deaths [11]. All World Health Organization (WHO) Regions except the WHO Region of the Americas recorded reductions in mortality in 2017 compared with 2010. The largest declines occurred in the WHO Regions of South-East Asia (54%), Africa (40%) and the Eastern Mediterranean (10%). About 3.2 billion people remain at risk of malaria and malaria still causes an unacceptably high number of deaths in children under the age of five [12]. In Nigeria, malaria is responsible for 60% of outpatient visits to health facilities, 30% of childhood deaths of children under 1 year and 11% of maternal deaths [13]. Approximately 20% of hospital admissions and 10% of hospital deaths in Nigeria have been attributed to malaria [14]. This secondary data analysis was carried out to epidemiologically describe severe malaria in Plateau State of Nigeria, highlight the burden of

the disease in the State and make recommendations for improvements on control in the face of declining global incidence of malaria infection.

2. Methods

2.1. Study Setting

Plateau State is the twelfth largest state of Nigeria [15]. According to the 2006 census, It has a population of 3,178,712 people [16]. It is bounded by Bauchi State to the northeast, Kaduna State to the northwest, Nasarawa State to the southwest and Taraba State to the southeast. It is located between latitude 80°24'N and longitude 80°32' and 100°38' east. The altitude ranges from around 1,200 meters to a peak of 1,829 meters above sea level in the Shere Hills range near Jos [17]. Years of tin mining have also left the area strewn with deep gorges and lakes which are possible breeding sites for mosquitoes. Though situated in the tropical zone, a higher altitude means that Plateau State has a near temperate climate with an average temperature of between 18 and 22°C [17]. Harmattan winds cause the coldest weather between December and February. The warmest temperatures usually occur in the dry season months of March and April. The mean annual rainfall varies from 131.75 cm (52 in) in the southern part to 146cm (57 in) on the Plateau. The highest rainfall is recorded during the wet season months of July and August. The average lower temperatures Plateau State has led to a reduced incidence of some tropical diseases such as malaria [17].

2.2. Study Design

This was a retrospective secondary data analysis of severe malaria-specific Integrated Disease Surveillance and Response (IDRS) records.

2.3. Study Population

All reported severe malaria cases in the IDSR records for the period of 2013 to 2017 were reviewed. IDSR monthly epidemiological data for the years under review was obtained from the Plateau State Ministry of Health. The document contained recorded severe malaria cases from the 17 Local Government Areas of the State.

2.4. Severe Malaria Surveillance in Nigeria

Severe malaria surveillance in Nigeria is through the IDSR platform. Information flows from the health facilities, through the ward focal persons to the local government areas (LGA) disease surveillance and notification officers (DSNOs), to the States DSNOs, and then to the Federal Ministry of Health. Feedback goes through the opposite direction.

2.5. IDSR Severe Malaria Case Definitions

1. Unconfirmed severe malaria: Any patient living in an area at risk of malaria hospitalized with a severe febrile

disease with accompanying vital organ dysfunction diagnosed clinically.

2. Confirmed Severe malaria: Any patient hospitalized with *P. falciparum* asexual parasitemia as confirmed by laboratory tests with accompanying symptoms and signs of severe disease (vital organ dysfunction) diagnosed through the laboratory.

2.6. Laboratory Investigations

Capillary blood samples were used in making malaria diagnosis by microscopy or rapid diagnostic test. For microscopy, thick and thin blood smears were made on microscope slides and stained with Giemsa. For rapid diagnostic testing, capillary blood was used to make the diagnosis by immunochromatographic methods following the manufacturers' instructions.

2.7. Data Management

Relevant data from the IDSR line list were sorted, extracted, and cleaned. These included the number of cases, number of deaths and location. The data were analyzed for frequencies and proportions.

3. Results

A total of 38, 467 cases of severe malaria were reported

Table 1. Number of cases, deaths and case fatality rates by years for severe malaria in Plateau State, Nigeria, from January 2013 to December 2017.

Year	Total number of cases	Percent (%)	Deaths	Case fatality rate (%)
2013	5,048	13.12	41	0.81
2014	950	2.47	0	0.00
2015	7,265	18.89	104	1.43
2016	14,098	36.65	141	1.00
2017	11,106	28.87	76	0.68
Total	38, 467	100.00	362	0.94

Table 2. Distribution of cases, deaths, and CFR of severe malaria by age groups in Plateau State, Nigeria, from January 2013 to December 2017.

Age groups	Cases	Percent (%)	Deaths	Case fatality rate (%)
0-28 days	894	2.32	28	3.13
1-11 months	3978	10.34	64	1.61
12-59 months	7909	20.56	102	1.29
5-9 years	8546	22.22	107	1.25
10-19 years	6918	17.98	49	0.71
20-40 years	6314	16.41	10	0.16
>40 years	3908	10.16	2	0.05
Total	38467	100.00	362	0.94

4. Discussion

This study found the case fatality rate of severe malaria to be highest among neonates.

Although it is well known that malaria is an important cause of infant morbidity and mortality in sub-Saharan Africa, neonatal malaria was considered a rare condition [18]. It was believed that the fetal hemoglobin provided some protection to the newborn against malaria [19]. This, however, is not the case as studies across Africa including Nigeria have shown neonatal malaria rates ranging from 0 to 54.2% [18-21].

between January 2013 and December 2017. The highest number of cases 14098 (36.65%) were reported in 2016, followed by 11106 (28.87%) in 2017. The least number of cases 950 (2.47%) were reported in 2014 (table 1). A total of 362 severe malaria deaths were reported within the same period with a case fatality rate (CFR) of 0.94%. The highest CFR 1.43% was recorded in 2015, followed by 1.00 % in 2016. The least CFR 0.00% was recorded in 2014 (table 1). The highest CFR according to age was 3.13% among those aged 0-28 days (neonates) while the least CFR 0.05% was among those older than 40 years (table 2).

The comparative monthly trend of severe malaria cases did not follow any consistent pattern during the 5 years under review. The highest number of cases occurred in March 2016, while no cases were reported in November and December of 2013 and May and October of 2014. (figure 1). However, the trends of total cases per year and CFRs followed the same pattern. The cases and CFRs declined to their lowest levels in 2014. This was followed by a sharp increase with the CFR peaking in 2015 and the number of cases peaking in 2016. As of 2017, both were on a downward trend (figure 2). Wase Local Government Area had the least number of reported cases within this five-year period, followed by Jos East and Mikang. Riyom Local Government Area had the highest number of cases, followed by Shendam and Langtang North in descending order (figure 3).

Whether the neonatal mortality in this review was due to severe malaria alone could not be ascertained. In any case, there is a need to intensify the administration of intermittent presumptive treatment of malaria in pregnancy and the use of long-lasting insecticide-treated bed nets among pregnant women and newborn babies. This will help in reducing cases of neonatal deaths that are caused by severe malaria in Plateau State.

The total number of cases and the CFRs of severe malaria in Plateau State has been on the downward trend since 2015 and 206 respectively. This is in keeping with the global downward trend in the morbidity and mortality of malaria in

Africa [11]. In 2008, the National Malaria Control Programme in Nigeria adopted the goal of reducing to 50% the country's malaria burden by 2013 by achieving at least 80 % coverage of long-lasting impregnated mosquito nets, 20 % of houses in targeted areas receiving indoor residual

spraying and treatment with two doses of intermittent preventative therapy (IPT) for 100 % of pregnant women who visit antenatal care clinics [22]. These efforts may have contributed to these downward trends.

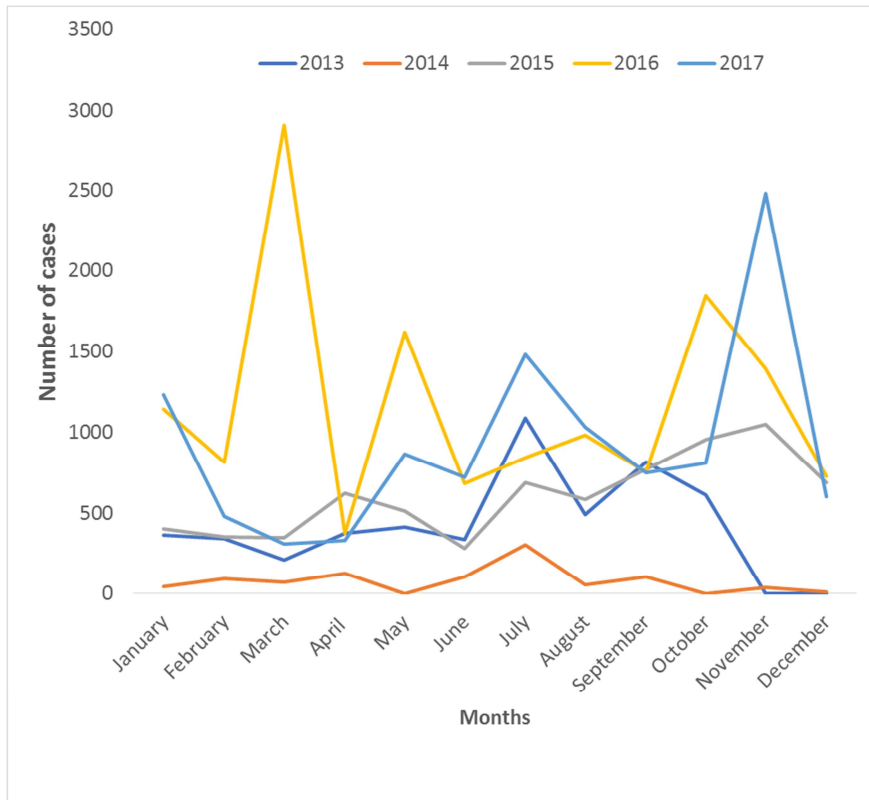


Figure 1. Comparative monthly trend of severe malaria cases in Plateau State from 2013 to 2017.

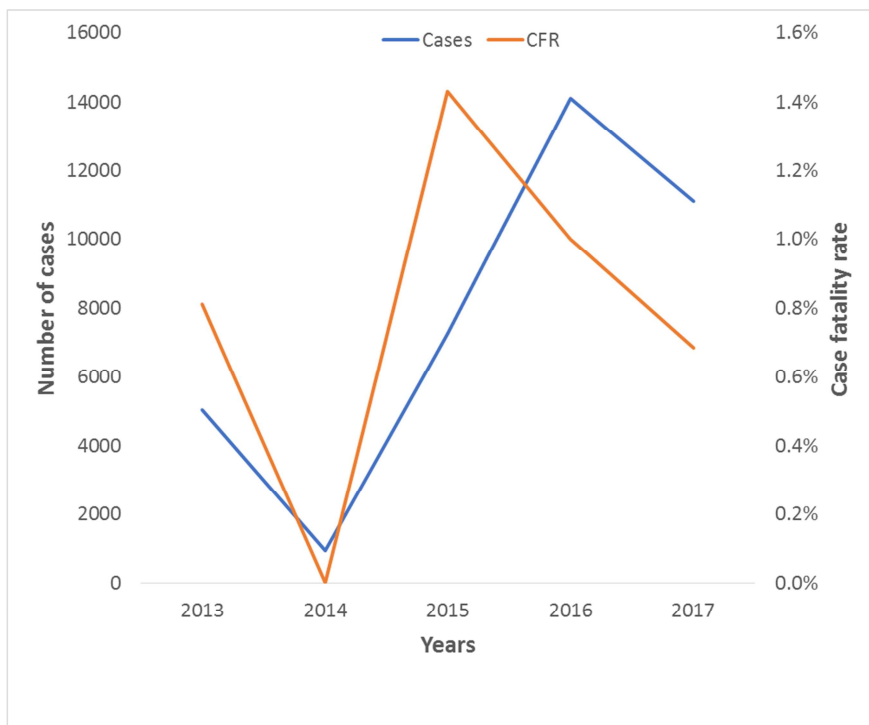


Figure 2. Yearly trend of cases and case fatality rates of severe malaria in Plateau State from 2013 to 2017.

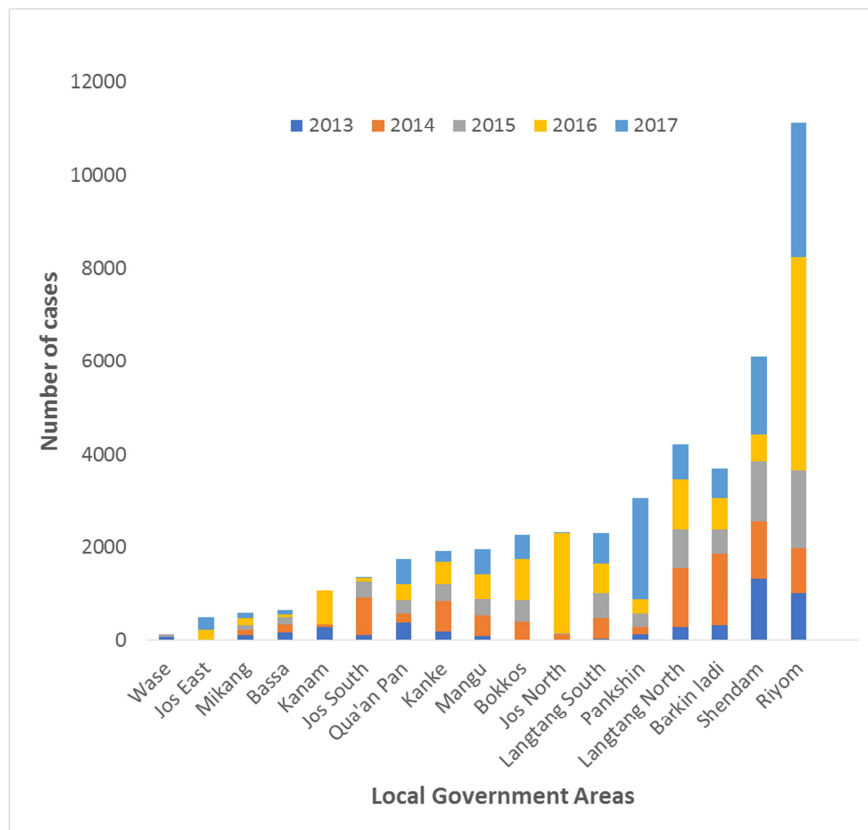


Figure 3. Distribution of severe malaria cases by Local Government Areas in Plateau State from January 2013 to December 2016.

5. Conclusion

Severe malaria remains a major cause of childhood mortality in Plateau State. Though the overall number of cases and deaths are declining, the CFR among neonates remains high. Case-based surveillance provided insight into understanding the epidemiology of severe malaria in Plateau State.

6. Recommendations

Currently, Nigeria is implementing its malaria elimination programme. Therefore, prevention and control efforts should be intensified and case based surveillance of malaria should be enhanced in Plateau State, in order to achieve the elimination of malaria in Nigeria.

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