

# Prevalence of *Plasmodium falciparum* and its Hepatic Impacts among Malaria Patients in Some Selected African Countries

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## ABSTRACT

Malaria is an infection caused by the parasites of the genus, *Plasmodium*. There are more than hundreds of different species of *Plasmodium* known to cause malaria in different animals such as: birds, monkeys, and humans. However, only five of them are notoriously implicated in causing the infection to humans, with *P. falciparum* being the most common and lethal especially in Africa. Malaria is a major public health issue affecting African countries with millions of cases every year. Among the annual 241 million malaria cases and 627,000 deaths recorded in 2020, majority of these cases was recorded in sub-Saharan African countries. Diseases caused by *P. falciparum* result in the deaths of millions of these people annually, with greater percentage being small children living in highly endemic areas. This study reviews the prevalence of *Plasmodium falciparum* and its hepatic impacts among malaria patients in some selected African countries.

**Keywords:** malaria, prevalence, *plasmodium*, *plasmodium falciparum* and Africa.

## 1.0 INTRODUCTION

Malaria is an infectious vector-borne disease arises as a result of female Anopheles mosquitoes' bite. Malaria is transmitted by one of 30-40 Anopheles species. However, among these 40 Anopheles species, Anopheles gambiae is reported to be the principal vector (Takken *et al.*, 2024). Malaria is transmitted by Anopheles gambiae to humans through a malarial parasite called *Plasmodium*. *Plasmodium* is of so many species, but only five of them, *Plasmodium falciparum*, *P. vivax*, *P. ovale*, *P. malariae*, and *P. knowlesi* are implicated in transmitting malaria to humans (Djihinto *et al.*, 2022). However, of these five species, *P. falciparum* is the species reported to cause severe and lethal malaria to humans (Hay *et al.*, 2004). Clinical diseases caused by *P. falciparum* result in the deaths of millions of people annually, with greater percentage of them being African children living in highly endemic areas (WHO, 2020).

Malaria is one of the major health issues affecting sub-Saharan African countries. In 2011, there were 28 million cases of malaria and 38,000 deaths. In 2020, there were 241 million malaria cases and death of 627,000 people worldwide. Among this, 96% of cases were recorded in sub-Saharan African countries (WHO, 2021). As reported by World Health Organization (WHO), 67% of these cases are small children under the age of 5 years (WHO, 2021). Cases of malaria in African regions bear the highest percentage of global malaria cases (Adum *et al.*, 2023). In 2021, there were 234 million cases in the region of Africa. Even in African region, some countries are more endemic than others. Nigeria (31%), Congo DR (13%), Niger (4%), and Tanzania (4%) were accounted

for more than half of all the deaths that occurred as a result of malaria worldwide (Lakew *et al.*, 2023).

Although prevalent in Africa, most of the people affected by malaria are pregnant women and small children where it causes morbidity and mortality (WHO, 2020). Malaria affects some vital organs of small children, especially the liver thereby complicating their conditions. Severe anemia, cerebral malaria, and respiratory distress are examples of complications caused by severe malaria among children especially those under the age of five (Jacob *et al.*, 2023). In the case of pregnant women, malaria causes adverse conditions during pregnancy such as abortion, stillbirth, congenital infections (Dosoo *et al.*, 2021) and low birth weight. This study reviews the prevalence of malaria in some African countries and how the liver of infected individuals is impacted by *P. falciparum*.

## 2.0 TRANSMISSION OF MALARIA

Malaria is transmitted to humans or any other organisms through the feeding of blood of infectious female Anopheles mosquitoes. Out of 100 species of Anopheles genus, about 50-60 are known to transmit malaria with good examples being *Anopheles gambiae* and *Anopheles stephensi* (Djihinto *et al.*, 2022). Malaria can also be contracted through coming in contact with contaminated blood. As parasites of malaria are found in red blood cells, it can also be transmitted through blood transfusion as well as organ transplant (Onosakponome *et al.*, 2024). Malaria may also be transmitted through congenital malaria, a condition when malaria is transmitted from mother to her fetus before or during delivery. Over 100

countries are endemic to malaria in Asia, Africa, Latin America, Middle East, and the South Pacific. About 10 species of *Plasmodium* are known to be infectious to humans while other species infect other animals such as reptiles, birds, and rodents, with 29 other species being infectious to non-human primates (Chavatt *et al.*, 2007). Among the *Plasmodia* infectious to humans are *Plasmodium falciparum* and *Plasmodium malariae*.

### 3.0 PREVALENCE OF MALARIA IN AFRICA

Malaria in humans is caused by *Plasmodium species* especially *P. falciparum*, *P. vivax*, *P. ovale*, *P. malariae* and *P. knowlesi* (Caraballo, 2014). However, majority of deaths as a result of malaria are caused by *Plasmodium falciparum* with other four species of *Plasmodium* only known to cause milder cases of malaria (Caraballo, 2014). *P. falciparum* is the major cause of lethality related to malaria in Africa and it accounts for 60% of malaria patients visiting the hospitals and 30% of those seeking hospital admissions in Nigeria (FMH, 2010). Epidemiological and clinical manifestations of malaria vary widely in different sections of the world. Factors such as the types of species of the malaria parasites in a particular area, climate and environmental conditions, susceptibility to commonly used antimalarial drugs among others are the reasons for this variability. Small children and pregnant women are mostly prone to severe illness (WHO, 2020) which could be due to a developing immunity in small children or alteration in the immunity of pregnant women as well as changes in their hormones levels courtesy of pregnancy.

### 3.1 Prevalence of Malaria In Nigeria

In Nigeria, *P. falciparum* is the major cause of malaria. In one study conducted at a hospital in Akure, Ondo State, South Western Nigeria, patients symptomatic to malaria recorded prevalence of 78.7% (Obimakinde and Simon, 2017). Likewise in Okada, Edo State, South Southern Nigeria, 76.8% prevalence was recorded (Otajevwo, 2013). However, Malaria recorded 77.4% prevalence in Owerri, Imo State, South Eastern, Nigeria (Mbanugo and Emenalo, 2004). Variability of malaria may be caused by different factors including climate and environmental conditions. In a study conducted at a hospital in Maiduguri, Borno State, North Eastern Nigeria, only 6.0% prevalence was recorded (Ahmad *et al.*, 2001). These variations in prevalence of malaria among patients at different hospitals across different parts of Nigeria may be attributed to different climatic and environmental conditions. Prevalence of malaria varies among different groups of people. Culturally, African women are known to get involved in domestic activities more than their male counterparts. This underscores the possibility of females to be more prone

to malaria compared to their male counterparts (Otajevwo, 2013). Therefore, the difference in susceptibility between males and females may be due to the exposure of females to domestic activities rendering them more exposed to mosquitoes' bites than male counterparts.

### 3.2 Prevalence of Malaria In Ghana

Ghana like other African countries is endemic to malaria. It is one of the 15 malaria endemic countries in the world and accounted for 4.3% of all the cases of malaria in the West Africa (Adum *et al.*, 2023). However, most of the sufferers are small children and pregnant women. The prevalence of malaria among small children especially under 5 years in Ghana was 20.6% in 2016 and reduced to 8.6% in 2023. This reduction may not be unconnected to significant strategies employed in reducing its prevalence. The strategies included but not limited to the use of vaccines, use of insecticide-treated mosquito nets, preventive treatment using sulfadoxine-pyrimethamine during pregnancy among others (Bardoe *et al.*, 2024). Prevalence of malaria among pregnant women was around 20.4% in Bono East in 2023 (Lakew *et al.*, 2023). Different other studies in different regions of the country reported a high prevalence of malaria infection among pregnant women (Dosoo *et al.*, 2020; Fondjo *et al.*, 2020; Dwumfour *et al.*, 2023). These studies are in agreement with other studies conducted in many other African countries aside Ghana. For example, Oyerogba *et al.*, (2023) reported a prevalence of malaria among pregnant women in Nigeria. The prevalence of malaria among pregnant women could be attributed to an altered immunity during pregnancy (Yaro *et al.*, 2021; Abu-Raya *et al.*, 2020).

### 3.3 Prevalence of Malaria In Ethiopia

Ethiopia like most of the other African countries continues to be a hotbed of malaria infection. However, unlike most African countries whereby *Plasmodium falciparum* is almost the only parasite implicated in causing malaria infection, other parasites of *Plasmodium* are also responsible in causing malaria in Ethiopia. *Plasmodium vivax*, *Plasmodium ovale*, and *Plasmodium malariae* have been reported to be major players responsible for malaria infection in Ethiopia (Glendening *et al.*, 2024). Ethiopia is one of the top 20 countries with high cases of malaria and deaths as a result of the disease (WHO, 2023). About 5.1 million estimated cases of malaria were reported in 2022 with an approximate figure of 10,570 deaths. Prevalence of *P. falciparum* among patients in different regions of Ethiopia was reported. For instance, 65% and 40.6% cases of *P. falciparum* were recorded in Lunga and Gambella regions respectively (Haileselassie *et al.*,

2023). In Majang zone, Gambella region, asymptomatic pregnant women attending clinics recorded 15.3 % prevalence of *P. falciparum* (Alemayehu *et al.*, 2024). However, Ethiopia, like other African countries have a high prevalence of *P. falciparum* in children, especially those under the age of five years.

### 3.4 Prevalence Of Malaria In Gabon

Like in any other African regions, malaria is also endemic in Central Africa, causing morbidity and mortality among small children and pregnant women (WHO, 2020). However, small children especially below the age of five are the most affected group of individuals (Global Fund, 2021). In Central Africa like Angola, this group represents about 67% of all the cases reported in the region (WHO, 2021). Unlike most African countries such as Nigeria where malaria is very intense during the rainy season which could be due to the availability of many breeding areas of mosquitoes, this is different in some regions of Africa. In some Central African regions like Gabon for instance, transmission of malaria is intense throughout the whole year (Wombo *et al.*, 2023). This difference could be due to difference in climatic and environmental factors. For example, Franceville is the 3<sup>rd</sup> largest city in Gabon with very high population of low-income earners. This city has a malaria prevalence of 20% with most of the encountered species of *Plasmodium* being *Plasmodium falciparum*. Like most cases of malaria, malaria infection is manifested as fever in 85.6% of patients in this city. This identification of the main symptom of malaria among patients is important for effective treatment of the disease.

### 4.0 IMPACT OF *P. FALCIPARUM* ON THE LIVER OF INDIVIDUALS INFECTED WITH MALARIA PARASITES

Malaria can be contracted through coming in contact with contaminated blood as its parasites are found in red blood cells. Liver is the major organ that suffers from the invasion of malaria parasites. The sporozoites of malaria infect the liver cells making it congested thereby causing sinus obstruction and inflammation of the liver cells. These changes caused to the liver cells lead to parenchymal enzymes and membranous enzymes to be leaked into the systemic circulation (Okeke *et al.*, 2020). Therefore, increase in serum levels of liver enzymes such as serum glutamic oxaloacetic-transaminase (SGOT), serum glutamic-pyruvic transaminase (SGPT), and alkaline phosphatase (ALP) and lipid profiles of malaria patients is directly proportional to the presence of the *P. falciparum* (Megabiaw *et al.*, 2022). These changes in the activities of these liver enzymes in especially in small children under the ages of 1-5 years are very significant

and common (Tsegaye *et al.*, 2021; Dao *et al.*, 2021). Changes under this age group could be attributable to developing immunity in small children.

Apart from these liver enzymes, albumin and total protein are another important compounds obstructed during invasion of malaria parasites especially in children and pregnant women. Albumin is a substance synthesized in the liver with a half-life of approximately twenty days. The rate of synthesis of this substance is dependent on nutritional status and age. It functions in maintaining vascular osmotic pressure, transport of endogenous and exogenous compounds, among others. Lower level of albumin is an indication of liver disease (Tufoni *et al.*, 2020). There is a reduction in the levels of albumin and protein among children infected with malaria. Comparison in the levels of these two important substances among children infected with malaria and those without infection shows that, children with malaria possessed lower levels of serum total protein, albumin and globulin when compared to those without malaria (Krushna and Vikas, 2022). This impairment of hepatic function may not be unconnected with severe malaria as malaria in children negatively impacts the integrity of the liver as evidenced by the leakage of liver function enzymes in to the blood as well as reduction in the level of albumin and protein levels which could subsequently lead to mortality if left unattended.

### 5.0 CONCLUSION

Malaria is one of the common diseases affecting sub-Saharan African countries. Although it is caused by many species of *Plasmodium*, *P. falciparum* is the lethal parasite in Africa causing the deaths of small children, adolescents and adults. Clinical diseases caused by *P. falciparum* result in the deaths of millions of people annually. In children, malaria negatively impacts the integrity of the liver as witnessed by the leakage of liver marker enzymes in to the systemic circulation, reduction in the levels of albumin and protein which could subsequently lead to mortality if left unattended.

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