

## EPIDEMIOLOGY OF MALARIA IN AFRICA

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Malaria is a life threatening parasitic disease transmitted by female anopheles mosquitoes. There are four types of human parasites; *Plasmodium vivax*, *P. malariae*, *P. ovale* and *P. falciparum*. *P. falciparum* and *P. vivax* are the most common and *P. falciparum*, the most deadly type of infection, is most common in sub-Saharan Africa. A large number of environmental factors affect the distribution, seasonality and transmission intensity of malaria. Rainfall provides breeding sites for mosquitoes and increases the humidity, which enhances their survival. While malaria is largely endemic in Africa, varying proportion of countries in the continent are at risk of endemic malaria. Today, approximately 40% of the world population, mostly those living in the world's poorest countries, is at risk of malaria. This is mostly in the tropical and sub-tropical regions of the world. There are at least 300 million acute cases of malaria each year globally resulting in more than a million deaths, around 90% of these occur in Africa, mostly young children. In areas of stable malaria transmission, very young children and pregnant women are the population at highest risk for malaria morbidity and mortality. The populations most at risk of epidemics are those living in highlands, arid and desert-fringe zones and those living in areas where successful control measures have not been consolidated or maintained.

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## INTRODUCTION

Malaria is a life threatening parasitic disease transmitted by mosquitoes. It was once thought that the disease came from fetid marshes, hence the name 'malaria' (bad air). In 1880, scientists discovered that the parasite was transmitted from person to person through the bite of female Anopheles mosquito. The agent transmitted was found to be a one-celled parasite called plasmodium.

There are four types of human malaria, *Plasmodium vivax*, *P. malariae*, *P. ovale* and *P. falciparum*. *P. falciparum* and *P. vivax* are the most common and *falciparum* the most deadly type of infection. *P. falciparum* is most common in sub-Saharan Africa (1). Malaria parasite enters the human host when an infected Anopheles mosquito takes a blood meal. Inside the human host, the parasite undergoes a series of changes as part of its complex life-cycle.

Malaria symptoms appear 9-14 days after the bite of an infectious mosquito.

## EPIDEMIOLOGY

The disease was once widespread globally but it was successfully eliminated from many countries with temperate climates during the mid-twentieth century. Today, approximately 40% of the world population, mostly those living in the world's poorest countries, is at risk of malaria. This is mostly the tropical and subtropical regions of the world.

The vast majority of deaths occur in sub-Saharan Africa where malaria also presents major obstacles to social and economic development. There are at least 300 million acute cases of malaria each year globally resulting in more than a million deaths, about 90% of these deaths occur in Africa, mostly in young children (2, 3).

Malaria is Africa's leading cause of under-five mortality and contributes 10% of

the continent's overall disease burden. It accounts for 40% of public health expenditure, 30-50% of in-patients admissions and up to 50% of outpatient visits in areas with high malaria transmission (2, 4-6). In all malaria-endemic countries in Africa, 25-40% (average 30%) of all outpatient clinic visits are for malaria (with most diagnosis made clinically). In these same countries, between 20% and 50% of all hospital admissions are a consequence of malaria (7).

In Africa, most cases of malaria are diagnosed on the basis of clinical symptoms and treatment is presumptive rather than based on laboratory confirmation. Moreover, malaria parasitaemia is common among clinic attendees in many endemic cases, so that a positive laboratory result does not necessarily mean that the patient is ill with malaria. Routine reports of the number of malaria cases and deaths have limited value for comparison of the malaria burden between countries because of the variation in timeliness and completeness of reporting (7).

About 90% of all malaria deaths in the world today occur in Africa south of the Sahara. This is because the majority of infections in Africa are caused by *P. falciparum* (1, 8), the most dangerous of the four human malaria parasites. It is also because the effective malaria vector, the mosquito *Anopheles gambiae*, is the most widespread in Africa and most difficult to control (7, 9).

#### **PATTERN OF TRANSMISSION**

A large number of environmental factors affect the distribution, seasonality and transmission intensity of malaria. Rainfall provides breeding sites for

mosquitoes and increases the humidity, which enhances their survival. Temperature affects the transmission cycle of malaria. At temperature below 22°C, the determining factor is the number of mosquitoes surviving the parasite incubation period, which takes 55 days at 18°C and ceases at around 16°C (10).

Malaria affects the lives of almost all people living in the area of Africa defined by the southern fringes of the Sahara desert in the North, and latitude of about 28° in the South. Most people at risk of the disease live in areas of relatively stable malaria transmission; infection is common and occurs with sufficient frequency that some level of immunity develops (7).

While malaria is largely endemic in Africa, varying proportion of countries in the continent are at risk of endemic malaria. Malaria is endemic in some of the offshore islands to the west of mainland Africa; Sao Tome and Principe and São Tiago Island of Cape Verde. In the East, malaria is endemic in Madagascar, in the Comoro islands (both the Islamic Federal Republic of the Comoros and the French Territorial Collectivity of Mayotte), and on Pemba and Zanzibar (6). The risk of endemic malaria in some African countries is as follows; Gambia 100%, Nigeria 97.0% and 39.7% in Ethiopia (3).

Endemic areas are defined as "areas with significant annual transmission, be it seasonal or perennial" (10). Where prevalence is greater than 75%, malaria is holo-endemic; where prevalence is between 51 and 75%, malaria is hyper-endemic; where prevalence is between 11 and 50%, malaria is meso-endemic, and where prevalence is less than 10%, malaria is hypo-endemic. In areas of stable malaria,

the amount of transmission is high without any marked fluctuations over the years, although seasonal fluctuations may exist. In unstable malaria, the amount of transmission varies from year to year. In areas of stable malaria, immunity is high and epidemics are unlikely and in unstable malaria, immunity of the population is low and epidemics are possible (11). In North Africa, a combination of high temperatures with rapid onset of a short duration of rainfall allow for a limited transmission of less than 3 months (10).

Malaria kills an African child every 30 seconds. Many children who survive an episode of severe malaria may suffer learning impairments or brain damage. Pregnant women and their unborn children are particularly vulnerable to malaria, which is a major cause of perinatal mortality, low birth weight and maternal anaemia (3).

In areas of stable malaria transmission, very young children and pregnant women are the population groups at highest risk for malaria morbidity and mortality. Most children experience their first malaria infections during the first year or two of life, when they have not yet acquired adequate clinical immunity, which makes these early years particularly dangerous. Ninety percent of all malaria deaths in Africa occur in the young children. Adult women in areas of stable transmission have a high level of immunity, but this is impaired especially in the first pregnancy, with the result that risk of infection increases (7).

Over 40% of the world's children live in malaria endemic countries. Each year 30-50 million infections leads to over 1 million deaths, of which over 75% occur in Africa

children under 5 years infected with *P. falciparum*. It is estimated that African children have between 1.6 and 5.4 episodes of malaria fever each year.

In areas with stable malaria transmission, *P. falciparum* infection during pregnancy is estimated to cause as many as 10,000 deaths each year, 8% to 14% of all the low birth weight babies and 3% to 8% of all infants' deaths. Adult women in areas of stable malaria transmission have high levels of immunity, but this is impaired especially in the first pregnancy, with the result that risk of infection increases (2, 7).

Poor people are at increased risk both of becoming infected with malaria and of becoming infected more frequently. Child mortality rates are known to be higher in poorer households and malaria is responsible for a substantial proportion of these deaths (12, 13). This is mainly because poor families live in dwellings that offer little protection against mosquitoes and are less able to afford insecticide-treated nets. Poor people are also less likely to be able to pay either for effective malaria treatment or transportation to a health facility.

The rapid increase in the world's urban population has major implications for the epidemiology of malaria. A review of malaria transmission in sub-Saharan African cities shows the strong likelihood of transmission occurring within these sprawling cities, whatever the size or characteristics of their bioecological environment (14).

#### **MALARIA EPIDEMICS**

Epidemics can occur when malaria attacks vulnerable populations with little or no immunity. In such situations, people of

all age groups are at risk of death or severe malaria. The populations most at risk of epidemics are those living in highlands, arid and desert-fringe zones and those living in areas where successful control measures have not been consolidated or maintained (2). Epidemic areas are defined as "areas prone to distinct inter-annual variation, in some years with no transmission taking place at all" (10). A smaller proportion of people live in areas where risk of malaria is more seasonal and less predictable, because of either altitude or rainfall patterns. People living in the peripheral areas north or south of the main endemic area or bordering highland areas are vulnerable to highly seasonal transmission and to malaria epidemics (7).

Two factors precipitate malaria epidemics; i. natural factors such as climatic variations and natural disasters and ii. man-made factors such as conflicts and war, agricultural activities, dam construction, mining, logging and failure of control measures (7, 8). These factors make the physical environment suitable for mosquitoes to transmit malaria.

In Mauritius, malaria has been well controlled since 1950s, but occasional outbreaks of vivax malaria occur, the last in association with a cyclone in 1982. Since that year, there has been a steady decrease in cases and risk is now extremely low (7). Only about 0.02% of Nigerians are at risk of epidemic malaria. In Ethiopia, 23.9% of the population is at risk of malaria epidemics.

Malaria has been well controlled or eliminated in the five northernmost African countries; Algeria, Egypt, Libya Arab Jamahiriya, Morocco and Tunisia. In these countries, the disease was predominantly

caused by *P. vivax* and transmitted by mosquitoes that were easier to control than those of the ones in Africa south of the Sahara (7). High altitudes in East Africa, Horn of Africa and among the arid deserts at the juncture of Kenya, Ethiopia and Somalia are unstable for malaria transmission (10)

#### **MALARIA IN NIGERIA**

In Nigeria, 37 Anopheles species of mosquito have been documented. The main agent of malaria is *P. falciparum*. Transmission occurs in the entire country and it is all year round in only small part of the southern part of the country. In the remaining parts, duration of transmission is 3-10 months (months of February to December). The risk of endemic malaria is 97% and epidemic risk 3%. Malaria is highly endemic in Nigeria and is one of the major causes of ill-health and death (15).

About 50% of Nigerian population experience at least one episode of malaria each year (16). In a survey of selected health facilities in 2001, 36% of deaths among children under 5 years of age were attributed to malaria, with 7.2% case fatality rate, and 31.7% attributable malaria morbidity (3).

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