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Annual Global Malaria Report

The World Health Organization (WHO) released its annual report for global malaria. In addition to updated disease surveillance, the report added a chapter about climate change and the disease.

Background

Malaria is caused by the protozoan *Plasmodium* spread among humans by mosquitoes. Malaria parasites have ancient lineages with different species affecting primates, rodents, birds, or reptiles. Based on historic records and antigen detection in Egyptian burial remains, malaria has affected humans for over five millennia. The agent was first identified in Algeria in 1880, resulting in the award of a Nobel Prize several decades later, by which time the mosquito vector, *Anopheles* mosquito species, had been recognized.

Infection with malaria varies with the species (*P. falciparum* being the most virulent) and with a host's immune status. There can be minimal symptoms, a febrile flu-like illness, severe organ involvement, or death. Disease impact is highest for younger children as well as during pregnancy. Potential adverse outcomes for children are anemia, malnutrition, and cerebral malaria. Negative pregnancy outcomes can be adult anemia, stillbirth, preterm birth, and low birthweight.

Interventions to reduce malaria include pre-exposure prophylaxis for travelers, reducing mosquito populations and preventing bites, providing prompt diagnosis and treatment, and vaccinating the most vulnerable groups. Insecticide-infused bed nets, removing potential mosquito breeding sites, and interior or environmental insecticide applications are approaches for preventing bites. Treatment with appropriate medication removes reservoirs in the transmission cycle. Recently available malaria vaccines are being targeted to children living in regions with high disease rates to reduce pediatric infections, which are most likely to progress to severe complications.



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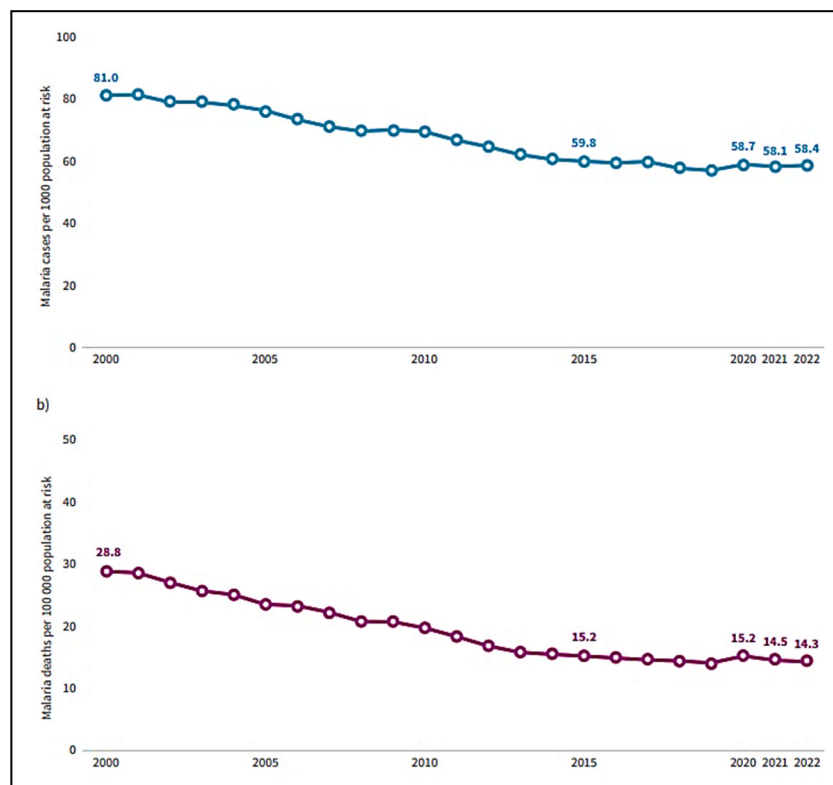


Surveillance for Malaria

WHO estimated that in 2022 there were almost 250 million malaria cases occurring in 85 countries and areas, primarily located in Africa and Asia, and around 610,000 malaria-associated deaths. About 95% of global cases occurred in 29 countries while almost half of cases occurred in four countries: Nigeria, Democratic Republic of the Congo, Mozambique, and Uganda.

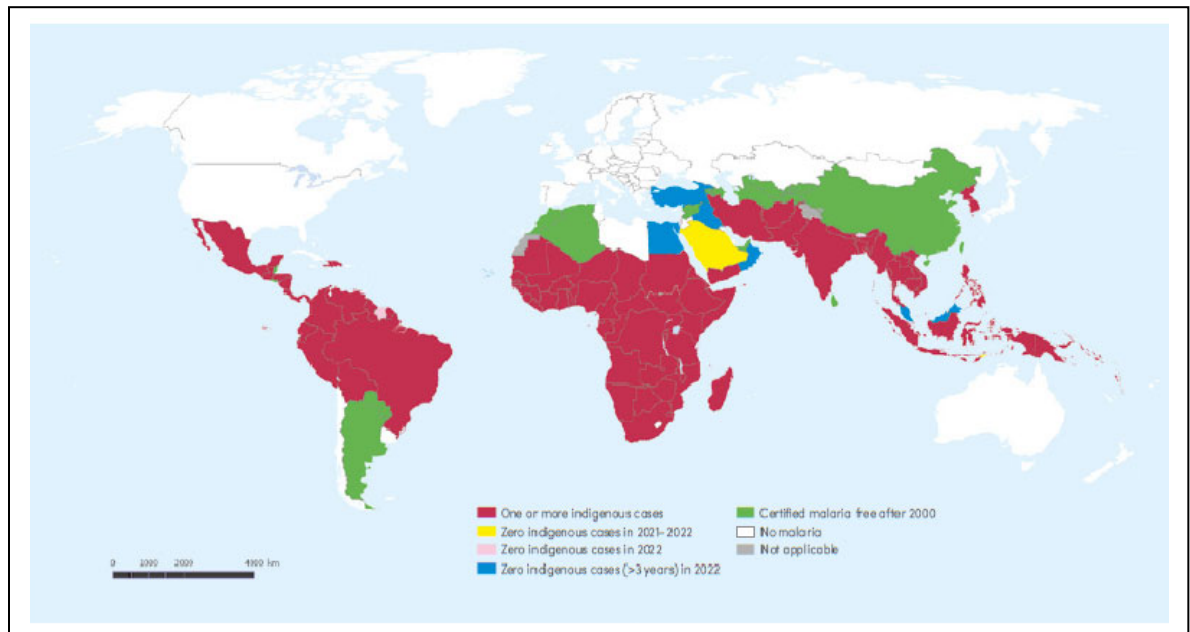
The WHO surveillance report included a general trend of declining rates of malaria during this millennium but with stalled progress since 2015. There was a small increase in both case rates and mortality rates during 2020, likely reflecting reduced ability to maintain malaria control measures during the initial response to COVID-19. This was followed by small reductions in those rates in the subsequent two years (Figures 1a and 1b). Global malaria case incidence fell from 81.0/1000 population at risk in 2000 to 58.7/1000 in 2019 and 58.4/1000 in 2022, essentially level over the last three years of data. Malaria deaths halved from 28.8/100,000 population at risk in 2000 to 14.3/100,000 in 2022. Most malaria-associated deaths are pediatric, with children under five years of age accounting for about three quarters of the total mortality.

Figure 1: Global malaria cases (a) and deaths (b) in populations at risk, 2000-2022 (WHO)



In 2000 there were 108 countries with indigenous malaria cases. By 2022, 85 countries remained malaria endemic. WHO tracks countries which achieve elimination, which is defined as having no indigenous malaria cases for at least the three prior years. For the 2023 WHO yearly update, three more countries were certified by WHO as malaria-free: Azerbaijan, Belize, and Tajikistan. After elimination has been achieved, countries must prevent reestablishment of malaria. Their efforts may involve continued control interventions as well as surveillance to maintain and confirm the country's malaria-free status. In Figure 2, countries shaded red have ongoing malaria transmission while other map colors represent countries having at least one year without cases of malaria.

Figure 2: Countries with indigenous malaria cases in 2000 and their status by 2022 (WHO)



In the United States, malaria was a major health threat in the nineteenth century, becoming a leading cause of death in southern states and Mississippi River drainage areas. Malaria was also a cause of mortality among United States troops during the Civil War. In 1946 the Communicable Disease Center (now the Centers for Disease Control and Prevention) was established in Georgia within the country's malaria zone with a major responsibility for national control of the disease, accomplished by 1951 through mosquito control with water management and insecticides.

Malaria cases continue to be reported in this country for persons exposed in endemic areas; annually there are around 15 to 50 such cases reported in Washington State. While still extremely rare, locally acquired malaria cases have been identified sporadically in the United States. During 2023, such cases were reported in Florida, Texas, Maryland, and Arkansas with presumed exposure when a mosquito bit an imported malaria case and then a person who had not traveled. Prompt interventions were taken by the four states to prevent transmission from the known cases.

Continuing Challenges

Malaria surveillance includes collecting data about resistance to therapeutics or to insecticides. Therapeutic choices have become challenging since resistance to anti-malarial drugs first emerged in the late 1950s. Resistance is a particular problem for *P. falciparum*, generally the most severe agent. Current treatment regimens are more complicated and more expensive (see Resources). Due to mosquitoes in some regions with resistance to typical insecticides used in bed nets, WHO gave a strong recommendation for such areas to use bed nets with a combination of insecticides; nets may still be less effective than in the past. Malaria testing is also increasingly difficult because in some areas rapid tests are no longer accurate due to genetic changes in *falciparum* strains.

Two recently developed malaria vaccines offer a new way to reduce the pediatric morbidity and mortality associated with malaria. Vaccine supplies are still limited. WHO coordinates a global program that has been delivering vaccine for children in Ghana, Kenya, and Malawi since 2019. A second vaccine became available in October 2023, and will be used in moderate and high transmission endemic areas to prevent *falciparum* malaria in children.

Climate Change

Temperature combines with rainfall and humidity to determine the levels of mosquito egg laying, larval development, and adult survival. While the specific outcomes are difficult to predict, both direct and indirect effects of climate change could impact the risk of malaria transmission. Direct effects could occur due to changes in temperatures and rainfall that contribute to increases in mosquito vector populations. Floods following more severe storms often provide greatly expanded breeding sites for mosquitoes; malaria cases in Pakistan increased about five-fold following massive monsoon floods there. While droughts may reduce some mosquito populations, storage of water in outdoor vessels could result in concentrations of the insects close to dwelling areas. Less severe winters could increase the level of adult survival and increase mosquito populations.

Indirect effects of climate change impacting malaria transmission could include population displacement and malnutrition. With increasing numbers of extreme weather events, food production and distribution can be disrupted, leading to malnutrition which increases the risk of severe illness with malaria. Climate changes could also increase population displacement due to storms, floods, and droughts. Climate refugees with inadequate housing may be more vulnerable to mosquito bites and if food supplies are inadequate may also face increased risk for malnutrition.

Malaria remains a major health burden in many areas of the planet, a burden particularly for children in risk areas. International and national activities continue to provide services that prevent, detect, treat, and track malaria.

Resources

WHO 2023 report on malaria: <https://www.who.int/teams/global-malaria-programme/reports/world-malaria-report-2023>

CDC update on locally acquired cases of malaria in the United States: https://www.cdc.gov/malaria/new_info/2023/malaria_US.html

CDC malaria treatment resources for clinicians: https://www.cdc.gov/malaria/resources/pdf/Malaria_Treatment_Table_202306.pdf

CDC travelers health link: <https://www.cdc.gov/malaria/travelers/index.html>

