

Contrasting patterns of malaria drug resistance found between humans and mosquitoes

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A study conducted by researchers at the Johns Hopkins Malaria Research Institute and their Zambian colleagues detected contrasting patterns of drug resistance in malaria-causing parasites taken from both humans and mosquitoes in rural Zambia. Parasites found in human blood samples showed a high prevalence for pyrimethamine-resistance, which was consistent with the class of drugs widely used to treat malaria in the region. However, parasites taken from mosquitoes themselves had very low prevalence of pyrimethamine-resistance and a high prevalence of cycloguanil-resistant mutants indicating resistance to a newer class of antimalaria drug not widely used in Zambia.

The findings are published November 7 in the online edition of the journal *PNAS* and will be discussed at the November 16 seminar, "The Forever War: Malaria versus the World," held in New York City by the Johns Hopkins Bloomberg School of Public Health and the New York Academy of Sciences.

Surveillance for drug-resistant parasites in human blood is a major effort in [malaria control](#). Malaria in humans is caused by the [parasite Plasmodium](#) falciparum, which is spread from person to person through the feeding of the Anopheles mosquito. Over time, through repeated exposure to medications, the parasites can become less susceptible to drugs used to treat [malaria infection](#), limiting their effectiveness.

"This contrast in resistance factors was a big surprise to us," said Peter Agre, MD, an author of the study and director of the Johns Hopkins Malaria Institute. "The contrast raises many questions, but we suspect that the [malaria parasite](#) can bear highly host-specific drug-resistant polymorphisms, most likely reflecting very different selection preferences between humans and mosquitos."

For the study, Sungano Mharakurwa, PhD, lead author and senior research associate with the Johns Hopkins Malaria Research Institute in Macha, Zambia, conducted a [DNA analysis](#) of *P. falciparum* found in human blood samples to those found in mosquitoes collected inside homes in rural Zambia. In samples taken from human blood, pyrimethamine-resistant mutations were greater than 90 percent and between 30 percent to 80 percent for other polymorphisms. Mutations of cycloguanil-resistance were 13 percent.

For parasites found in the mosquito midgut, cycloguanil-resistant mutants were at 90 percent while pyrimethamine-resistant mutants were detected between 2 percent and 12 percent.

"Our study indicates that mosquitoes exert an independent selection on drug resistant parasites—a finding that has not previously been noticed. If confirmed in other malaria endemic regions, it suggests an explanation for why [drug resistance](#) may appear so rapidly," said Mharakurwa.

Worldwide, malaria afflicts more than 225 million people. Each year, the disease kills approximately 800,000, many of whom are children living in Africa.

More information: "Malaria antifolate resistance with contrasting *Plasmodium falciparum* dihydrofolate reductase (DHFR) polymorphisms in humans and *Anopheles* mosquitoes", *PNAS*.

Provided by Johns Hopkins University Bloomberg School of Public Health

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