Fact sheet: *Plasmodium vivax* malaria

Malaria is a devastating parasitic disease transmitted through the bite of infected *Anopheles* mosquitoes. Endemic to tropical and subtropical areas of Asia, North and South America, the Middle East, North Africa, and the South Pacific, *Plasmodium vivax* is the most common of four human malaria species (*P. falciparum*, *malariae*, *ovale*, and *vivax*).[1,2] *P. vivax* causes up to 65% of malaria in India and is becoming increasingly resistant to malaria drugs. By contrast, *P. falciparum* is the most deadly species and the subject of most malaria-related research and literature. (For more information, see http://malariavaccine.org/mal-what_is_malaria.htm.)

India reported 2,660,057 cases of malaria in 1997

More frequent international travel, widespread presence of *Anopheles* mosquitoes, and environmental conditions that favor malaria transmission have caused *P. vivax* to occur with increasing frequency in non-endemic areas. For example, in 1993, one soldier in Korea was diagnosed with *P. vivax;* the following year saw 25 cases, and the numbers have increased each year thereafter. In 1999, Korea documented 3,621 cases of *P. vivax* malaria.[3] Even in the U.S., *P. vivax* malaria seems to be spreading, with cases as far north as Virginia and New York.

Symptoms of *P. vivax* malaria are similar to those of other types of malaria and include cyclical fever and chills, headache, weakness, vomiting, and diarrhea. The most common complication is enlargement of the spleen. *P. vivax* malaria is rarely fatal, but relapses often occur months to years after treatment because some of the parasites can become dormant in the liver. Special medication can be taken to kill the dormant parasites.

Life cycle:[4] Like *P. falciparum*, *P. vivax* is introduced into the bloodstream by the *Anopheles* mosquito. The parasites enter the liver cells, where most[5] divide to form schizonts consisting of numerous merozoites. Leaving the liver, merozoites invade red blood cells and reproduce. After 48 hours or so, enough merozoites are produced to burst the red blood cells, resulting in fever and chills characteristic of malaria. Some merozoites then develop into male or female forms, which if taken up by a mosquito, can start the cycle over again.

Comparison to *P. falciparum*: *P. vivax* differs from *P. falciparum* in several ways. The parasite preferentially invades younger, smaller red blood cells. It can "hibernate" in the liver for months or even years and then resurface, causing disease. And it cannot infect people (95% of West Africans) with a certain blood type (Duffy+). *P. vivax* has fewer severe complications, is more common in temperate zones, and is more widespread than *P. falciparum*. Most importantly, *P. vivax* cannot attach to endothelial cells deep in the network of blood vessels and is rarely fatal.

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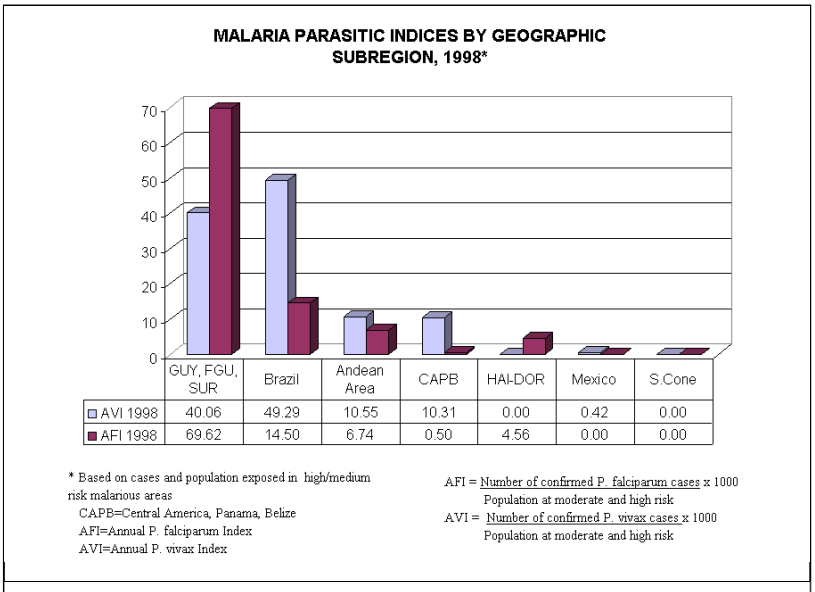
[1] Li J et al., Geographic Subdivision of the Range of the Malaria Parasite, *Plasmodium vivax. Emerging Infectious Diseases*, Centers for Disease Control and Prevention, Vol. 7, No. 1, Jan-Feb 2001.
[2] CDC. Parasites and Health: Malaria, http://dpd.cdc.gov/dpdx/HTML/Frames/M-R/Malaria/body_Malaria_page2.htm
[3] Sherman IW (ed.), *Malaria – Parasite Biology, Pathogenesis, and Protection.* ASM Press, Washington, DC, 1998.
[4] Markell Ek, Voge M, John DT., *Medical Parasitology*, 7th Ed., W.B. Saunders Company, Philadelphia, PA, 1992.
[5] Some of the sporozoites go dormant in the liver. These "hypnozites" are activated weeks, months, or years later.

Treatment: *P. vivax* malaria has classically been treated with chloroquine and primaquine. Primaquine acts against the liver stage, decreasing the risk of relapse. The parasite is becoming resistant to chloroquine and primaquine, so alternate drugs are being used and explored.

Cost: The Indian government may spend almost half its health budget combating malaria, including *P. vivax*. Other countries also spend significant resources on treatment and control. Because infection often leads to severe disease, quality of life and workplace productivity also suffer.



This PAHO graph shows *P. falciparum* and *P. vivax* incidence in Latin America and the Caribbean. Three large subregions have more *vivax* than *falciparum*.

Vaccine development: Globally, a relatively small proportion of malaria vaccine development funding goes toward *P. vivax* vaccine candidates, even though much less is known about this form of the malaria parasite. However, 1999 saw the establishment of an Asian *P. vivax* network to create, improve, and expand: research on the parasite, cGMP[6] production of candidate vaccines for human clinical trials, clinical testing site development, and funding. The leading vivax candidate vaccines include several blood-stage candidates, a transmission-blocking candidate, and a liver-stage candidate.[7] Because of the frequency of concurrent *P. vivax* and *P. falciparum* infection, scientists hope to eventually develop a combined vaccine that will prevent and/or lessen the severity of both these types of malaria.

MVI's *P. vivax* strategy: While concentrating primarily on vaccines against *P. falciparum*, MVI cannot ignore the large number of people *P. vivax* affects worldwide and the severity of the disease. MVI is currently focusing its *P. vivax* efforts on a project with the International Centre for Genetic Engineering and Biotechnology (ICGEB) and Bharat Biotech in India.

[6] Current Good Manufacturing Practices (cGMP)

[7] World Health Organization, Meetings on *Plasmodium vivax* and *Schistosoma japonicum* in Asia. *TDR News*, 1999. http://www.who.int/tdr/publications/tdrnews/news60/vac cine.htm

Photos courtesy of Richard Franco.