

Chapter 5

Men, Mosquito, and Malaria: The Circle of Life in Plasmodium

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ABSTRACT

The chapter is dedicated to malaria, plasmodium, their ecology, evolution, life cycle, and host interaction. Authors divided the chapter into different subheadings to easily elucidate several aspects of the parasite and disease, which also include disease model evolution of zoonotic malaria of past and present, rise and fall of malaria drugs due to resistant plasmodium strains, and also situations of urban malaria. This may be useful for the reader as the authors also included many scientific anecdotes regarding the history of malaria, plasmodium, and human society.

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INTRODUCTION

Noble laureate and Buddhist spiritual leader, the Dalai Lama (14th), has once famously said, “If you think you are too small to make a difference, try sleeping with a mosquito.” It is quite evident that from the dawn of the Paleolithic age to the modern Anthropocene timescale, a tiny dipteran insect had piled up more human kill than any other large predator, including humans itself, on this little blue planet. This remarkable yet infamous achievement by mosquitos could not be possible unless with the presence of a pathogen or/and parasite. Of them, *Plasmodium* is a top-tier executive always at work. With a tiny mobile insect vector and a globally distributed enormous host population of naked apes, the business of Malaria is still booming even after the epic chloroquine and Artemisinin era. To this date, humans as a society knowingly and accidentally learned a few things about their oldest foe, malaria, which helped them to survive in the long run. A brief glimpse of this knowledge and occasional insights are placed here, ranging from the origin of malaria, its global consequences, counteracting between host and pathogens, and the new-old problems of malaria with some foreshadowing of nature.

GENERAL OUTLINE OF *PLASMODIUM SPECIES* AND THEIR LIFE CYCLE INSIDE HOSTS

Plasmodium is a prominent genus of protozoan endoparasite under the large phylum Apicomplexa that they share with other parasitic honchos such as *Babesia*, *Cryptosporidium*, *Toxoplasma*, etc. *Plasmodium* asexually initiates merogonic replication inside the host's erythrocytes and after digesting host haemoglobin produces haemozoin pigment as a byproduct. Due to the presence of apical complex and apicoplast (product of ancient secondary endosymbiosis), they are grouped into the phylum Apicomplexa (McFadden & Yeh, 2017). This obligate endoparasitic apicomplexan affects a vast range of terrestrial vertebrates as their definitive host and dipteran invertebrates as an intermediate host to accomplish their complex life cycle. Despite having more than 170 extant species and four subgenera, only 4 to 5 species are known to infect human beings with their severe pathogenicity, namely *Plasmodium vivax*, *P. ovale*, *P. malariae*, *P. knowlesi*, and *P. falciparum* and have distinct virulence and fever cycles. Infection is solely transferred by the vector, female *Anopheles sp.* mosquitoes, during their obligatory feeding of warm blood before oviposition. 10–100 sporozoites are injected with insect saliva into the host bloodstream during a blood meal. Sporozoites invade the host liver and migrate through macrophages (Kupffer stellate cells) and hepatic parenchymal cells within a short period. After 6-16 days, the mature sporozoites in the liver lead to 10 000-30

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