Plasmodium falciparum and *P. malariae* epidemiology in a West African village

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Transmission of Plasmodium falciparum *and* P. malariae *was studied in a village in Burkina Faso. Consecutive captures of mosquitos were organized twice a month over a year and the species of the mosquitos identified. Also, the prevalences and densities of* Plasmodium *spp. were determined every 2 months in a sample of children who lived in the village.* Anopheles gambiae, A. funestus, *and* A. nili *were the local vectors, but only the first two played a predominant role in both* P. falciparum *and* P. malariae *transmission. The parasitological sporozoite index (SI) was 4.48% for* A. gambiae *and 4.22% for* A. funestus. *The immunological SIs were higher: 5.82% of* A. gambiae *were infected with* P. falciparum *and only 0.16% with* P. malariae; *the corresponding proportions for* A. funestus *were 6.45% and 0.41%. Transmission of* Plasmodium *spp. by* A. gambiae *was important during the rainy season (July–October) and by* A. funestus *at the beginning of the dry season (September–November). Each child in the study village could receive about 396* P. falciparum*-infected bites per year but only 22 of* P. malariae. *The* P. falciparum *parasite indices were maximum during the middle of the rainy season (August), while those for* P. malariae *reached a peak during the dry season (February).*

Introduction

After *Plasmodium falciparum, P. malariae* is the most important cause of human malaria in West Africa (*6*). The geographical distribution of both species is widespread, but *P. malariae* is localized in foci (*7*). The periods during which these two species are transmitted are different (*12*). *P. malariae* is responsible for some malaria morbidity and chronic infections in endemic areas, and can sometimes induce a nephrotic syndrome (*9*). In some foci it can therefore be important to follow *P. malariae* transmission in order to select specific control measures against this parasite species.

By microscopy, it is virtually impossible to differentiate *P. malariae* sporozoites and *P. falciparum* in the salivary glands of infected mosquitos. Recently, however, a two-site enzyme-linked immunosorbent assay (ELISA) that uses a monoclonal *malariae* have already been characterized in Kenya (*1*), but there has been no investigation of the transmission of this species in West Africa.

Using the above-mentioned ELISA with monoclonal antibodies against either *P. falciparum* or *P. malariae*, as well as entomological and parasitological surveys, we carried out a longitudinal investigation of malaria transmission in a savanna area of Burkina Faso.

Materials and methods

Characteristics of the study area

The study was conducted in Karangasso, Burkina Faso, near the city of Bobo-Dioulasso. Karangasso is a typical savanna village with a semipermanent river but is sufficiently distant from Bobo-Dioulasso to preclude significant use of chloroquine by the

during the rainy season, was randomly divided into two lots: one for microscopy of salivary glands and ovaries and the other for immunological testing.

The proportion of parous females (parity rate, PR) was calculated for each survey (*5*). The percentage of infected glands (parasitological sporozoite rate, *s*) was also determined. The human biting rate ([illegible]) was estimated by determining the mean

Parasitological investigations

Parasitological surveys were performed every 2 months on the s me population sample of 31 voluntary families. No particular control measure was taken other than treating the malaria patients. Only children aged 0–14 years were examined. Samples of peripheral blood were taken from each [illegible]

Fig. 1. **Evolution of a) anopheline densities (bites per person per night); b) parity rates (%); and c) entomological inoculation rates (infected bites per person per night), for *Anopheles gambiae*, *A. funestus*, and *A. nili*, in an African savanna area.**

positive in the ELISA (5.82% with *P. falciparum* and 0.16% with *P. malariae*). In addition, 4.22% of *A. funestus* were infected with *Plasmodium* spp. and 6.86% were positive in the ELISA (6.45% with *P. falciparum* and 0.41% with *P. malariae*). A total of 1.15% of *A. nili* had sporozoites in their salivary glands and 13.5% were positive in the ELISA (10.8% with *P. falciparum* and 2.7% with *P.*

contrast, 20 out of 33 *A. funestus* were diagnosed by dissection, and ELISA detected 25/31 infected with *P. falciparum* and two with *P. malariae*. *A. nili* mosquitos were also occasionally infected: 3/4 mosquitos infected with *P. falciparum* were detected by ELISA and 1/2, by dissection.

For *A. gambiae*, *h* became positive in June, reached a maximum in July–September (about 1.5 infected bites per person per day) and then decreased (Fig. 1c). The annual average value was 0.39 infectious bites per person per night. In contrast, for *A. funestus* the rate became detectable in July and reached its maximum (about 1.3 infectious bites per person per night) in October. An individual living in the village could therefore have received an average of 0.31 infectious bites per night. For *A. nili* it was difficult to analyse the fluctuations in *h* because of the small number of mosquitos in the sample. The annual mean value of the rate in the study village was 0.72 infectious bites per person per night. The evolution of the three entomological indices (*ma*, PP, and *h*) showed that *A. funestus* progressively

parasites per μl, with the annual means being 1675, 854, and 596 per μl for 0–4-, 5–9-, and 10–14-year-olds, respectively. Parasitological loads reached their maximum in August–October (Fig. 2a), during the rainy season. Subsequently, they decreased more rapidly in groups II and III than in group I, despite a high level of transmission (2.5 infected bites per person per night in September and 1.4 in October).

The prevalences of gametocytes fluctuated from 9.2% to 39.7% (Table 3), with the annual means being 27.1%, 23.7% and 30.3% among 0–4-, 5–9-, and 10–14-year-olds, respectively. Gametocyte densities (in logarithmic units) varied from 7 to 32 per μl according to both the age and the season. Those aged 0–4 years had higher levels of gametocytes (21.6 per μl) than the older age groups (14.6 and 11.6 gametocytes per μl for 5–9- and 10–14-year-olds, respectively).

The prevalence of *P. malariae* fluctuated from 3.5% to 25% and the annual means were 14.2%, 14%, and 10.8% in groups I, II, and III, respectively

Table 3: **Prevalence of *Plasmodium falciparum* in different age groups determined in a malaria longitudinal study in Karangasso, Burkina Faso**

		Survey number (month/year)					
Age group	Index[a]	1 (3/1985)	2 (5/1985)	3 (8/1985)	4 (10/1985)	5 (12/1985)	6 (2/1986)
	n	57	65	62	40	60	62
I	IPF	58.4	35.4	72.5	82.5	73.3	54.8
(0–4 years)	IPM	3.5	9.2	8	25	25	14.5
	IGF	37.3	9.2	32.2	20	31.6	22.5
	n	65	79	67	44	75	83
II	IPF	56.9	48.1	64.1	75	57.3	47
(5–9 years)	IPM	12.3	10.4	16.2	22.7	13.3	9.6
	IGF	30	22.7	28.3	4.5	25.3	16.8
	n	37	57	38	47	45	50
III	IPF	61	59.6	78.9	72.3	53.3	54
(10–14 years)	IPM	8.1	14	13.1	19.1	6.6	4
	IGF	39.7	29.8	39.4	8.5	31.1	28

[a] *n* = sample size; IPF = *P. falciparum* prevalence (%); IPM = *P. malariae* prevalence (%); IGF = *P. falciparum* gametocyte index (%).

Parasite densities varied from 260 to 1400 These findings are in accord with those reported by

falciparum and *P. malariae* according to the mosquito cytotype.

At the beginning of the transmission period in

not optimal vectors under natural conditions.

P. malariae infection exhibits three conflicting phenomena that cannot be readily accounted for:

pendant la première moitié de cette période (juin–octobre), puis le relais est pris par *A. funestus*. A la dissection, 4,48% des *A. gambiae* et 4,22% des *A.*

zyme-linked immunosorbent assay (ELISA) for detection of *Plasmodium malariae* sporozoites in mosquitoes. *American journal of tropical medicine and hygiene*, 38: 283–288 (1988)