

EPIDEMIOLOGICAL STUDIES OF MALARIA AT PONG NAM RON, EASTERN THAILAND

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Abstract. Malaria is still a serious health problem in Thailand. Present attempts at controlling the disease by drug treatment and other means remain unsatisfactory. Thus, development of vaccination against malaria is a major research goal of malaria immunology. The objective of this study was to acquire epidemiological base line data for subsequent vaccine trials.

A cross-sectional descriptive survey was conducted among 451 local inhabitants during the beginning of the transmission season in June 1989 at Pong Nam Ron District, Chanthaburi Province, Eastern Thailand where malaria transmission was likely to be high. Following the cross-sectional survey weekly morbidity surveillance was started to detect new cases of malaria by using active and passive case detection at the district hospital, local health centers and at neighboring malaria clinics. Entomological observations were made monthly to determine inoculation rates.

Forty-six percent of the population were male and 54% female; one third were under the age of 15 and 14% under the age of 5 years. Eighty percent of the adults were married. Sixty percent of the subjects interviewed gave a history of malarial illness in the past. Malaria, malnutrition, abnormal hemoglobin diseases and parasitic infestation were the main health problems in the study area.

The annual parasite incidence of malaria was 149.6/1,000 population and two-thirds of them were asymptomatic indicating a semi-immune condition among these subjects. It was difficult to interpret the results of entomological studies due to low density of the malaria vector.

INTRODUCTION

Malaria has been a major health problem of Thailand for more than the past century (Malaria Division, 1990). Extensive anti-malaria activities with WHO and UNICEF assistance, were started in 1950. The results were quite impressive, and there appears to be a real possibility of eradication. Three major problems that have led to resurgence of the disease include the rapid dissemination of *Plasmodium falciparum* (Pf) strains highly resistant to both 4-aminoquinolines and sulfadoxine-pyrimethamine drugs, the exophilic behavior of malaria vectors, and occupational migration of the people (Pinichpongse, 1986). Present attempts at controlling the disease by drug treatment and other means remain unsatisfactory. Malaria vaccines may offer an alternative weapon for control of the disease (Anonymous, 1981). The objective of this study was to

acquire epidemiological base line data important for the selection of vaccine candidate antigens and the performance of vaccine trials.

MATERIALS AND METHODS

Study area

The study was carried out in two villages (Klong Takon and Na Jork) in a rural area of eastern Thailand, 230 km southeast of Bangkok, where malaria transmission was likely to be high. It lies along the Thai-Cambodia border which is known as highly endemic for multidrug-resistant falciparum malaria. The district is surrounded on the north, east and west by heavily forested mountains. Malaria transmission tends to show seasonal fluctuation. The climatological conditions are characterized as rainy (May-October), cool dry (November-February) and hot-dry (March-April) (Malaria Sector, 1989).

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Study population

Four hundred and fifty-one local inhabitants living in two villages of Pong Nam Ron District were followed. Most of them have a long history of continuous or frequent intermittent exposure to the parasites.

Study design

The cross-sectional descriptive survey was conducted during the beginning of the transmission season in June 1989 to gather base line information including important epidemiological factors (hosts, parasites, vectors and their environment) related to malaria transmission, population at risk and background immune status. A health interview survey was made among 271 studied subjects aged more than 15.

Following the cross-sectional survey, malaria surveillance by active case detection, *ie* weekly morbidity surveillance and monthly thick blood smear for all subjects was carried out regardless of morbidity by field staffs, and passive case detection by health service personnel at provincial and district hospitals and at local health centers.

Baseline assessment

Epidemiological baseline data were recorded. Subjects were examined for splenomegaly, other abnormalities (eg nutritional status) and blood samples were obtained for microscopy, immunological and biochemical investigation.

Malaria surveillance

Parasitological examinations : A thick blood smear was performed for all subjects every month. Two hundred fields using 100 × objectives were carefully examined by well-trained microscopists and if no evidence of malarial parasites was found the smear was declared negative. All the slides were reviewed independently by one of the investigator who was blind to individual subjects. All malaria cases detected by this survey were contacted and given radical treatment in accordance with Malaria Division Policies (mefloquine and primaquine for Pf and chloroquine and primaquine for Pv) (Malaria Division, 1990).

Entomological parameters : Mosquitos were collected regularly three days a month by human bait with

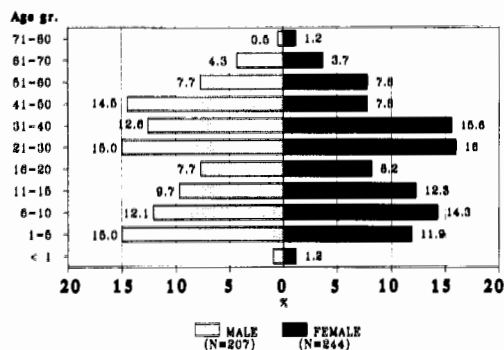


Fig 1—Age and sex distribution of the 451 studied subjects.

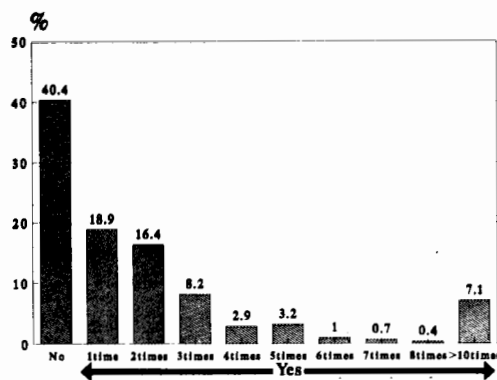


Fig 2—Past history of malaria among interviewed subjects.

a sucking tube. Collections were made between dusk and dawn (1800 to 0600 hours) by 2 collectors serving as bait. All specimens collected on each site were stored in paper lined plastic cups labeled with time, date and site of collection. The specimens were microscopically identified by a qualified entomologist. Mosquitos were also dissected for sporozoites. Man-vector contact was analyzed and related to human infection.

Serological examination : Serological cross-sectional surveys were done twice for all subjects in June 1989 and July 1990. Among those with previous episodes of *P. falciparum* infection, a finger-prick blood samples collected in preheparinized 75 ml capillary tubes were done for serological studies (antibodies against crude *P. falciparum* antigens, antibodies against Pf 155/RESA antigen and antibodies to synthetic peptides) every month. Blood was centrifuged, separated and plasma stored at -20°C until analysis. The result of this study was presented elsewhere.

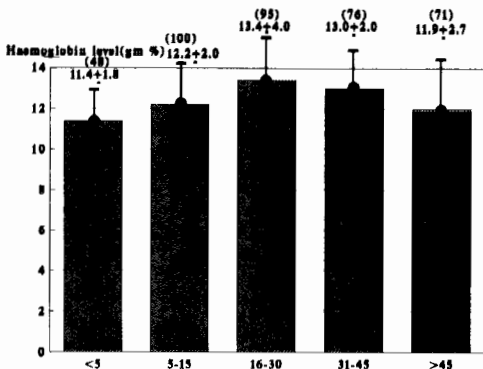


Fig 3--The distribution of hemoglobin by age.

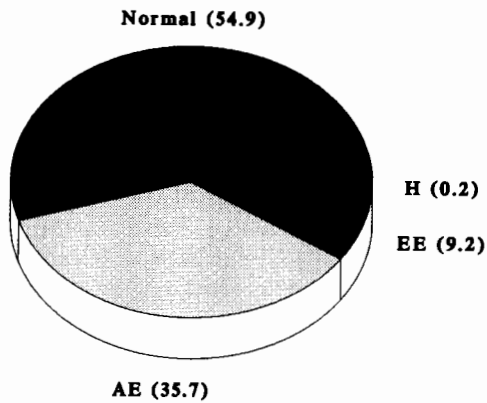


Fig 4--Hemoglobin genotype determination.

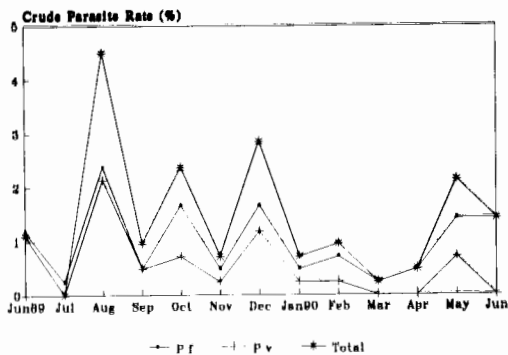


Fig 5--Crude parasite rate by month.

RESULTS

Baseline observations

The age and sex distribution of the 451 subjects studied are shown in Fig 1. Forty-six percent of the

Table 1

Incidence of malaria during 1-year of observation.

No. subjects starting study	451
Subjects completing study (during 1-year of observation)	421
Subjects with malaria	63
Annual Parasite Incidence (API)	149.6
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Total person-week (421 × 52)	21,892
Total malaria episodes	79
Episodes per 1,000/week	3.61
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Species : Pf	55 (69.6%)
Pv	17 (21.5%)
mixed	7 (8.9%)
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Symtomatic cases	27
Asymptomatic cases	52

Table 2

The age-specific parasite rate.

Age group (year)	No.	parasite rate (%)
< 5	14	24.6
5-15	20	17.0
16-40	20	11.7
> 40	9	8.3

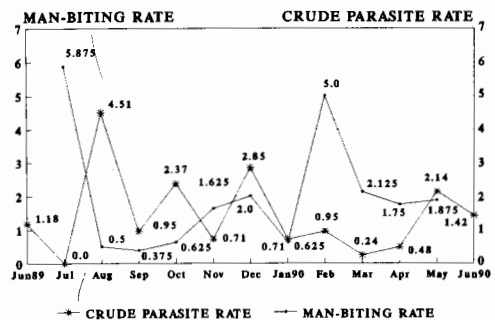


Fig 6--Correlation between man-biting rate and crude parasite rate during 1-year of observation.

population were male and fifty-four percent female; one third were under the age of 15 years and 14% under the age of 5 years. Eighty percent of adults were married. Most subjects (73.4%) had finished grade four level and only 10% had no formal education, 75.3% were farmers and 13% gave a history of working at some time outside the area.

Approximately 60% of the subjects interviewed gave a history of a malaria illness in the past and many had a history of more than one episode (Fig 2). Ninety-three percent gave a history of sleeping under a mosquito net every night while only 3% never slept under a net. The major reason given for not sleeping under a net was that this made it hot and uncomfortable. Only 20% of the population used any other form of personal protection.

On examination only 1% of subjects were found to have splenomegaly. Seventeen percent and 6% of preschool and school children respectively were undernourished using weight for their age as the direct nutritional assessment.

Laboratory examination showed that 36% of the subjects were anemic Hb < 12 gm%. The distribution of hemoglobin by age is shown in Fig 3. Approximately 45% of subjects had an abnormal hemoglobin (Fig 4). The prevalence of hookworm and giardia was 25% and 18% respectively.

Incidence of malaria during one-year period of observation

Among 421 inhabitants, 63 had malaria infection. Thus, the annual parasite incidence (API) equaled 149.6/1,000 population (Table 1). If we counted all malarial episodes, 79 episodes were found. Crude parasite rates by month of observation are shown in Fig 5. We can see trends of fluctuation.

In terms of species specific parasitemia, 55 episodes (69.6%) of falciparum parasitemia and 17 episodes (21.5%) of vivax parasitemia were seen. Two-thirds of the malarial infection cases were asymptomatic (Table 1).

Table 2 shows the incidence of malarial infection decreased with age.

Entomological studies

Anopheles dirus and *Anopheles minimus* were the

main vectors in the study area. The density of *An. minimus* and *An. dirus* were 0.687/man-hours and 0.053/man-hours respectively. Parous rate of *An. dirus* was 76.9% and 58.3% for *An. minimus*. Man-biting rates in correlation with crude parasite rate are shown in Fig 6.

DISCUSSION

Most of the studied subjects were children and young adults of low socio-economic status. Malaria is the most important health problem for such a population. Only a few of them had history of self protection from malaria. Malnutrition, anemia, abnormal hemoglobin diseases and parasitic infestation were also health problems in this area. Some of these conditions may be associated with malaria infection.

During one year of observation, we found that the incidence of malaria was quite high when compared with other areas in the same period of time (Malaria Division, 1990) but the morbidity rate in this area and throughout the country has been greatly reduced when compared with the past years. The steady decrease in morbidity and mortality rates may be due to the expansion of malaria clinics and expansion of primary health care by malaria volunteers, resulting in early diagnosis and prompt treatment in an area of high transmission (Ketrangsee, 1989).

The proportions of parasite species were not different from those found in the whole country.

The fact that the age-specific parasite rate decreased steadily with age may indicate that our study population develop some protective antibodies against malaria during adult life.

Two-thirds of malarial infections were asymptomatic cases indicating that most of the studied subjects were semi-immunes and usually indigenous to an endemic area. These people have a long history of continuous or frequent intermittent exposure to the parasite. The influence of acquired immunity on the course of malaria infection is indicated by the rising clinical threshold, producing little clinical disturbance (Playfair, 1982; WHO Scientific Group, 1968).

Since the observed density of malaria vector in the study area was low, it was difficult to correlate the man-biting rate with the crude parasite rate.

The information obtained from these field studies should be useful to optimize the development of vaccines to the asexual blood stages of *P. falciparum* and will provide epidemiological baseline data for subsequent vaccine trials.

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