STUDY OF THE MALARIA SITUATION IN FORESTED FOOTHILL AND NEARBY PLAIN AREAS OF MYANMAR

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Abstract. A longitudinal demographic-parasitological survey on malaria was conducted at 10 weekly intervals starting from September in one foothill village with the population of 1,095 and one epidemiologically comparable plain village with the population of 962 in Kyauktaga township, Bago division, 120 miles north of Yangon. The objective was to describe and analyse the current malaria situation in a forested foothill area and an adjacent plain area. Ten weekly blood film collections for malaria parasite examination, six monthly sera collections on filter paper for serological examination from the whole study population and ten weekly splenic measurements from 2-9 year children were done.

The malaria parasite rate in the foothill area was invariably higher than that in the plain area in all age groups throughout the study period. Moreover, the parasite rate decreased with the increase in distance from the forested foothill area indicating that the deep forest malaria may have some influence on the foothill villages. The total age specific parasite rate in foothill villages was found to be highest in the 5-8 year age group and decreased as the age advanced which may be due to the increasing immunity. The study revealed the presence of local transmission in the foothill village. From these data it is evident that new village sites should be chosen at least 5 miles away from the forest fringe and the malaria control measures in the plain area should utilize chemoprophylaxis and effective chemotherapy focusing on the people who travel into the forest.

INTRODUCTION

Malaria has a high prevalence in Myanmar, especially in hilly and foothill forest regions. Though the intensity of transmission is not uniform all over Myanmar, it remains at the top of the list of diseases causing high morbidity and mortality.

According to the 1988 Annual Report of the Vector Borne Disease Control Division of Myanmar, 35.5% of the total population of the country live in malaria high risk areas. In 1988, the 4072 recorded deaths represented a 3% case fatality rate.

Malaria control activities have been carried out by stratifying the country into five different strata based on accessibility, development of health infrastructure, malaria prevalence, vector bionomics, results of previous antimalaria activities and availability of resources.

In Myanmar, out of 400 species of anophelines, the one identified as the principal vector in the hills and topographically similar regions in Southeast Asia is *Anopheles dirus* (Khin Maung Kyi, 1971). *An. minimus* also co-exists together with *An. dirus* year-round in the forested foothill areas in Myanmar (Khin Maung Kyi and Winn, 1976; Myo Paing *et al,* 1988).

With the objective of describing and analysing the current malaria situation in a forested foothill area and an adjacent plain area, this study was conducted to find out the relationship among entomological, parasitological and other related factors.

MATERIALS AND METHODS

Study area

The study area is located within Kyauktaga township, Bago division, about 120 miles north of Yangon. It lies on the eastern foothill side of Bago Yoma (mountain range), at longitude 17.59 N and latitude 94.44 E. The annual rainfall is 80 inches

(2032 mm) and the average temperature ranges from 22°C to 38°C.

The study area comprises are one foothill village tract (including 3 villages, Gwe Gone (GG), Khindangyi (KDG) and Ngoato (NGT) and one plain village (Bwetchin, BC). Among the foothill villages, NGT is 0.3 mile, KDG 0.5 mile and GG 1.5 mile from the forest fringe with a total population of 1,095. The plain village (BC) is 5 miles away from the forest fringe with a population of 962. The majority of the people living in both the areas go to the forest for wood and bamboo cutting or leaf and fruit picking as their livelihood. There are no active antimalaria measures within the last 5 years in the study areas.

Field visit

The demographic-parasitological (D-P) surveys were conducted at ten weekly intervals from September 1984 to September 1986.

Activities

Particulars of each household and individual member of the families were recorded by code numbers.

Parasitological activities included (1) collection of blood slides, both thick and thin films, every 10 weeks from all the study population; (2) filter paper blood collection for serology every 6 months and (3) splenic examination (according to Hackett's classification) done on the 2-9 year age group every 10 weeks.

Parasite examination was done over 100 thick film oil fields and malaria antibody titer was measured by immunofluorescent antibody test (IFAT) (Voller and O'Neal, 1971).

Data analysis

Parasitological indices included calculation of parasite rate (PR), parasite density index (PDI), positive parasite density index (PPDI) according to the Garki project (Molineaux and Gramiccia, 1980).

Care of the malaria cases

Presumptive treatment with chloroquine (10 mg/kg) single dose was given to clinically suspected malaria cases. Severe and complicated malaria cases were referred to the nearest station hospital (which is 7 miles away).

RESULTS

The sample coverage rate in both foothill and plain areas were above 92% in all the surveys.

The PR of total, *Plasmodium falciparum (Pf); P. vivax (Pv)* and mixed infection *(Pf + Pv)* were invariably higher in the foothill villages than in the plain village throughout the study period. In both areas, *Pf* constituted more than 80% of the total parasitemia (Fig la,b).

Although foothill data showed no significant sex preponderance, higher male than female parasite rates existed in the plain (Fig 2c). There was no significant difference between male and female parasite rates in the foothill area, which may either be due to similar forest travelling status or to presence of local transmission in the area. In the plain area, male preponderance was observed, which may be due to a higher travel rate of the male population into the forest where they might acquire the infection.

In the foothill area, an increase in PR (total, *Pf, Pv*) above 7% was noted in the monsoon (surveys I and IV) and cold dry seasons (surveys II and VII), whereas in the plain, the increase of PR (total, *Pf, Pv*) was observed in the monsoon season only (surveys I, IV and V).

The cumulative prevalence rate of malaria calculated over ten surveys was higher in the foothill area than in the plain in all age groups (Fig 2a). The maximal cumulative prevalence rate in the foothill area was seen in the 5 to 8 year age group whereas in the plain, it reached its maximum in the 9 to 18 year age group.

The parasite rates in villages with varying distances from the forested foothills showed the highest rate in the nearest village, NGT (0.3 mile from the foothill) intermediate in GG (1.5 miles from the foothill) and lowest in farthest BC (5 miles from the foothill). This finding shows that PR decreases with increase in distance from the forested foothill (Fig 3a).

The PDI for the foothill area was predomi-

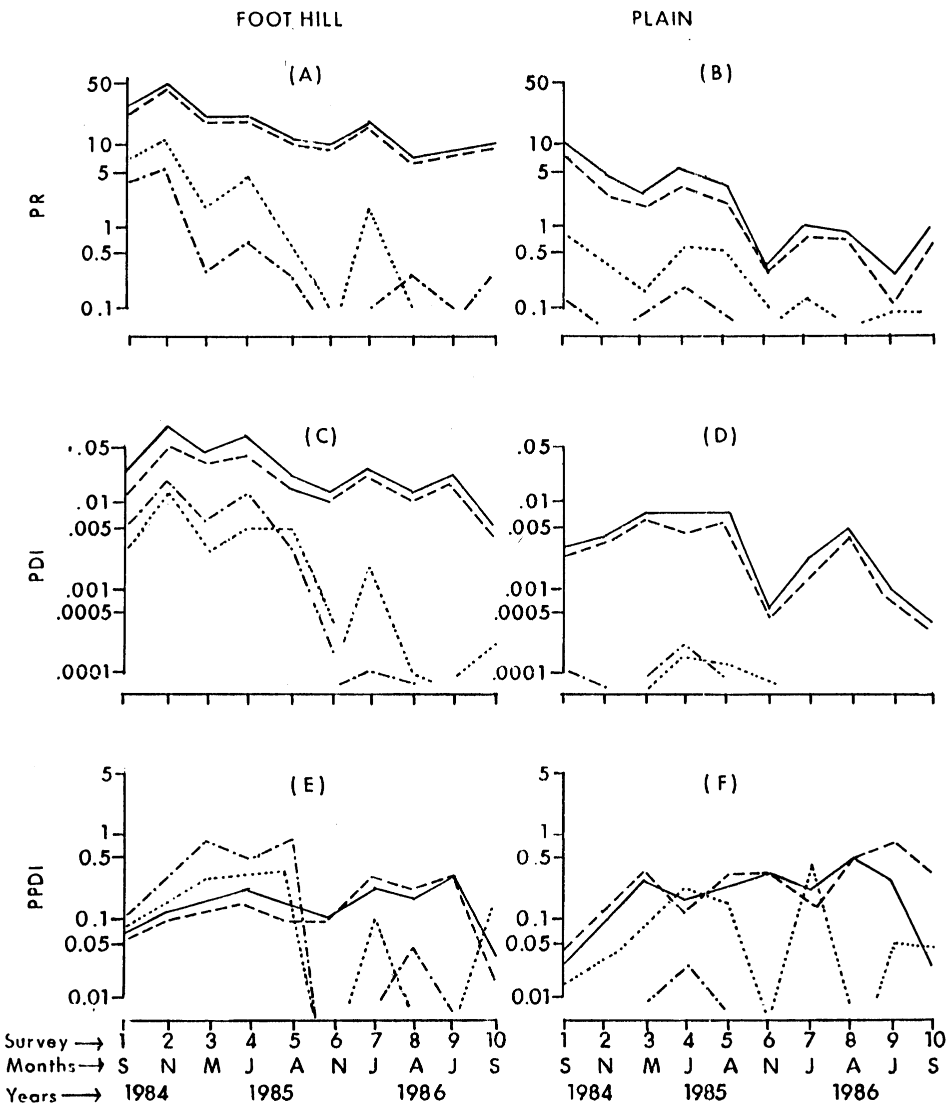

Fig 1—Comparison of parasite rates (PR), Parasite density index (PDR) and Positive parasite density index (PPDI) of foothill and plain areas.

———— Total	– – – – – *P. falciparum*
·············· *P. vivax*	—·—·—·— Mixed

nantly higher than that of the plain area in all the surveys. PDI of *Pf* constituted the major share of the total PDI in both areas. In the foothill area, the total PDI ranged between 0.0003 and 0.091 throughout the study period, reaching its maximum in the cold dry season (survey II, Nov 1984) with slight rises in the monsoon months (surveys IV and IX) (Fig 1c).

In the plain area, the PDI started to increase in the hot dry season (survey III, March 1985), then plateaued out (at 0.005) during the monsoon season (surveys IV and V, June and August 1985). After a drop in November (survey VI) the PDI increased again in hot dry season (survey VII, April 1986) (Fig 1d).

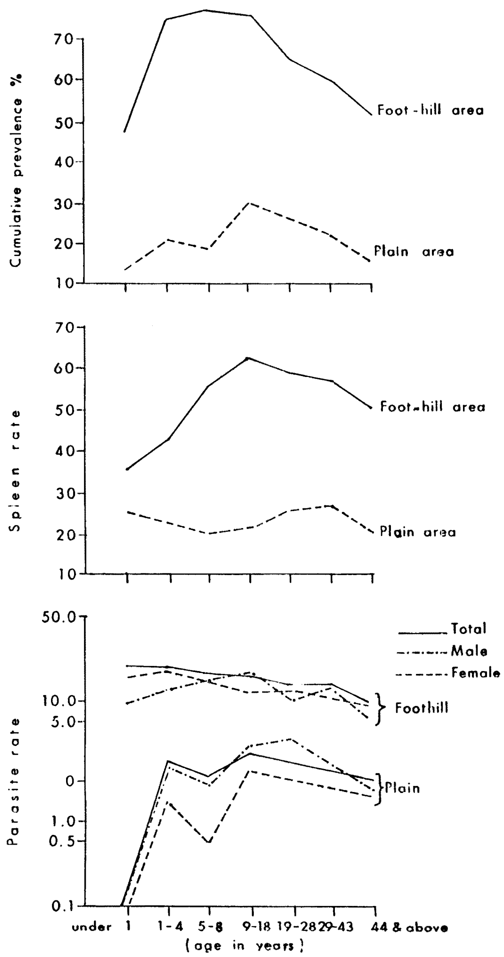

Fig 2—Age specific cumulative, spleen rates and parasite rates, in foothill and plain areas.

The PPDI of *Pf* and *Pv* were comparable in both foothill and plain villages regardless of the dry or wet season. The PPDI of each species in each area showed no difference (Fig 1e, f).

In the plain area, the PPDI in the dry season was higher, particularly in the 9-18 year age group and 19-28 year age groups. However the PPDI appeared to be higher in the foothill in the younger age group (5-8 years and infants).

The gametocyte rate (GR) of the foothill area was invariably higher than that of the plain area as was the PR, showing the presence of a relationship between these two parameters (Fig 3b). The GR was highest in the 1 to 4 year age group in the foothill whereas in the plain area, it was highest in the 9-18 year age group.

Age specific spleen rates of the foothill group were also significantly higher than that of the plain area.

In the foothill area, the spleen rate increased abruptly from the 1 year age group up to the 9 to 18 year age group where it reached its maximum and then plateaued out. However the spleen rate was lower, from 8% to 12%, in the plain area (Fig 2b).

DISCUSSION

The malaria parasite rate in the foothill area was invariably higher than the plain area in all the surveys and in all age groups, indicating that the deep forest malaria may have some influence on the foothill villages. This fact was also verified by the results shown in Fig 3a where the parasite rate decreased with increase in distance from the forested foothill area, which was again supported by the entomological findings of the same study. In this context it is of interest to note that the density of *An. minimus* is related to the distance from the forested foothills (Myo Paing *et al,* 1988).

The high malaria prevalence in the foothill villages may be due to the presence of malaria transmission throughout the whole year.

Rosenberg and Mahesway (1982) showed that malaria foci in the forest are small, isolated holoendemic and subject to very high seasonal inoculation by *An. dirus.* According to our entomological data, *An. minimus* was present throughout the whole year as a potential vector (Myo Paing *et al,* 1988). *An. dirus* was found mainly in the rainy season in the foothill area. However both were absent in the plain area.

In our study, the parasite rate was found to be higher in the first year than the second year in both the areas. The same decreasing trend of malaria in nearby townships (Daik U) has also been reported by regional malariologists (H Gyi, personal communication). This was also verified by entomological findings of the same study revealing a lower man biting rate (range 0.36 to 4.90 in the 1985, compared to that of 7.44 to 9.08 in 1984) (Myo Paing *et al,* 1988).

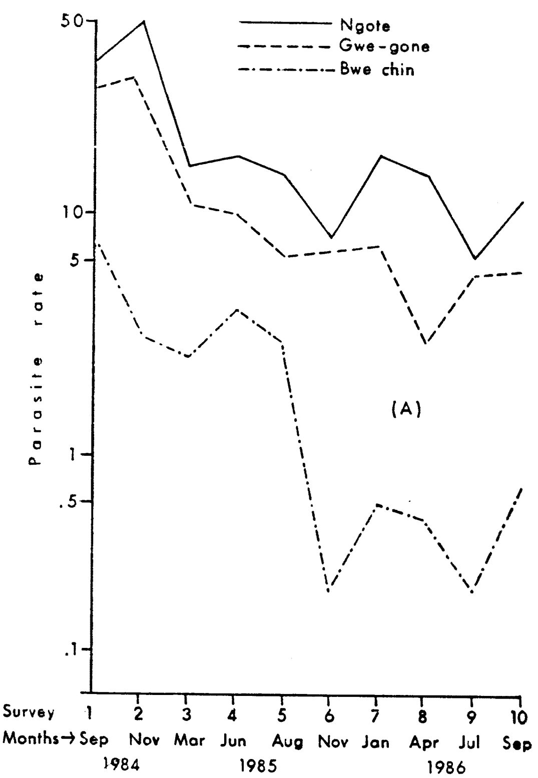

Fig 3a—Comparison of total parasite rates in individual villages of foothill and plain areas.

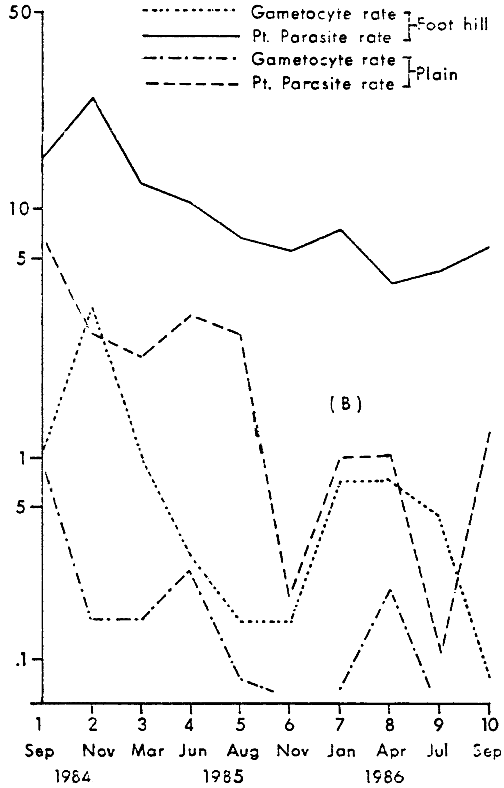

Fig 3b—Comparison of gametocyte rates and parasite rates (Pf) in foothill and plain areas.

The total age specific parasite rate in the foothill villages was found to be highest in the 5-8 year age group and decreased as the age advanced which may be due to the increasing immunity, expressing itself as increasing recovery and decreasing detectability or decreasing susceptibility.

Though there appears to be no local transmission in the plain area, there is evidence indicating local transmission in the foothill villages, such as high spleen rate in the 2-9 year age group, high gametocyte rates in younger age groups, high malaria prevalence rate in the infant age group with a majority of them giving no history of travel into the forest.

PDI has some relationship with the parasite rate in both areas (Fig 1c, d). PDI being on estimate of parasite load in a particular population, it may be useful as an adjunct to parasite rate for assessment of effectiveness of control measures.

PPDI is an estimate of the density of infections in the patients, so it could reflect the severity. Since PPDI in both areas showed no marked differences above 5-8 years age (Fig 1e, f) it is assumed that there is similarity of severity of infections in both areas. This may be due to a similarity of the immune status of the infected cases in the two areas.

High cumulative prevalence (CP) in the middle age group and low CP in the extreme age groups may be due to different immune status. Infants might acquire passive immunity from their mothers whereas in old age groups the immunity may be the result of repeated infections. In the plain area the highest level was obtained at a later age group (ie 9 to 18 years).

Control of malaria in foothill villages should be based on knowledge of the relationship between forest fringe malaria and deep forest malaria. It is suggested that a detailed study should be conducted to find out to what extent the forest malaria is contributing to the prevalence of malaria occurring in forest fringe or foothill villages.

From our findings it is evident that any new village site should be chosen at least 5 miles away from the forest fringe. Constitution of vector control measures against *An. minimus* and *An. dirus* in the foothill villages may need to be reconsidered.

In the plain areas, the control of malaria should be by chemoprophylaxis and effective chemotherapy focusing on the forest travellers only.

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