# CHLOROQUINE SENSITIVITY OF *PLASMODIUM FALCIPARUM IN* BERAKIT, BINTAN ISLAND, SUMATRA, AFTER MASS CHEMOPROPHYLAXIS THROUGH COMMUNITY PARTICIPATION, AND ITS SOCIOLOGICAL STUDIES.

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***ABSTRAK***

***SENSITIVITAS KLOROKUIN TERHADAP* PLASMODIUM FALCIPARUM *DI BERAKIT, PULAU BINTAN, SUMATERA, SETELAH PENGOBATAN MASAL MELALUI PERAN SERTA MASYARAKAT, DAN STUDI SOSIOLOGI***

*Profilaksis minggguan dengan klorokuin yang dilakukan secara massal melalui peran serta masyarakat telah dilakukan pada penduduk RK I di desa Berakit, Bintan, Propinsi Riau, Sumatra selama dua tahun (1983-1985). Delapan tahun kemudian (1993), pemeriksaan sensitivitas* Plasmodium falciparum *terhadap klorokuin in vivo dan in vitro dilakukan di RK I untuk mengetahui apakah pemberian klorokuin setiap minggu pada penduduk secara massal selama 2 tahun mempunyai dampak terhadap timbulnya resistensi* P. falciparum *terhadap obat tersebut di RK I atau dapat menyebar-luaskan resistensi klorokuin.*

*Penelitian sosial dilakukan untuk mendapatkan informasi melalui pemeriksaan pengetahuan, sikap dan perilaku (KAP) tentang malaria pada penduduk RK II di desa Berakit. RK II letaknya bersebelahan dengan RK I yang penduduknya telah diwawancara dan diberi penyuluhan kesehatan dengan "learning module" tentang malaria, dan. apakah hal ini mempengaruhi situasi/keadaan malaria di RK II.*

*Hasil penelitian malariometrik di RK I dan RK II menunjukkan angka limpa dan angka parasit menurun secara bermakna, bila dibandingkan dengan hasil pada tahun 1991 tetapi di RK I tidak berbeda bermakna dibandingkan dengan hasil tahun 1995.*

*Dari pemeriksaan 644 sediaan darah dari RK I dan RK II untuk tes sensitivitas, prevalensi parasitnya adalah 8.2 % (53/644) dan 58.5 % kasus positif adalah* P. falciparum *dan infeksi campur, selebihnya adalah* P. vivax *(41.5 %). Sayang sekali, hanya satu infeksi* P. falciparum *yang memenuhi syarat untuk tes dengan hasil S/R I* in vivo *7 hari yang disederhanakan. Tes mikro* in vitro *menunjukkan resistensi (R) terhadap klorokuin dan masih sensitif (S) terhadap obat malaria lain (kina, S-P, meflokuin).*

*Hasil pemeriksaan sosiologis menunjukkan adanya pengaruh "learning module" mengenai penyakit malaria sebanyak 20 % responden di RK II yang mempunyai sikap dan perilaku yang positif, bila dibandingkan dengan penelitian di RK II tahun 1991 sebesar 27.9 % dan tahun 1995 sebesar 47.9%. Hal ini dapat tercermin pada hasil malariometrik di RK II . Walaupun demikian, masih diperlukan penyuluhan kesehatan tentang malaria untuk penduduk RK II. Perlu diketahui bahwa setelah penelitian selesai sampai dilakukan evaluasi tahun 1991 dan tahun 1993, di daerah ini tidak pernah dilakukan intervensi dalam bentuk apa pun kecuali satu kali penyemprotan pada tahun 1992.*

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## INTRODUCTION

Berakit Village, a malaria endemic area, is situated in the northeastern coast of the island Bintan in the Regency (District) of Riau Islands, Riau Province, Indonesia. The village is 70 km from the capital Tanjung Pinang (Fig 1). The area of this village is 107.25 km2. It consists of 3 RK's (subvillages). RK I, situated in the northern part of Berakit Village, has 5 RT's (neighbourhood units). RK II , in the south central part of the village, adjacent to RK I, has 3 RT's and RK III is spread out in the south western part. According to the 1980 census, the population of Berakit Village was 1.649 (850 males and 799 females) consisting of 375 families. About 45 % of the people live in RK I and the remaining live in RK II and RK III (Fig 2)[1].

Study of malaria control with weekly chloroquine mass-prophylaxis through community participation, was carried out in RK I of Berakit Village during a period of 1983 to 1985, along with another study evaluating community participation with health education in the same area. After two years intervention spleen and parasite rates were significantly decreased[1,2,3,4]. During the period of 1986 to 1990 the key persons and the community were expected to continue with malaria control activities according to the limited knowledge of malaria they have gained during intervention study in 1983 - 1985. In 1991, five years after the sudy was terminated, evaluation was carried out in the same village to know about the malaria situation. Although health education was given to key persons and the community with the aid of a simple learning module to keep the malaria down, community participation deteriorated because of many problems/factors. As a result, spleen and parasite rates increased again, but still lower than before intervention in 1983[5]. One of the factors of this increase could be the emergence of chloroquine resistant P. falciparum in this area was due to long term (2 years) weekly chloroquine mass prophylaxis .Malaria intervention in any form has never been conducted in this area during the period of 1985 and 1993 except by the community and house spraying was done once in 1992 by the health authorities.

For this reason, in 1993 sensitivity study was carried out in this village, and it also evaluated the social aspects whether intervention with the learning module about malaria that was used in 1983 – 1985 in RK I as a tool for health education, has an impact on the malaria situation in the neighbourhood of RK II. It should be borne in mind that health education about malaria and other kinds of intervention have never been conducted in RK II except insecticide house spraying in both RK's in 1992 by the local health authorities.

## OBJECTIVES

The objective of this study was :

1. to know whether weekly chloroquine mass prophylaxis during a period of 2 years (1983 – 1985) given to the population of RK I would have an impact on the existence and spread of chloroquine resistant *P. falciparum* or reduce resistance in this area (RK I)
2. to obtain information through KAP (knowledge, attitude and practice) studies about malaria among people living in the adjacent village of RK II, whether intervention with a learning module for health education given to the population of RK I, could have an influence in RK II.

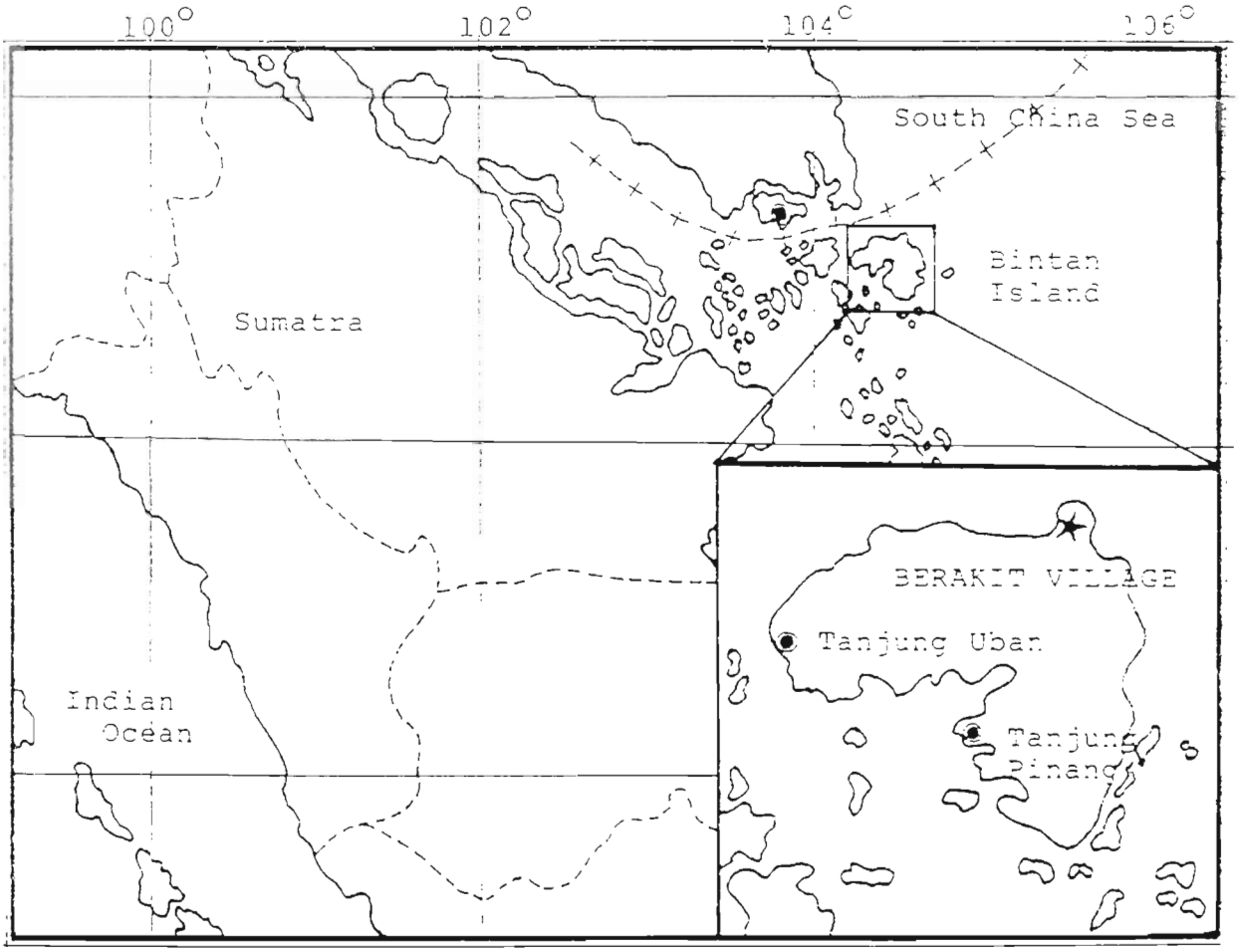


**Fig 1. Geographic situation of Berakit village**

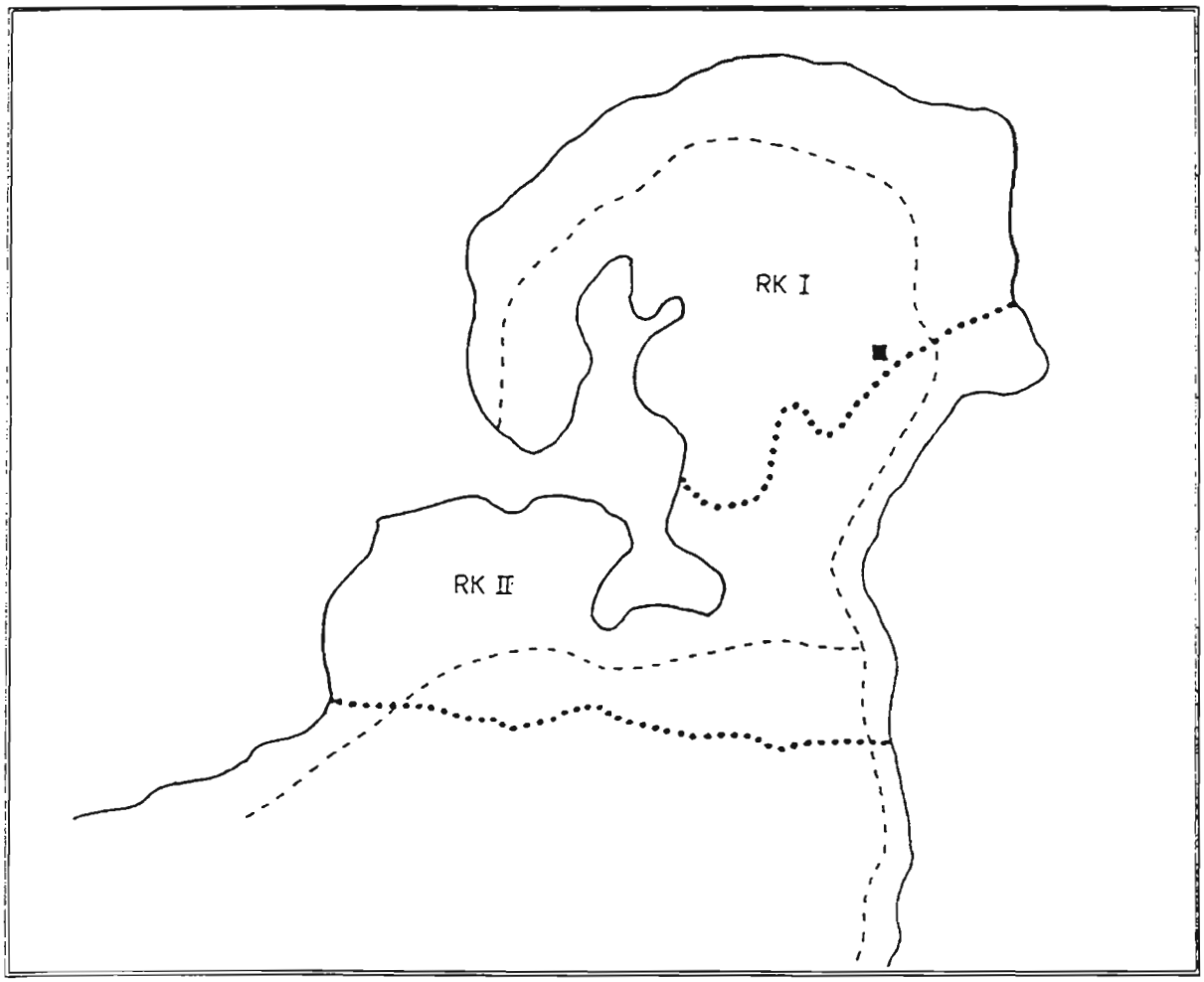


Fig 2. Map of Berakit village

## METHODOLOGY

### Site of study

The study was conducted on July 11 through 17, 1993 in RK I, consisting of RT 1, 2, 3, 4 and 5, and RK II with its RT 6, 7 and 8 of Berakit village, situated on the north eastern part of Bintan Island, Riau Island Regency {District}, Riau Province, (Fig. 1). RK III was not included in the study.

### A. Biomedical studies

1. Malariometric survey

Villagers of RK I of RK II were examined clinically for determination of spleen rates with the Hackett method. Blood specimens for identification of malaria parasites were collected by finger prick method. Thick and thin smears were made and stained with the conventional Giemsa method. Spleen and parasite rates were analyzed with the chi square test.

2. Sensitivity study

In vivo and micro in vitro sensitivity tests of *P. falciparum* to chloroquine and eventually other antimalarials were conducted according to the WHO method 6,7 . Selection of positive falciparum malaria cases was carried out by blood examination of 644 out of 1449 inhabitants of RK I and RK II. Out of 53 malaria positive cases, 31 had *P. falciparum* infection, but only 1 falciparum case met the requirement for the in vivo and micro in vitro sensitivity test. And on another patient - an infant of 11 months old - the simplified 7 day in vivo test could not be completed.

### B. Sociological studies

Heads of households of RK 1 who have been respondents for the previous studies in 1983 through 1985 and in 1991, and heads of households of RK II who have never been respondents of these studies, were interviewed house to house with a set of questionnaires to obtain information about the change in their knowledge, attitude and practice towards malaria and the use of the learning module. Data collections were done by 2 skilled interviewers. The results were analyzed and described qualitatively as well as quantitatively.

## RESULTS

### A. Results of biomedical studies

The results of spleen examination carried out in RK I for all participants showed an overall spleen rate of 25.5% and for the 2 - 9 year old children it was 27.1%, while the overall parasite rate was 9.0% and the rate for 2 - 9 year old was 8.3% (Table 1).
The villagers of RK II, as a control group with no malaria intervention of any kind, had an overall spleen rate of 19.1% with 17.4 % for the 2 - 9 years old and the parasite rates respectively were 8.7% and 17.4% (Table 1).

The overall parasite formula in RK I was 68.0% for *P. falciparum* and 32.0% for *P. vivax*, while that of children between 2 - 9 years was 57.1% for *P. falciparum* and 42.9% for *P. vivax* (Table 2). In RK II, *P. falciparum* was 40.0% and 25.0% respectively for overall and 2 - 9 year old group. *P. vivax* was 50.0% and 75.0%, and *P. malariae* 10.0% and 0% respectively (Table 2).

**Table 1. Spleen and parasite rates in different age groups in RK I and RK II, Berakit village, Bintan Island, Riau Province, July 1993.**

| Age group (years) | RK I | | RK II | |
|---|---|---|---|---|
| | Spleen rate | Parasite rate | Spleen rate | Parasite rate |
| 0 – 4 | 11.5 % (3/26) | 3.8 % (1/26) | 14.3 % (2/14) | 14.3 % (2/14) |
| 5 – 9 | 35.3 % (12/34) | 17.6 % (3/34) | 13.3 % (2/15) | 20.0 % (3/15) |
| 10 – 14 | 40.7 % (24/59) | 13.6 % (8/59) | 10.0 % (2/20) | 15.0 % (3/20) |
| > = 15 | 18.4 % (29/158) | 6.3 % (10/158) | 24.2 % (16/66) | 3.0 % (2/66) |
| Total | 25.5 % (68/277) | 9.0 % (25/277) | 19.1 % (22/115) | 8.7 % (10/115) |
| Age group (years) | | | | |
| 0 - < 1 | 20.0 % (1/5) | 0 % (0/5) | 0 % (0/3) | 33.3 % (1/3) |
| 1 - < 2 | 14.3 % (1/7) | 0 % (0/7) | 0 % (0/3) | 0 % (0/3) |
| 2 – 9 | 27.1 % (13/48) | 8.3 % (4/48) | 17.4 % (4/23) | 17.4 % (4/23) |

**Table 2. Parasite species in different age groups and parasite formula in RK I and RK II, Berakit village, Bintan Island, Riau Province, July 1993.**

| | Parasite species | | | | | Parasite formula | | |
|---|---|---|---|---|---|---|---|---|
| | *P.falciparum* | *P. vivax* | *P. malariae* | Mixed | Total | *P. falc.* | *P. vivax* | *P. mal.* |
| RK I (intervention group) | 17 | 8 | 0 | 0 | 25 | 68.0 % (17/25) | 32.0 % (8/25) | 0 |
| RK II (control group) | 4 | 5 | 1 | 0 | 10 | 40.0 % (4/10) | 50.0 % (5/10) | 10.0% (1/10) |

**Spleen Rates**

Table 3 showed spleen rates in RK I and RK II examined in 1983 before intervention, in 1985, two years after intervention with weekly chloroquine mass prophylaxis, in 1991, evaluation five years after termination of the study, and in 1993.

The overall spleen rate and spleen rate of 2 – 9 years old in RK I examined in 1993, showed a significant decrease when compared with spleen rates in 1991 ($p>0.01$ and $0.02 < p < 0.05$ respectively), and did not differ significantly with spleen rates of 1985 ($p < 0.05$ and $p > 0.05$ respectively).

**Tabel 3. Spleen rates in RK I and RK II, Berakit village**

| Spleen rates | Before intervention Nov. 1983 | After intervention Nov. 1985 (2 yrs) | After the end of intervention July 1991 (5 ½ yrs) | July 1993 (7 ½ yrs) |
|---|---|---|---|---|
| RK I : | | | | |
| Overall | 54.3 % (287/529) | 21.8 % (109/500) | 35.4 % (133/372) | 25.5 % (68/277) |
| 2 – 9 | 69.2 % (10/159) | 27.6 % (40/145) | 45.9 % (39/85) | 27.1 % (13/48) |
| RK II . | | | | |
| Overall | 47.5 % (58/122) | NE | 53.0 % (70/132) | 19.1 % (22/115) |
| 2 – 9 | 65.2 % (30/46) | | 67.6 % ( 23/34) | 13.8 % (4/29) |

NE = not examined

Moreover the overall spleen rate and spleen rate of 2 – 9 years old in RK II also examined in 1993 showed a very significant reduction, compared to that in 1991 ($p < 0.01$ and $p < 0.01$ respectively).

**Parasite Rates**

Table 4 shows parasite rates in RK I and RK II from examination in 1983, 1985, 1991 and 1993. The overall parasite rate and parasite rate of 2 – 9 years old group of RK I examined in 1993 decreased very significantly compared to results of examination in 1991 ($p < 0.01$ and $p < 0.01$ respectively), on the other hand, the overall parasite rate increased significantly compared to that in 1985 ($p < 0.01$), whereas the parasite rate of 2 – 9 years old not sigificantly different ($p < 0.05$).

In RK II however, only the overall parasite rate in 1993 was significantly reduced compared to one from 1991 ($0.02 < p < 0.05$). The parasite rate in the 2 – 9 years old group did not differ significantly ($p > 0.05$).

**Sensitivity studies**

The total parasite rate from 644 blood specimens was 8.2% (53/644) and in the age group of 0 - 9 years it was 9.6% with infant parasite rate of 7.7% (1/53). A total of 58.5% consisted of *P. falciparum* and mixed infection and 41.5% *P. vivax*. Gametocytes were found in 24 falciparum cases but with low density. One positive *P. falciparum* case was an infant of 11 months old from RT 6 in RK II, indicating ongoing transmission . Unfortunately only one *P. falciparum* case met the requirement for simplified in vivo 7 day test and micro in vitro test.

The results were as follows :

a. simplified in vivo 7-day test to chloroquine[6] : S/RI
b. micro in vitro test [7]
   - chloroquine : R (resistant)
   - mefloquine : S (sensitive)
   - quinine : S (sensitive)
   - S - P (sulfadoxine-pyrimethamine) : S (sensitive)

**Table 4. Parasite rates in RK I and RK II, Berakit village**

| Parasite rates | Before intervention | After intervention | After termination of intervention | |
|---|---|---|---|---|
| | November 1983 | November 1985 (2 years) | July 1991 (5 ½ years) | July 1993 (7 ½ years) |
| In RK I : | | | | |
| Overall | 13.2 % (70/529) | 2.6 % (13/500) | 22.3 % (83/372) | 9.0 % (25/277) |
| 2 – 9 years | 24.5 % (39/159) | 6.9 % (10/145) | 38.8 % (33/85) | 8.3 % (4/48) |
| In RK II : | | | | |
| Overall | 35.2 % (43/122) | NE | 18.2 % (24/132) | 8.7 % (10/115) |
| 2 – 9 years | 54.3 % (25/46) | NE | 32.4 % (11/34) | 17.4 % (4/23) |

The similar simplified 7-day in vivo test was carried out on another patient, the above mentioned 11 months old infant with falciparum malaria. It showed an initial parasite count of 115 per 300 leukocytes. The patient did not show up on Day 3 and 7. However, on Day 9 and 10 the patient became feverish. The patient's blood was examined and showed higher count of asexual *P. falciparum* parasites (178/300 leukocytes). It could be assumed that the parasite was R I resistant with an early recrudescence. This infant - of course - was not qualified for the in vitro test.

**B. Results of sociological studies.**

Most of the respondents were natives in RK I (62.2 %) as well as in RK II (66.7%) while the remaining percentages were newcomers from Java, West Sumatra, Ujung Pandang, Maluku and a few of Chinese origin (Table 3). The majority of the population in RK I and RK II were Moslems (95.8 % and 72.9 % respectively) whereas others were Christian, Confucian, and Buddhist. The educational level of the respondents was relatively low (Table 5). The percentage of illiterates in RK II was lower (14.5 %) compared to RK I (41.8 %). The majority of respondents in RK I and RK II were farmers (74.0 % and 83.3 % respectively) and some were fishermen (14.2 % and 10.4 % respectively) while the remainings were entrepreneurs ( 10.2 % and 4.2 % respectively ), government civil servants or office workers ( 1.6 % and 2.1 % respectively ) ( Table 5 ).

Knowledge, Attitude and Practice ( KAP ) study

Most of the respondents were familiar with the word malaria and the disease. In RK I, information about the disease was obtained from key persons (31.3 %), malaria learning module (20.4 %), malaria research team (13.4 %), school (13.4 %), families and relatives (13.4%), health workers (6.3 %) and radio/TV broadcast (1.6 %) (Table 6).
On the contrary, in RK II the majority of respondents were informed about the disease through the mantri (male nurse practitioner) who was head of the subhealth center in Berakit since 1983 (34.0 %), the radio and TV broadcasts (17.4 %), their families and relatives (17.4 %). It was interesting to know that a sufficient number of respondents (20.0 %) knew the disease from the malaria learning module that was only distributed to the heads of the households in RK I. Only a small number obtained the information from key persons of RK I (5.2 %) or from school (7.8 %) Table 6).

**Table 5. Characteristics of respondents in RK I and RK II according to origin, level of education, main occupation and housing**

| Characteristics of respondents | | RK I | RK II |
|---|---|---|---|
| Origin | Natives | 62.2 % (79/127) | 66.7 % (32/48) |
| | Newcomers | 37.8 % (48/127) | 33.3 % (16/48) |
| Level of Education | No schooling | 41.8 % (53/127) | 14.5 % (7/48) |
| | Primary school drop out | 31.5 % (40/127) | 54.2 % (26/48) |
| | Primary school graduates | 17.3 % (22/127) | 18.8 % (9/48) |
| | Junior high school graduates | 5.5 % (7/127) | 8.3 % (4/48) |
| | Senior high school graduates | 3.9 % (5/127) | 4.2 % (2/48) |
| Main Occupation | Farmers | 74.0 % (94/127) | 83.3 % (40/48) |
| | Government civil servants | 1.6 % (2/127) | 0 |
| | Office workers | 0 | 2.1 % (1/48) |
| | Entrepreneurs | 10.2 % (13/127) | 4.2 % (2/48) |
| | Fishermen | 14.2 % (18/127) | 10.4 % (5/48) |

**Tabel 6. Source of knowledge about malaria of respondents in RK I and RK II.**

| Source from | RK I | | RK II | |
|---|---|---|---|---|
| | n | % | n | % |
| 1. Key persons of RK I | 40 | 31.5 | 6 | 5.2 |
| 2. Malaria learning module | 26 | 20.4 | 23 | 20.0 |
| 3. Malaria team from Jakarta | 17 | 13.4 | - | - |
| 4. School | 17 | 13.4 | 9 | 7.8 |
| 5. Families / relatives | 17 | 13.4 | 20 | 17.4 |
| 6. Health workers | 8 | 6.3 | 35 | 30.4 |
| 7. Radio / TV broadcast | 2 | 1.6 | 20 | 17.4 |
| 8. Others | - | - | 2 | 1.8 |
| | 127 | 100 | 115* | 100 |

* Respondents may have more than one answer

About the signs and symptoms of malaria,most of the respondents of RK I and RK II were already familiar with the main symptoms of malaria, i.e. fever and chills (63.8 %) and 43.7 % respectivey) and in RK I enlargement of the left abdomen (25.2 %) but in RK II only 4.8 %.
Although malaria health education was given in RK I by the malaria team in 1983, a sufficient percentage of respondents (11.0 %) still did not know about the signs and symptoms of malaria, while in RK II without any health education of the malaria team, the percentage was only 1.9 % (Table 7).

In RK I as well as in RK II the respondents knew that mosquitoes transmitted the disease (64.6 % and 83.3 % respectively). Still 35.4 % of the respondents in RK I were not familiar with it (35.4%) in contrast to only 6.3 % in RK II.

Many of the respondents in RK I and RK II had malaria before (70.9 % and 72.9 % respectively). At the time of interview 48.0 % of respondents in RK I stated that there was someone in the family who was having malaria and in RK II 37.5 % . Their attitude and practice towards the malaria patients were outlined in Table 8.

When a member of the family contracted the disease, most of the respondents would take the patient to the subhealth center (67.7 % in RK I and 50.0 % in RK II). In RK II, 33.3 % of the respondents took the patient to the mantri, but in RK I still tried to treat the patient by themselves (22.8 % and 16.7 % respectively).

**Tabel 7. Knowledge about signs and symptoms of malaria in RK I and RK II.**

| Sign and symptoms | RK I | | RK II | |
|---|---|---|---|---|
| | n | % | n | % |
| 1. Fever and chills | 81 | 63.8 | 45 | 43.7 |
| 2. Fever, headache | - | - | 8 | 7.8 |
| 3. Protruding upper left abdomen | 32 | 25.2 | 5 | 4.8 |
| 4. Paleness | - | - | 18 | 17.5 |
| 5. Anorexia | - | - | 15 | 14.6 |
| 6. Prostration | - | - | 10 | 9.7 |
| 7. Do not know | 14 | 11.0 | 2 | 1.9 |
| | 127 | 100 | 103* | 100 |

* Respondents may have more than one answer.

**Table 8. Decision and measures taken in the case of a malaria patient in the house.**

| | RK I | | RK II | |
|---|---|---|---|---|
| | n | % | n | % |
| 1. First step : | | | | |
| a. try to treat patient by themselves | 29 | 22.8 | 8 | 16.7 |
| b. take patient to mantri | 6 | 4.7 | 16 | 33.3 |
| c. take patient to Puskesmas | 86 | 67.7 | 24 | 50.0 |
| d. take patient to the doctor | 4 | 3.2 | - | - |
| e. drink traditional bitter medicine | 2 | 1.6 | - | - |
| | 127 | 100 | 48 | 100 |
| 2. Decision taken to treat patient by : | | | | |
| a. wife | 16 | 12.6 | 9 | 18.8 |
| b. husband | 111 | 87.4 | 39 | 81.2 |
| | 127 | 100 | 48 | 100 |
| 3. Drugs used : | | | | |
| a. modern medicine | 120* | 94.5 | 41** | 85.4 |
| b. traditional medicine | 7 | 5.5 | 7 | 14.6 |

* chloroquine
** malaria pills

The decision who would treat the patient was dominated by the husbands (87.4 % in RK I and 81.2 % in RK II) and most of the respondents used the modern drugs instead of the traditional ones (94.5 % in RK I and 85.4 % in RK II).
All respondents stated that the patients were cured (100 % in RK I and RK II).
About the question whether the sickness would affect the work, 65.4 % of RK I and 89.6 % of RK II respondents agreed. When a child was sick with malaria, 52.0 % of RK I stated that the child could not attend school while only 6.3 of RK II agreed with the statement; and 48.0 % of RK I and 93.7 % of RK II respondents stated that they could not work. A large percentage of respondents stated that when they had malaria, they felt disturbed because they were not able to do their work (65.4 % in RK I and 89.6 % in RK II).

Knowledge of breeding places of the malaria vector appeared to be different in RK I and RK II; 66.4 % respondents of RK I and only 22.1 % of RK II stated that the breeding places were the ditches abundant among the coconut trees; in contrast 68.4 % respondents of RK II stated that the breeding places were stagnant pools, while 35.4 % respondents of RK I did not know about breeding places in contrast to 3.9 % of RK II (Table 9).

**Table 9. Knowledge about the breeding places of vectors and how to eliminate.**

| | RK I | | RK II | |
|---|---|---|---|---|
| | n | % | n | % |
| 1. Breeding places of larvae : | | | | |
| a. bushes | - | - | 7 | 9.1 |
| b. ditches | 82 | 64.6 | 17 | 22.1 |
| c. stagnant pools | - | - | 45 | 58.4 |
| d. used tin cans | - | - | 5 | 6.5 |
| e. do not know | 45 | 35.4 | 3 | 3.9 |
| | 127 | 100 | 77* | 100 |
| 2. How to eliminate the larvae (only for RK II respondents) | | | | |
| a. chemical agents (solar, karosene, herbicides) | | | 7 | 12.7 |
| b. filling and drying of breeding places | | | 39 | 70.9 |
| c. planting of mangrove trees at the breeding places | | | 1 | 1.8 |
| d. cleaning of environment with pesticides | | | 8 | 14.6 |
| | | | 55* | 100 |
| 3. Adult mosquitoes can be destroyed | | | | |
| a. yes, but difficult to do it | 91 | 71.7 | 32 | 66.7 |
| b. yes, very easy | 20 | 15.7 | 15 | 31.3 |
| c. no | 16 | 12.6 | 1 | 2.0 |
| | 127 | 100 | 48 | 100 |

* Respondents may have more than one answer.

Respondents of RK I and RK II stated that the adult mosquitoes could be destroyed or killed although quite difficult (66.7 % and 71.7 % respectively). In RK II, 70.9 % of the respondents suggested by filling and drying the breeding places when asked. But respondents of RK I and RK II (50.4 % and 75.0 % respectively) never cleaned up or cleared the environment collectively because of the large areas around their houses.

A large percentage of respondents mentioned that malaria could be prevented (75.0 % in RK I and 86.6 % in RK II) (Table 10). Preventive measures against malaria could be carried out according to 86.6 % of respondents in RK I and 75.0 % in RK II with drug prophylaxis to prevent malaria according to 86.6 % of respondents in RK I and 39.1 % in RK II.

**Table 10. Knowledge and behavior about prevention of malaria in RK I and RK II.**

| | RK I | | RK II | |
|---|---|---|---|---|
| | n | % | n | % |
| 1. Malaria can be prevented : | | | | |
| a. yes | 110 | 86.6 | 36 | 75.0 |
| b. probably yes | - | - | 6 | 12.5 |
| c. no | 17 | 13.4 | 3 | 6.2 |
| d. do not know | - | - | 3 | 6.3 |
| | 127 | 100 | 48 | 100 |
| 2. How to prevent malaria : | | | | |
| a. with traditional medicine | - | - | 31 | 45.0 |
| b. take anti malaria pills regularly | 110 | 86.6 | 27 | 39.1 |
| c. take pills + traditional medicine regularly | - | - | 5 | 7.2 |
| d. can not be prevented | 17 | 13.4 | 1 | 1.4 |
| e. do not know | - | - | 5 | 7.3 |
| | 127 | 100 | 69* | 100 |
| 3. How to prevent mosquito bites : | | | | |
| a. sleep under the bed nets | 33 | 26.0 | 27 | 27.8 |
| b. burning mosquito coils | 85 | 66.9 | 48 | 49.5 |
| c. spraying with insecticides | 3 | 2.4 | 12 | 12.4 |
| d. using repellents | 1 | 0.8 | 1 | 1.0 |
| e. make a bonfire | 4 | 3.1 | 9 | 9.3 |
| f. iron screen | 1 | 0.8 | - | - |
| | 127 | 100 | 97* | 100 |
| 4. The cost to prevent mosquito bites (per month) | | | | |
| a. Rp. 500,- - Rp. 1,000,- | 33 | 26.0 | 9 | 18.8 |
| b. Rp. 1,001,- - Rp. 2,000,- | 57 | 44.9 | 25 | 52.0 |
| c. Rp. 2,001,- - Rp. 3,000,- | 28 | 22.0 | 13 | 27.1 |
| d. > Rp. 3,000,- | 9 | 7.1 | 1 | 2.1 |
| | 127 | 100 | 48 | 100 |

* Respondents may have more than one answer.

Protection against mosquito bites was mostly done with mosquito coils (66.9 % in RK I and 49.5% in RK II), the use of bed nets (26.0 % in RK I and 27.8 % in RK II ) and some with repellents or fire smoke.
The cost to prevent mosquito bites was between Rp.1000.- and Rp. 2000.- per month according to 44.9% of RK I and 52.0 % of RK II respondents and between Rp. 2000.- and Rp. 3000.- per month according to 22.0 % of RK I and 27.1 % of RK II respondents.

The learning module distributed in 1983 to heads of households in RK I was known to 47.9 % of RK II respondents and they were of the opinion that it was very useful for improvement of their knowledge about malaria (Table 11).

Insecticide house spraying has been carried out once according to 90.6 % and 95.8 % of RK I and RK II respondents respectively. In addition, 75.6 % and 85.4 % respondents of both RK's respectively mentioned that they never received any information about malaria from health workers.

## DISCUSSION

In July 1993, the second evaluation of the malaria situation in Berakit Village, Riau Islands Sumatra, showed no significant difference ($p > 0.05$) in the spleen and parasite rates between populations of RK I as well as of RK II (Table 1), although RK II did not have any intervention before., except insecticide

**Table 11. Intervention and visits of health workers in RK I and RK II.**

| | RK I | | RK II | |
|---|---|---|---|---|
| | n | % | n | % |
| 1. Knowledge and importance of malaria learning module : | | | | |
| a. Yes | 112 | 88.2 | 23 | 47.9 |
| b. No | 15 | 11.8 | 25 | 52.1 |
| | 127 | 100 | 48 | 100 |
| 2. Insecticide spraying : | | | | |
| a. Ever done | 115 | 90.6 | 46 | 95.8 |
| b. Never done | 12 | 9.4 | 2 | 4.2 |
| | 127 | 100 | 48 | 100 |
| 3. Health education : | | | | |
| a. Yes | 31 | 24.4 | 7 | 14.6 |
| b. No | 96 | 75.6 | 41 | 85.4 |
| | 127 | 100 | 48 | 100 |

house spraying once in 1992 (5). Probably because of the geographical situation of RK II which is more favorable (less isolated) than RK I (see Fig 2) so that communication was more intensive. Moreover, according to sociological study the malaria kowledge in RK II was quite sufficient, even without any health education about malaria to the inhabitants. It could be due to their significantly higher level of education compared to RK I and by the less isolated location of RK II.

Spleen and parasite rates in RK I, evaluated in 1991 were increased significantly compared to rates in 1985, 5 ½ years after intervention study was terminated 1,2,3,4,5 However, in 1993, only two years after, spleen rates were back to rates of 1985 (Table 3). This was also the case with the parasite rate of 2-9 years old children. The overall parasite rate was significantly higher than that in 1985 ($p < 0.01$), but again significantly reduced compared to that in 1991 (Table 4). It was mentioned in the previous report 5 that in an area where intervention or control of malaria with community participation was carried out, evaluation studies should be conducted at least two years after intervention was terminated. Constraints and problems of key persons and the community in their participation of malaria control was solved as was experienced in the first evaluation study where no malaria drugs were available in this village for a certain period of time. As a result, malaria control activities of key persons started to deteriorate; they were helpless without malaria drugs when visiting the household 5. The second evaluation in 1993 showed a better malaria situation than in 1991 with a spleen and parasite rate, more or less the same as the situation in 1985 2 which was the expected goal of the malaria control study with community participation.

To obtain any information regarding chloroquine resistance in RK I Berakit Village where intervention with weekly chloroquine mass prophylaxis was carried out during a period of two years (1983-1985), a sensitivity study was conducted . However, due to the low parasite densities in the positive blood smear of falciparum malaria cases identified during the screening and selection process, only one case could meet the requirement for the test and was found still to be sensitive to chloroquine in vivo but resistant in vitro.

The low parasite rate with its low parasite density showed that malaria control with chloroquine prophylaxis through community participation in RK I after 8 years still has a positive effect on the malaria situation. This result could be assumed as a continuous participation of the key persons and the community to keep the malaria down. During the 8 years no malaria intervention in any form was conducted in this area except single insecticide house spraying in 1992 by the health authorities. The existence and spread of chloroquine resistant *P. falciparum* in RK I where the villagers have had two years' weekly chloroquine prophylaxis was not observed because sensitivity tests could not be performed due to the low parasite densities among the patients. In 1990 however, 3 resistant cases out of 9 in vitro tests done by Romzan 8 was found in Berakit Village. We also could not discuss any comparison between chloroquine resistance in RK I after 2 years chloroquine mass prophylaxis and in RK II with no prophylaxis at all.

The malaria situation in RK II was worth mentioning. No intervention studies have been conducted in RK II except one cycle insecticide spraying by the local health authorities in 1992. Spleen rates in 1991 were almost the same as in 1983 (Table 3), but in 1993 it significantly reduced. Parasite rates in 1991 were already lower compared to results than those in 1983

and it further reduced in 1993. Unfortunately, spleen and parasite rates of 1985 could not be obtained, because malariometric examination was not conducted at that time. This situation could be explained as the results of drastic change in the environment in RK II, where roads were renovated , houses were relocated and newly built because of many newcomers settled in this area and the geographical situation of RK II which is close to the crossroads of the main road.

On the contrary, RK I is situated more remotely at the end of the small peninsula (Fig. 1) where no drastic environmental changes could be observed except the renovated road and more abundant breeding places among the old coconut plantations.

But still the visits of the malaria intervention team to RK II in 1991 and 1993 for evaluation studies had a positive influence on the spleen and parasite rates in 1993. These visits could be considered as a reminder to the community that they should always be aware of the malaria disease in this endemic area.

Sociological study conducted in RK II showed that it has a positive effect as was shown in the malariometric results in 1993. Their level of education was better than that of the community in RK I(Table 5), thus it was no problem to obtain knowledge about malaria through the learning module and audiovisual system. A total of 30.4 % of respondents obtain their knowledge through the mantri of the community subhealth center, which is situated close to RK II and more advantageous to the RK II community (Table 6).

It is understandable that respondents of RK I already knew about the typical symptoms of malaria as a result of health education given to them before and during intervention studies 2,3,4 (Table 7). In RK I the community tried to treat malaria patients by themselves using chloroquine tablets, as was taught by the key persons, whereas in RK II the patient was sent to the mantri because they could not treat malaria patients by themselves(Table 8).

The husbands in both RK's were the decision makers in patient's treatment, except for a small percentage of wives. In Thailand, sex differences in the utilization of health resources were confirmed, with a distinctly higher proportion of females who used various types of health facilities 9.

Respondents of RK I knew more about breeding places of the malaria vector than those in RK II when vector study was conducted in RK I in 1982 4 (Table 9). A significantly larger proportion of RK II respondents mentioned that adult mosquitoes could be easily destroyed. This was true because they were of the opinion that stagnant pools as breeding places of the vector in this area could be filled and drained, whereas in RK I with the numerous ditches that are required for watering the abudant coconut plantation, thus it was impossible to eliminate the vector.

For prevention of mosquito bites the villagers in both RK's used antimosquito coils containing pyrethroid which are less expensive and readily available. On the contrary, Thai people preferred bed nets 9

In conclusion, the most important thing of the sociological aspects of this study is the influence of the malaria learning module to 20 % of RK II respondents, resulting in a positive attitude and behavior of the community as was proven by the malariometric results in RK II, although health education about malaria in RK II is still needed and should be implemented soon.

## Conclusion

The existence and spread of chloroquine resistant *P. falciparum* could not be detected in RK I where chloroquine prophylaxis has been given to the community for a period of two

years because sensitivity studies could not be performed due to the very low parasite densities in positive falciparum malaria cases.

The malaria situation in RK II without intervention did not differ much from RK I with 2 year intervention because of the drastic environmental changes in RK II.

The positive influence of the malaria learning module to 20 % of RK II respondents was also of great benefit to the community.

Return of the malaria intervention team to this area for evaluation studies, twice after the termination of intervention, was very beneficial and was a booster for the key persons and the community to continue with their activities of malaria control in their own village.

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