

Malaria in China and the Equatorial Pacific Area from 1937 to 1943

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Malariometric data in the endemic areas are available from most parts of the world (1), but information is still meager in areas such as China and Indonesia. It happened that the Japanese personnel contracted malaria themselves extensively, or investigated it on the local inhabitants in those areas during 1937-1943.

The information may be valuable if the epidemiologic situation—particularly the ratio of parasite species prevalent there—remained the same now as it was a quarter of a century ago. An anonymous writer (2) mentions that the infectivity of mosquitoes in Africa is almost the same as it was in the days of Livingstone 100 years ago.

Numerous reports of the heavy toll of wartime malaria are available (3), but our records appeared still worthy of publication as detailed parasitological investigation was made simultaneously. It is the purpose of this paper to present those old records and compare them with the results of recent investigation published from the endemic areas.

MATERIALS

The records of the Imperial Japanese Navy Medical Division were kept at the Naval Historical Records Investigation Association.² They remained unpublished due to the chaos and disintegration of the armed forces after the last war. The areas which are covered in this paper include Central China including the Yangtze River regions, South China, Hainan Island, Singapore, Southern Malaysia and

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²The records were made available to me through the courtesy of the late S. Tomioka, and H. Sekino of the Association. The name of the naval medical officer who compiled the report, where it is available, will be attached to the tables to be presented in this paper.

Djawa Island. Information on other islands of Indonesia and New Guinea were incomplete and are not presented here.

The recent malariometric information on the above-mentioned areas was collected after 1960.

RESULTS

Malaria in China

The coastal regions of Central and South China north of Kwanchow and the Yangtze riverain regions. The number of malaria patients infected in Shanghai, Kyukiang and Yangtze riverain regions (about 30–32° N), in Amoi (24.5° N) and Kwanchow (23° N) (Fig. 1) during 1937–1939 was 7,558, of which the parasite species were identified in 5,695 (Table 1). *P. vivax* predominated (96.4%), followed by *P. falciparum* (3.0%), *P. malariae* (0.4%) and mixed infections (0.2%).

The predominance of *P. vivax* in these areas is substantiated from another data obtained at the Sasebo Naval Hospital in Kyushu, Japan during March to September 1939. The patients were infected in the same operating areas and were brought back to Japan or developed malaria after return to Japan. Ninety-nine percent

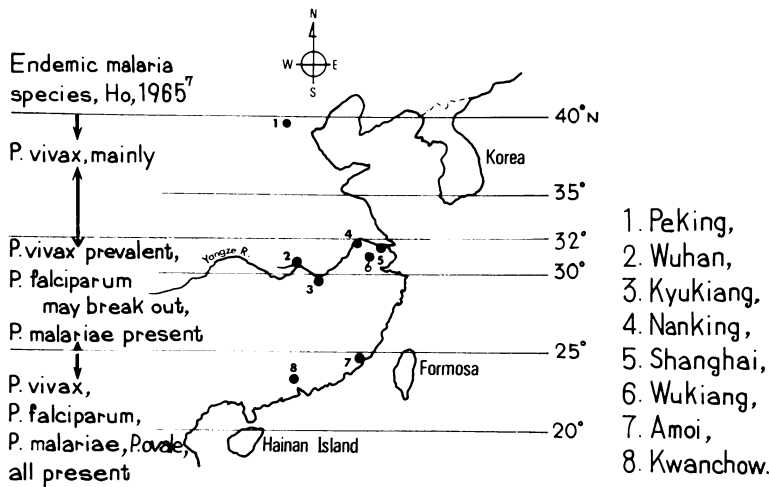


FIG. 1. Map of China showing the endemic species of malaria parasite (7) and the areas where the Japanese contracted malaria during 1937–1943.

TABLE 1
MALARIA CONTRACTED BY JAPANESE NAVAL PERSONNEL IN
CENTRAL AND SOUTH CHINA (1937–1939, ANONYMOUS)^a

Malaria parasite	No. of patients ^b	Percent
<i>P. vivax</i>	5490	96.4
<i>P. falciparum</i>	171	3.0
<i>P. malariae</i>	20	0.4
Mixed	14	0.2
Total	5695	100.0

^a Locale of infection: Yangtze R., Shanghai, Amoi, Kyukiang and Kwanchow.

^b Clinical malaria patients, 1863. Total malaria patients, 7558.

TABLE 2

MALARIA PATIENTS ADMITTED TO THE SASEBO NAVAL HOSPITAL (MARCH-SEPTEMBER, 1939. NISHIDA FUKUJI) ^a		
Malaria parasites	No. of patients	Percent
<i>P. vivax</i>	229	99
<i>P. falciparum</i>	1	0.5
<i>P. malariae</i>	1	0.5
Total	231	100

^a Locale of infection: Central and South China.

of 231 parasitologically confirmed patients were infected by *P. vivax* and one of the remaining patients was infected by *P. falciparum* and the other by *P. malariae*, respectively (Table 2).³

Most patients developed *vivax* malaria within 9 mo of, and 112 (63%) developed malaria 4, 5, and 6 mo after, leaving the endemic areas. The interval between the initial attack of fever and the first relapse was most at 8 mo followed by 9, 7, and 10 mo. Namely, the relapse pattern of the Chinese *vivax* malaria was type III in the majority, but some cases showed type II relapse pattern (1).

Malaria in the Wu-Han campaign (1938). The Wu-Han region is a marshy area striding on the Yangtze River and is located at around 31° N. (Fig. 1).

The malaria morbidity of the Japanese army during the Wu-Han campaign was as high as 30% and more than 50% of all the morbidity was attributed to malaria. The monthly number of malaria patients from July to December, 1938, was 8791, 24098, 39343, 40598, 34204 and 4614, respectively, with a total of 151,648 cases in 6 mo. No mention was made of the species of malaria parasites infecting these patients. Although the predominant species might have been *P. vivax*, simultaneous prevalence of *P. falciparum* can not be excluded, judging from the study to be mentioned later.

The overall malaria patients in the US armed forces during World War II is estimated to be roughly 500,000 (4). Therefore, this figure of 151,648 cases in 6 mo in one campaign alone is a tremendously large figure.

Malaria on board the hospital ship Muro-maru. Eighty patients with malaria were treated on board the hospital ship Muro-maru during the 10 mo of February to November, 1939. *P. vivax*, *P. falciparum* and mixed infections accounted for 69, 28 and 3%, respectively (Table 3). An increase of *P. falciparum* infections is noteworthy. It was not mentioned where they got malaria, but the area of their activity was probably more in the southern China rather than in the Yangtze River regions. It was also confirmed that the hospital ship usually called at several ports to pick up patients during her one voyage to the battle front. Sixty patients were infected on the land, and 20 patients caught malaria although they never left the ship. This is another indication that one may catch malaria during a short exposure to infection on the occasion of a stopover by boat or by plane for a few hours in the endemic area (5).

³ The writer also keeps in mind the possibility that the high ratio of *P. vivax* malaria in the patients mentioned in Table 2 may partly represent the so-called repatriates' malaria. The latter refers to the higher incidence of *vivax* than *falciparum* malaria among the repatriates from the areas where both *vivax* and *falciparum* malaria are prevalent.

TABLE 3
MALARIA PATIENTS TREATED ON BOARD THE HOSPITAL SHIP
MURO-MARU (FEBRUARY-NOVEMBER, 1939. ANONYMOUS)

Malaria parasite	No. of patients ^a	Percent
<i>P. vivax</i>	55	68.8
<i>P. falciparum</i>	22	27.5
Mixed	3	3.7
Total	80	100.0

^a Infected on board the ship: 20; infected on land: 60.

TABLE 4
JAPANESE MALARIA PATIENTS ON HAINAN ISLAND
(JANUARY, 1940-APRIL, 1942. ABE ISAO)^a

Malaria parasite	No. of patients	Percent
<i>P. vivax</i>	505	50.0
<i>P. falciparum</i>	492	48.8
<i>P. malariae</i>	4	0.4
Mixed	8	0.8
Total	1009	100.0

^a Malaria parasite rate of local residents: 13/40.

Malaria on Hainan Island. One thousand and nine patients developed malaria during the 26 mo of January, 1940 to April, 1942 on Hainan Island (8-10° N). *P. vivax* infections accounted for 50.0% of the cases followed by *P. falciparum* 48.8%, *P. malariae* 0.4% and mixed infections 0.8% (Table 4). Increasing proportion of *P. falciparum* infection is apparent. *Vivax* malaria was prevalent in the flat coastal regions (north) and *falciparum* malaria was frequent in the hilly regions (south). The parasite rate of inhabitants in a village was 13 over 40 people investigated. No species of parasites were mentioned.

Malaria in Singapore and Southern Malaysia

Five hundred and seventeen patients of malaria were admitted to the Singapore Naval Hospital during March to September, 1942. *P. vivax* accounted for 62.2% of the infections, followed by *P. falciparum* 36.5%, mixed infections of *P. vivax* and *P. falciparum* 0.7%, and *P. malariae* 0.6%, respectively (Table 5).

TABLE 5
MALARIA PATIENTS TREATED AT THE SINGAPORE NAVAL HOSPITAL
(MARCH-SEPTEMBER, 1942. KAYASHIMA KAZUO)

Malaria parasite	No. of patients	Percent
<i>P. vivax</i>	321	62.2
<i>P. falciparum</i>	189	36.5
<i>P. vivax</i> and <i>falciparum</i>	4	0.7
<i>P. malariae</i>	3	0.6
Total	517	100.0

TABLE 6
MALARIOMETRIC DATA ON RESIDENTS OF 21 VILLAGES NEAR
SURABAJA, DJAWA (NOVEMBER, 1943. FUKUHARA FUMIO)

Number of people examined: adults and children of both sexes	5009
Splenomegaly	1952 (39.0) ^a
Malaria parasitaemia	539 (10.8)
<i>P. falciparum</i>	278 (51.6)
<i>P. vivax</i>	192 (35.6)
<i>P. malariae</i>	69 (12.8)

^a Numbers in parentheses are percents.

It is rather surprising to find that *vivax* malaria was more frequent than *falciparum* malaria in view of the geographical location of Singapore and Malaysia.⁴

On this occasion, it may be interesting to remember that a soldier who got malaria at Johore Bahru, southern Malaysia, in 1945 was repatriated to Japan in 1946 and remained free of malaria attacks. His blood was injected into his 4-yr and 3-mo-old boy intramuscularly in 1965 when the latter got measles. The boy developed *malariae* malaria subsequently (6). This case record and the results mentioned in Table 5 are convincing evidence that *P. malariae* was prevalent in southern Malaysia in 1942–1945.

Malaria in Indonesia

Five thousand and nine adults and children of both sexes in 21 villages near Surabaya, Djawa Island were investigated. The spleen index of the whole population was 39.0%, and the parasite rate was 10.8% (Table 6). *P. falciparum* accounted for 51.6%, followed by *P. vivax* (35.6%) and *P. malariae* (12.8%). No mention was made of mixed infections.

DISCUSSION

Malaria in China

Recent study (7) showed that *P. vivax* was the predominant endemic species north of 32° N, and that, although the same species was ordinarily most prevalent in the areas of 25–32° N, *P. falciparum* infection might increase in the season favorable for its transmission. *P. malariae* was also prevalent in the area. The study is endorsed by the report of Hsieh *et al.* (8) who recorded clinical experience on 329 cases of *vivax* malaria which were seen during January 1958 to October 1963 in Shanghai.

These reports, published in 1965, agree with the data presented in Tables 1 and 2 showing a preponderance of *P. vivax* infections in the patients contracting the disease in the coastal and Yangtze River regions of Central and Southern China.

Yan *et al.* (9) from Wukiang, Kiangsu Province (Fig. 1) reported in 1965 that the ratio of *P. vivax* and *P. falciparum* infections in the age groups of 0–5, 6–10,

⁴ *Vivax* malaria was also more frequent than *falciparum* malaria in the Army Hospital in Singapore during the same period (K. Togawa, personal communication, 1972).

11–15, over 16 years and the total population was 5:1, 7:1, 4:1, 2:1 and 4:1, respectively. The study indicates that the nonimmune population is more likely to get *vivax* than *falciparum* malaria in this area. Wukiang and Wuhan areas are located at around 31° N and are similar geographically—marshy areas with many lakes and pools of water. Because of these factors, it is supposed that the majority of the Japanese malaria patients during the Wuhan campaign mentioned above might have caught *vivax*, although the rest of them might have caught *falciparum* malaria.

No case of *ovale* malaria was seen among 1009 malaria patients contracted on Hainan Island, although it was mentioned that all the four species of human malaria parasites were present south of 25° N (7). It may be interesting to see if *P. ovale* is really present in southern mainland China, because this species has been reported from the nearby Vietnam (10), Thailand (11) and the Philippines (12), although it was not confirmed beyond criticism in the former two countries.

Malaria in Singapore and Malaysia

Endemic malaria is almost absent in Singapore now and the majority of 397 malaria patients reported in 1968 (13) contracted the disease in the opposite Malaysian peninsula. The west coast of the peninsula is known for the high endemicity of malaria and the ratio of infections with *P. falciparum*, *P. vivax*, *P. malariae* and mixed species in a rural area was 46.8:45.7:3.1:4.4 (14). However, other reports (1) mention a higher ratio of *P. falciparum* than *P. vivax* in the western Malaysia. The same is true in northern Perlis (15).

As the ratio of each parasite species in malaria patients may differ from one place to another, or by season and various other factors, it may not be surprising to see that the Japanese patients in a Singapore hospital were infected more with the *P. vivax* than with *P. falciparum*.

Malaria in Indonesia

The malaria eradication program MEP with insecticide spraying was started in Djawa and Bali Islands from 1959 and was continued until 1965 when they had to stop it because of political and economic reasons. The parasite ratio for *P. falciparum* in these areas remained below 35% until 1 yr after the MEP was stopped, but it started to rise from 1967 and reached 49% in 1969 (16). A similar trend was noted in the statistics of the East Djawa State (17). The parasite ratio for *P. falciparum* rose from 27 to 52.5% in the 7 yr from 1964 to 1970 (Fig. 2).

Therefore, the parasite ratio for *P. falciparum* of 51.6% obtained in 1943 on the villagers near Surabaya may indicate the level of parasite ratio when no insecticide spraying was or is made for some years.

The parasite ratio for *P. vivax* in 1969 was 48% in the Djawa and Bali Islands and 47% in 1970 in the East Djawa State in contrast to 35.6% in 1943 in the villages near Surabaya. This difference is explained by the negligible incidence of *P. malariae* in the recent statistics.

The parasite ratio for *P. malariae* in recent statistics declined from 5% in 1963 to 2% in 1965 and remained so after the MEP was stopped. The ratio remained below 1% in the East Djawa State. It is difficult to explain the high parasite ratio for *P. malariae* of 12.8% in 1943. One possibility is that the particular area was prominently endemic with *P. malariae*. The other may be that because of some

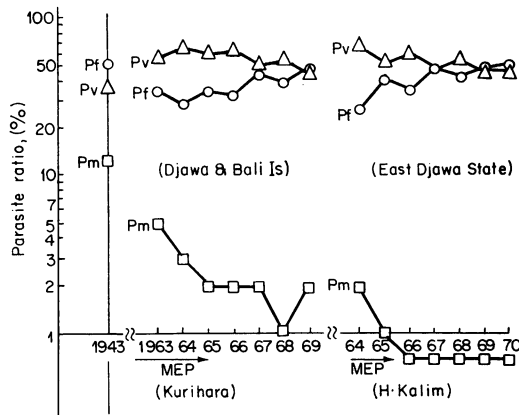


FIG. 2. Parasite ratio of malaria in Indonesia. Pf, *Plasmodium falciparum*; Pm, *P. malariae*; Pv, *P. vivax*; MEP, Malaria eradication program. (The figure is published with permission of the author.)

difficulty in differentiating *P. malariae* from *P. vivax*, the former may be mistaken for the latter when the survey is made on a national scale.

SUMMARY

The records of malaria contracted or investigated by the Japanese naval personnel during 1937–1943 in Central and South China including the Yangtze River regions and Hainan Island, Singapore–southern Malaysia, the Djawa Island are presented. They are compared with the information on malaria in these areas after 1960.

The old records were found to be still useful as they reflected correctly the malaria situation in these areas before malaria eradication program was started with insecticide spraying. The parasite ratio of the Japanese malaria patients who contracted the disease in China a quarter of a century ago was generally similar to that of the local patients in recent years.

More *vivax* than *falciparum* malaria patients were seen in 1942 in the Japanese in Singapore–southern Malaysia area, although the reverse is generally true in Malaysia recently.

An unusually high incidence of *P. malariae* infection was seen in rural areas near Surabaya in 1943. The parasite ratio of *P. falciparum* in Djawa and Bali Islands was considered to have returned to the pre-eradication level (1943) in the 4 yr since the malaria eradication program with insecticide spraying was stopped.

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REFERENCES

1. Report of a WHO Scientific Group: WHO Technical Report Series, No. 433. Parasitology of Malaria. 1969, Geneva.
2. Editorial: Malaria in Britain. *Brit. Med. J.* 2, 776 (1969).

3. Bruce-Chwatt, L. J. Malaria and its prevention in military campaigns. *Z. Tropenmed. Parasitol.* **22**, 370-390 (1971).
4. Blount, R. E. Malaria: an unsolved military medical problem. *Amer. J. Med. Sci.* **247**, 407-411 (1964).
5. Shute, P. G. and Maryon, M. Imported malaria in the United Kingdom. *Brit. Med. J.* **2**, 781-785 (1969).
6. Hanada, K., Sunabe, K. and Morishita, S. Transfusion malaria. *Nihon Med. J. No.* **2208**, 53-54 (1966) (in Japanese).
7. Ho, C.-I. Studies on malaria in new China. *Chin. Med. J.* **84**, 491-497 (1965).
8. Hsieh, S.-C., Wang, C.-J., Chu, C.-P., Hu, M.-S., Weng, H.-S. and Tai, T.-Y. Certain unusual manifestations of tertian malaria. *Chin. Med. J.* **84**, 307-312 (1965).
9. Yan, T.-H., Kan, S.-N., Yang, S.-A., Chan, L. and Huang, P.-P. The effect of biweekly administration of 50 mg of pyrimethamine in prevention of *falciparum* and *vivax* malaria. *Chin. Med. J.* **84**, 809-812 (1965).
10. Gleason, N. N., Fisher, G. U., Blumhardt, R., Roth, A. E. and Gaffney, G. W. *Plasmodium ovale* malaria acquired in Vietnam. *Bull. W.H.O.* **42**, 399-403 (1970).
11. Cadigan, F. C. and Desowitz, R. S. Two cases of *Plasmodium ovale* malaria from central Thailand. *Trans. Roy. Soc. Trop. Med. Hyg.* **63**, 681-682 (1969).
12. Lysenko, A. J. and Beljaev, A. E. An analysis of the geographical distribution of *Plasmodium ovale*. *Bull. W.H.O.* **40**, 383-394 (1969).
13. Ng, W. C., Fung, W. P., Colburne, M. J. and Gilles, H. M. Chloroquine-resistant malaria in Singapore. *Ann. Trop. Med. Parasitol.* **63**, 313-316 (1969).
14. Huehne, W. H., Ahmad, M. D. B. and Seng, L. D. Malaria. A primary health problem in rural West Malaysia. *Med. J. Malaya* **22**, 60-71 (1967).
15. Sandosham, A. A., Wharton, R. H., Eyles, D. E., Warren, M. and Cheong, W. H. Malaria in Perlis. *Med. J. Malaya* **18**, 46-51 (1963).
16. Kurihara, T. Malaria on Djawa and Bali Islands: its ecology and preventive measures. *Nettai* **5**, 98-105 (1970) (in Japanese).
17. Karim, H. Malaria surveillance in East Djawa. Mimeographed document. Communicable Dis. Section of the Min. of Education, Tjiloto, 1970.