

The malaria situation in the People's Republic of China

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This report describes the measures being applied to control malaria in China and outlines the present situation in the country. In the 1940s, it was estimated that approximately 350 million people were at risk of infection and that about 30 million cases of malaria occurred annually. In the last 30 years, large-scale antimalaria campaigns have been established and have achieved much success. In 1979, there were just over 2 million reported cases of malaria and approximately 64% of the population now live in areas where the incidence is below 5 per 10 000. However, there are still several major difficulties to be overcome, and much work is needed before the ultimate goal of complete eradication of malaria in China can be achieved.

Because of its extensive distribution and because a large proportion of the population has been at risk, malaria has long been a constant menace to the people of China. In 1932, the lower part of the Chang Jiang (Yangtze) was flooded, and soon after, the malaria incidence rose to 60%, causing 300 000 deaths. Before the foundation of the People's Republic in 1949, it was estimated that 30 million malaria cases occurred yearly, that 70% of the counties were endemic for malaria, and that about 350 million people were at risk of infection.^a Since then, anti-malaria organizations for control and scientific research have been established, technical personnel carefully trained, and large-scale surveys and anti-malaria campaigns carried out. However, malaria is still one of the major parasitic diseases in China.

MALARIA ZONES

On the basis of information obtained from extensive epidemiological surveys, the country can be divided into four broad zones (Fig. 1).

Zone 1 is the area south of latitude 25 °N where *Anopheles minimus* is the main vector. This zone covers the tropical and subtropical parts of China, including the southern part of Yunnan province, the greater part of Guangdong province, Guangxi autonomous region, the south-east part of Fujian province, and the whole of Taiwan province, with a total population in 1953 of 63 million (this represented 10.7% of the total population in 1953).

In this zone, malaria has a long transmission season, lasting 9–12 months. Three species of human malaria parasite are present, with *Plasmodium falciparum* the predominant species. Mixed infections of *P. falciparum* and *P. vivax* are very common, and the distribution of *P. malariae* is patchy.^b Malaria in mountainous and hilly districts is of the stable type; in addition to *A. minimus*, the main vector, *A. jeyporiensis candidiensis* is the secondary vector, with *A. balabacensis balabacensis* an important vector in the jungle areas of Hainan Island. In the plains, malaria transmission is of the unstable type. *A. sinensis*, although found in large numbers, is a relatively inefficient vector. Parasite rates vary according to topography, altitude, and latitude, and children generally have a higher parasite rate than do adults. On Hainan Island, the peak incidence of malaria occurs before the rainy season, from April to May, whereas on the mainland, it occurs after the rainy season, from August to October.

Zone 2 lies between latitudes 25 °N and 33 °N with *A. lesteri anthropophagus* and *A. sinensis* as vectors. This zone includes the whole of Guizhou, Hunan, Jiangxi, Hubei, and Zhejiang provinces, Shanghai municipality, the greater part of Sichuan, Fujian, Anhui, and Jiangsu provinces, the northern part of Yunnan province, and parts of Xizang and Guangxi autonomous regions, and Guangdong, Gansu, Shanxi, and Henan provinces, with a population in 1953 of 295 million, i.e., 49.9% of the total population.

The malaria transmission season lasts for 6–8 months, with the peak malaria incidence occurring from August to October. Usually, *vivax* malaria pre-

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^a The estimated total population in 1953 was 591 300 000.

^b *P. ovale* was also suspected of being present along the south-west border of Yunnan province (unpublished observation, 1953).

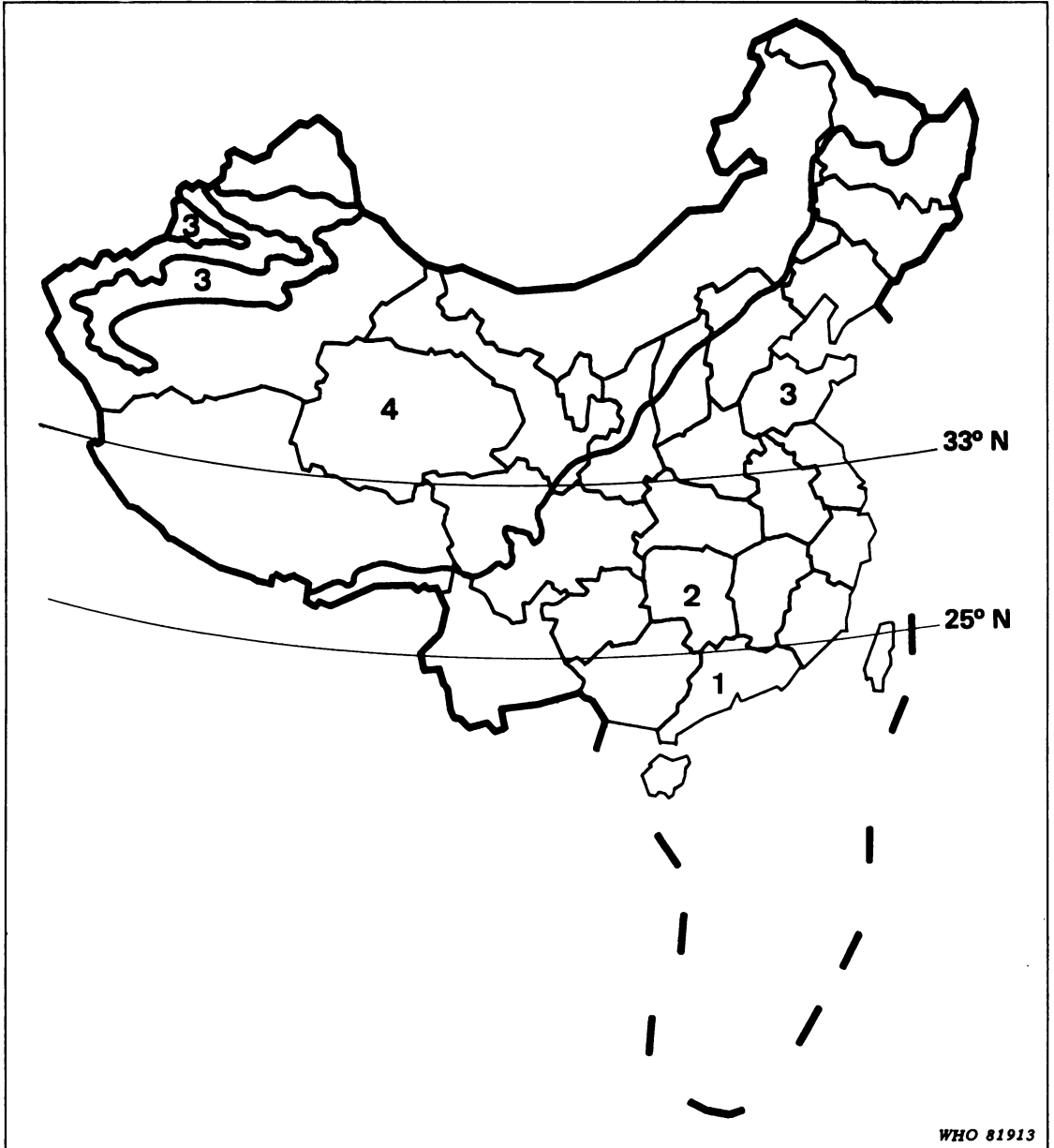


Fig. 1. The four epidemiological zones for malaria in China (for explanation, see text).

vails, but falciparum malaria may also have a diffuse distribution. Malaria in both hilly and lowland regions is of the unstable type. *A. lesteri anthropophagus* and *A. sinensis* are the known vectors, although *A. minimus* may also play a role in some hilly districts. Under certain circumstances, *P. vivax* and *P. falciparum* may give rise to severe malaria outbreaks. The parasite rates in hilly districts are usually higher than those in the lowland areas.

Zone 3 is the area north of latitude 33 °N with *A. sinensis* as vector. This zone covers the northern part of China, including the whole of Shandong, Liaoning, Jilin, and Heilongjiang provinces, Beijing and Tianjin municipalities, the greater part of Hebei and Shaanxi provinces, and parts of Shanxi, Henan, Jiangsu, and Anhui provinces, and Xinjiang autonomous region, with a population in 1953 of 186 million (31.5%).

The malaria transmission season lasts for 3–6 months, with the peak incidence of malaria occurring from August to October. Only vivax infections are prevalent. (In Yili Valley in the north-west of the Xinjiang autonomous region, falciparum infection was reported occasionally in the early 1950s). The endemicity is moderate or low, and malaria in the region is generally of the unstable type. In certain circumstances, such as unusual climatic conditions or floods, severe and important outbreaks may occur. *A. sinensis* is the chief vector in most of the zone, with *A. messae* being found in Yili Valley. The parasite rates are usually below 5% with very little difference between the various age groups.

The malaria-free zone includes the cold, high altitude area in the south-west, dry desert in the north-west and north, the loess plateau in the north, and mountainous districts in the north-east of China, with an estimated population of 47 million in 1953, i.e., 7.9% of the total population.

ANTIMALARIA ACTIVITIES

Antimalaria campaigns were launched in 1950, under the leadership of the Sanitary and Anti-epidemic Bureau, Ministry of Public Health. The Institute of Parasitic Diseases of the Chinese Academy of Medical Sciences was in charge of applied field research and technical guidance for malaria control in the whole country. Each province, municipality, and autonomous region has a bureau of health to lead and organize the antimalaria activities. At the provincial level, the sanitary and anti-epidemic station and/or the Institute of Parasitic Diseases are responsible for technical guidance, whereas the sanitary and anti-epidemic stations, under the

directorship of the Health Bureau, share this responsibility at the prefectural and county level. At the people's commune level, antimalaria operations are assigned to the health centres, with the production brigades and teams, "barefoot doctors", and health aides sharing responsibility for the antimalaria activities. At the national level, the departments of agriculture, water conservancy, commerce, and chemical industry work closely together to fight against malaria.

In view of the diverse characteristics of the malaria zones in the country, the strategy adopted is to eradicate malaria through gradual control and elimination of the disease. Special emphasis has been placed on combined measures to meet the local conditions and to reflect the different phases and progress of the antimalaria campaign.

Different measures have been taken in the various zones, according to the chief vector of the disease.

(a) In areas where *A. minimus* is the chief vector, control measures consist of indoor residual spraying, mass drug administration twice a year, mass chemoprophylaxis during the transmission season, treatment of all clinical cases, and wide use of bed-nets and screens for personal protection. In addition, in the forested mountainous areas of Hainan Island, the shrubs within a radius of 300–500 m of the residential quarters and on both sides of the streams and brooks have been cleared, to control the breeding and resting places of *A. b. balabacensis*.

(b) In the zone where *A. lesteri anthropophagus* is the chief vector, control is effected by indoor residual spraying once a year, treatment of clinical cases, anti-relapse treatment during the intertransmission period, and the use of bed-nets for personal protection.

(c) In areas where *A. sinensis* is the chief vector, the basic measures for vector control vary according to the local conditions. In some areas, insecticides are used for livestock spraying, while elsewhere larvicides, cultivation of rice in mud, intermittent irrigation, pisciculture in flooded rice-fields, and improvement of the environmental conditions for larva control are used, in combination with treatment of clinical cases, anti-relapse treatment in the intertransmission period, chemoprophylaxis during the transmission season, and individual protection measures.

A county is considered to have eliminated malaria when its incidence has dropped below 5 cases per 10 000 population. Antimalaria measures then involve the timely detection of residual sources of infection, radical treatment of cases and their follow-up, residual focal spraying, prophylactic treatment, and application of personal protection measures.

Some examples

Hainan Island in Guangdong province was originally a hyper- and holoendemic area with *A. minimus* the main vector in the mountainous and hilly regions. Since 1958, an antimalaria campaign has been conducted, with residual spraying twice yearly, treatment of clinical cases, and mass chemoprophylaxis during the transmission season. By 1965, the malaria incidence had dropped to 0.89%. During the following ten years the antimalaria campaign was greatly reduced and the incidence rose again to 1.55% in 1970. The campaign was reorganized in 1977, and the malaria incidence again decreased to 0.66% in 1978 and 0.50% in 1979.

Miaoxi people's commune, Wuxing county of Zhejiang province, was an area with unstable malaria, where mixed infections of *P. vivax* and *P. falciparum* occurred, with *A. lesteri anthropophagus* as the main vector. In 1963, prior to the antimalaria campaign, the clinical incidence of malaria was 27.5% with a parasite rate of 20.8% (*P. vivax*, 69.8%; *P. falciparum*, 30.2%). Combined antimalaria measures were carried out in 1964, involving indoor residual spraying once a year, mass antirelapse treatment during the intertransmission season, and treatment of all clinical cases. The malaria incidence dropped to 0.57% in 1965 and has remained at a low level since then. The adult vector density was 47.8 per 100 nets prior to the residual spraying, dropped to 3.7 per 100 nets soon after the application of the control measures, and is now almost zero.

Kaili county of Guizhou province was a mesoendemic area with *A. sinensis* and *A. minimus* as vectors. In 1957, prior to the antimalaria campaign, the clinical incidence among the autochthonous population was 9.4% with a parasite rate of 11.2% (*P. vivax* 78.9%, *P. falciparum* 18.4%, and *P. malariae* 2.7%). Control measures were initiated in 1957 with indoor residual spraying once a year, treatment of clinical cases, antirelapse treatment in the intertransmission period, and mass treatment just before the peak of transmission. The malaria incidence was brought down to 0.01% in 1965 and 0.004% in 1979.

Pintai people's commune in Henan province is situated in the dry area of a vast plain between the Huanghe and Huaihe Rivers, and was a hypoendemic area with *A. sinensis* as the sole vector, and *P. vivax* malaria of the unstable type. Antimalarial measures were started in 1974, when the malaria incidence was 4.13% with a parasite rate of 5.18%. The main measures were: mass mobilization to improve environmental conditions, residual spraying of live-stock sheds, treatment of breeding places, antirelapse treatment during the intertransmission period, and

treatment of all clinical cases. Through these measures, the malaria incidence decreased to 2.19% in 1975, 1.40% in 1976, 0.84% in 1977, and 0.42% in 1978.

PRESENT STATUS OF MALARIA

The status of malaria in China in 1979 is shown in Fig. 2. According to the statistics collected through the case reporting system, there were 2 384 543 malaria cases in 1979 in the whole country,^c a morbidity rate of 0.246%; this figure is 22.99% lower than the 3 096 240 cases recorded in 1978.

In the southern part of China, blood examinations carried out in 1979 in Guangdong, Fujian, and Guangxi indicated that *P. vivax* had become the predominant species (64.9%), *P. falciparum* was next in order (35.1%), while *P. malariae* accounted for only 0.02%. In the central and northern parts, *P. vivax* was the only species encountered.

In 1979, there were 948 counties (40.7%), with a population of 284 859 000 (29.3%), that were malaria-free; 725 counties (31.2%), with a population of 341 524 000 (35.2%), where the malaria incidence was lower than 5 per 10 000; 523 counties (22.5%), with a population of 270 104 000 (27.8%), where the malaria incidence was between 5 and 100 per 10 000, and 131 counties (5.6%), with a population of 74 440 000 (7.7%), where there was a high malaria risk, with an incidence above 100 per 10 000.

Of the total number of malaria cases reported, 76.11% occurred in the plain between the Huanghe and Huaihe Rivers and the plain between Chang Jiang and Hanshui Rivers, an area which includes Anhui, Jiangsu, Henan, Shandong, and Hubei provinces. However, most of the formerly highly endemic areas in the south have been brought under control. There, the malaria incidence was 5.6 per 10 000 for Guangdong, 4.4 per 10 000 for Guangxi, 4.1 per 10 000 for Fujian, and 4.5 per 10 000 for Guizhou. In Yunnan province, however, the incidence is still higher than 10 per 10 000.

Major technical problems

There are still several major obstacles to the control of malaria.

— The widely distributed *A. sinensis* is difficult to control because of its exophilic habits.

— *A. b. balabacensis*, the important vector in the persistent foci in the forested hill regions of Hainan Island, is difficult to control.

— A simple and satisfactory method for the radical treatment of vivax malaria is not available.

^c Excluding Taiwan province.

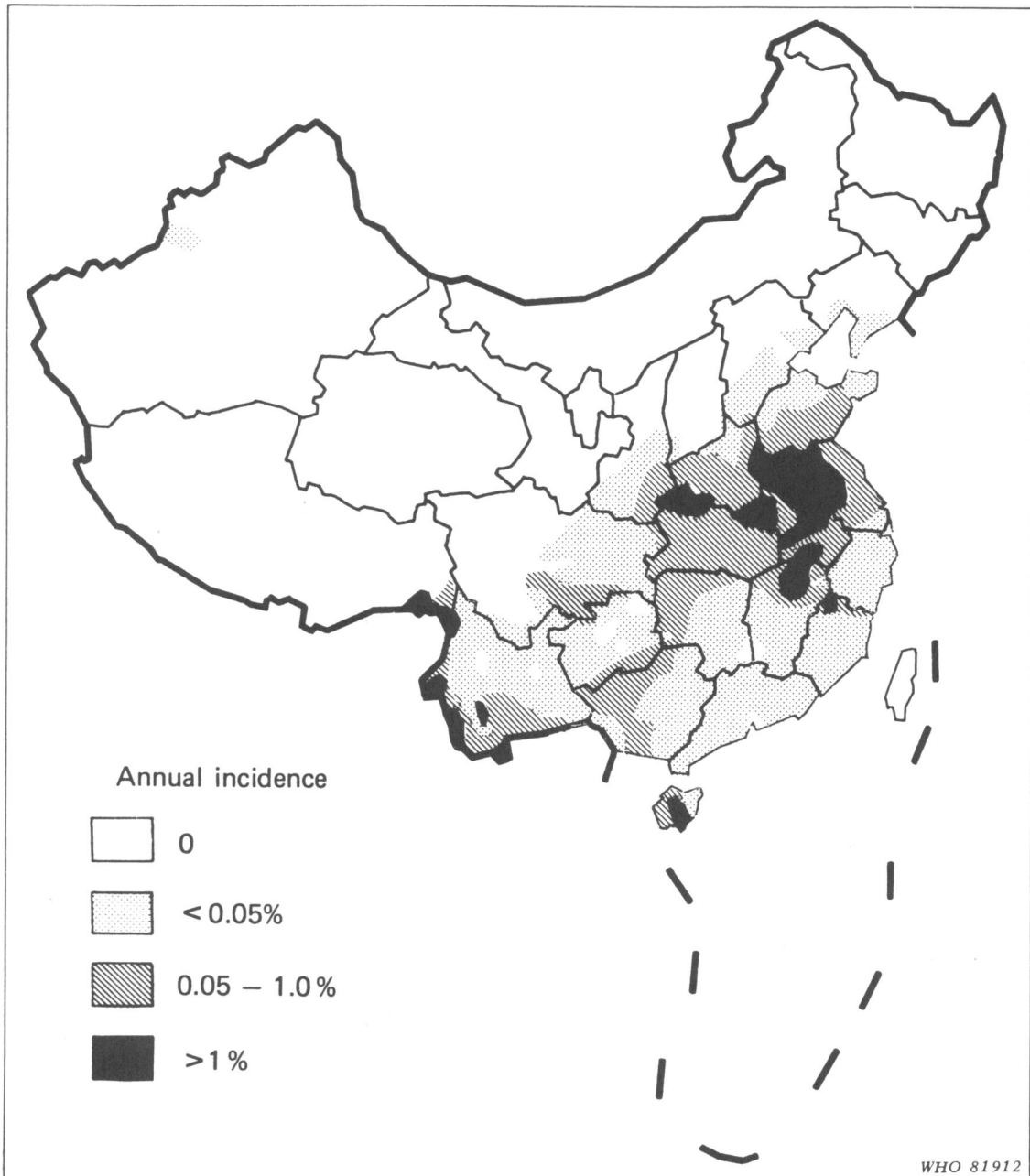


Fig. 2. The annual incidence of malaria in China in 1979.

— It is not possible to trace people infected with long-incubation vivax malaria, between transmission seasons.

— There is a need for a simple and efficient method to control and prevent the spread of malaria due to chloroquine-resistant strains of *P.falciparum* found

on Hainan Island and in the China – Burma border area of Yunnan province.

Many difficulties have still to be overcome and much work is needed before the ultimate goal of complete eradication of malaria in China can be achieved.

RÉSUMÉ

SITUATION DU PALUDISME EN RÉPUBLIQUE POPULAIRE DE CHINE

Dans des années 1940, on estimait que 30 millions de cas de paludisme se produisaient chaque année et qu'environ 350 millions de personnes risquaient l'infection. Au cours des 30 dernières années, des dispositifs antipaludiques ont été créés et des campagnes à grandes échelles ont été menées. Les méthodes employées étaient dictées par les conditions locales ainsi que par l'espèce du vecteur et le genre d'infection palustre en cause. En règle générale, toutefois, les mesures de lutte comprenaient quelques-unes ou la totalité des actions suivantes: pulvérisations à l'intérieur des maisons d'insecticides à effet rémanent, chimiothérapie et chimioprophylaxie de masse, traitement de tous les cas

cliniques, enfin recours à des moustiquaires et à des treillis de protection individuels. Dans quelques contrées, on a en outre tablé sur l'épandage de produits antilarvaires et sur l'amélioration générale des conditions environnementales. Ces mesures ont été largement couronnées de succès. En 1979, il subsistait à peine plus de 2 millions de cas déclarés de paludisme et l'on estime actuellement qu'environ 64% de la population vivent dans des régions où l'incidence annuelle du paludisme est inférieure à 5 pour 10 000. Néanmoins, il reste plusieurs difficultés majeures à surmonter et beaucoup à faire avant qu'ait été atteint l'objectif ultime de l'éradication intégrale du paludisme en Chine.
