

REVIEW ARTICLE

A study of malaria in bordering countries of India: Nepal, Pakistan, and Thailand

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ABSTRACT

Background: Malaria still occurs in Nepal, Pakistan and Thailand which are countries of the South-east Asia region. **Material and Methods:** For the present study, three countries' (Nepal, Thailand, and Pakistan) Malaria Prevalence and their strategic elimination programs of were taken into consideration based on all the available online data. These countries were compared by their preventive strategies and stipulated eradication time according to their geographical areas. They were further classified as endemic, non-endemic areas of their country maps and tabulated respectively. **Results:** During 2021, there were 623 reported confirmed cases of Malaria in Nepal. Of these, 94% were caused by *Plasmodium vivax* while 5% were due to *P. falciparum*. During 2021, there were 350,467 reported confirmed cases of Malaria in Pakistan. Of these, 78% were caused by *Plasmodium vivax* while 21% were due to *P. falciparum*. During 2021, there were 7420 cases of Malaria in Thailand of which 61% were due to *Plasmodium vivax* and 23% were due to *P. falciparum*. **Conclusion:** The number of imported cases of Malaria from India to Nepal and vice versa would decrease if anti-Malaria measures are stepped up in the respective countries' border districts. The main species causing Malaria in Pakistan is *Plasmodium vivax*. This will prove a challenge to eliminate because of the hypnozoites that are difficult to treat which remain latent in the liver and cause recurrent attacks of the disease even if the initial phase is apparently cured. Thailand aims to eliminate Malaria by 2024 using the methods of timely surveillance and quick response.

Keywords: Malaria, Nepal, Pakistan, Thailand, *Plasmodium*

Introduction

Nepal is in South-east Asia (Fig. 1).¹ It is bordered on the west and east and south by India and on the north by China. The Annual Parasite Incidence (API) of Malaria was recorded 0.09 per 1,000 and the cases of Malaria decreased drastically from 11,000 in 2000 to 1,065 in 2019. Out of these 1065 cases, 440 were indigenous and 625 were imported cases. This decreasing trend is because of the free distribution of long-lasting insecticidal nets (LLINs), systematic spraying of indoor residual spraying (IRS) in endemic area, skillful monitoring for new cases identification and the use of active Artemisinin Combination Therapy (ACT) administration. Nepal is targeting for elimination of Malaria by 2025.²

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Fig. -1: Map of Nepal [Source: (1)]



Fig. -2: Map of Pakistan [Source: (3)]



Pakistan is in South-east Asia (Fig. 2).³ It is bordered on the north-east by China and India; in the south-east by India; by Afghanistan in the north-west and in the south-west by Iran; in the south by the Arabian Sea. Pakistan is still confronting several hurdles to control the transmission of Malaria like inadequate diagnostic measures and improper treatment options. Limited and stringent data resources on the Malaria case clusters are contributing factors for the ineffective control strategies.⁴ Annually 3.5 million malaria positive cases are documented. Despite the relentless efforts from the last three decades on the National Malaria Control Program, it is posing an increasing threat to the public.⁵ As per WHO recent report, *P. vivax* Malaria prevalence is 84% in Pakistan. However, 14.9% and 1.1% cases are contributed by *P. falciparum* and mixed cases.⁶

Fig. 3. Map of Thailand [Source: (7)]



Thailand is in South-east Asia (Fig. 3).⁷ It is bordered on the west and north-west by Myanmar, on the east and north-east by Laos, on the south-east by Cambodia and in the South by Malaysia. Thailand also set a goal for a Malaria-free country by 2024. Reaching this milestone, Ministry of Public Health (MOPH) adopted a formula in 2016: 1-3-7. This strategy includes within 1 day of diagnosis followed by 3 days case investigation and classification. At the end of 7 days all the investigation including the diagnosis, classification, and stratification for every index case in order to rectify and arrest the transmission in that particular area.⁸

Materials and Methods

For the present study, three countries’ (Nepal, Thailand, and Pakistan) malaria prevalence and their strategic elimination programs of were taken into consideration based on all the available online data. These countries were

compared by their preventive strategies and stipulated eradication time according to their geographical areas. They were further classified as endemic, non-endemic areas of their country maps and tabulated respectively.

Results

According to one WHO document, during 2021, there were 623 reported confirmed cases of Malaria in Nepal. Of these, 94% were caused by *Plasmodium vivax* while 5% were due to *P. falciparum*.⁹

Table- 1: API for the Provinces of Pakistan, 2018

S. No.	Province	API
1.	Tribal Districts	12.9
2.	Balochistan	4.1
3.	Khyber Pakhtunkhwa	3.7
4.	Sindh	2.6
5.	Punjab	0.0
6.	Pakistan-occupied Jammu & Kashmir	0.0
	Overall	1.7

[Source: (11)]

As per one reference, during 2021, there were 350,467 reported confirmed cases of Malaria in Pakistan. Of these, 78% were caused by *Plasmodium vivax* while 21% were due to *P. falciparum*.¹⁰ The Annual Parasite Incidence (API) for the country was 1.7 per 1000 population at risk.¹¹ From Table 1, the Tribal Districts had the highest API of 12.9 in the country.

Table- 2: API for the Tribal Districts (Global Fund-supported Districts only), 2018

S. No.	District	API
1.	FR Lakki Marwat	92.1
2.	FR Tank	67.2
3.	FR D. I. Khan	49.2
4.	FR Bannu	48.0
4.	FR Kohat	18.8
6.	South Waziristan	16.4
7.	FR Peshawar	15.7
8.	Mohmand	15.6
9.	Khyber	13.7
10.	North Waziristan	12.4
11.	Orakzai	10.6
12.	Kurram	5.9
13.	Bajaur	5.2

[Source: (11)]

From Table 2, FR Lakki Marwat District had the highest API of 92.1 among the Global Fund-supported Tribal Districts.

Table-3: API for Balochistan Province (Global Fund-supported Districts only), 2018

S. No.	District	API
1.	Sherani	22.2
2.	Zhob	19.9
3.	Musa Khal	18.8
4.	Awaran	16.4
5.	Kohlu	16.2
6.	Harnai	15.5
7.	Jhal Magsi	13.3
8.	Killa Saifulla	11.8
9.	Lasbela	10.3
10.	Barkhan	9.5
11.	Loralai	8.8
12.	Jaffarabad	8.3
13.	Kachhi / Bolan	7.5
14.	Nasirabad	6.5
15.	Sibi	6.1
16.	Mastung	4.5
17.	Dera Bugti	4.2
18.	Khuzdar	4.1
19.	Ziarat	3.8
20.	Kharan	3.6
21.	Gwadar	3.2
22.	Washuk	1.6
23.	Nushki	1.3
24.	Kech	1.3
25.	Panjgur	1.0
26.	Pishi	0.7
27.	Chagai	0.6
28.	Killa Abdulla	0.2
29.	Quetta	0.1

[Source: (11)]

From Table 3, Sherani District had the highest API of 22.2 among the Global Fund-supported Balochistan Province Districts.

Table - 4: API for Khyber Pakhtunkhwa Province (Global Fund-supported Districts only), 2018

S. No.	District	API
1.	Tank	12.0
2.	Buner	11.4
3.	Lakki Marwat	10.2
4.	Lower Dir	9.7
5.	Mardan	7.4
6.	Dear Ismail Khan	7.2
7.	Karak	6.3
8.	Shangla	6.0
9.	Bannu	5.3
10.	Hangu	5.2
11.	Nowshera	4.9
12.	Charshadda	4.7
13.	Kohat	3.9
14.	Swat	2.2

[Source: (11)]

From Table 4, Tank District had the highest API of 12.0 among the Global Fund-supported Khyber Pakhtunkhwa Province Districts.

Table- 5: API for Sindh Province (Global Fund-supported Districts only), 2018

S. No.	District	API
1.	Thatta	27.0
2.	Tando Mohammad Khan	15.4
3.	Sujawal	14.7
4.	Umer Kot	8.6
5.	Mirpur Khas	7.4
6.	Badin	5.6
7.	Larkana	4.2
8.	Tharparkar	3.2
9.	Khairpur	3.0
10.	Tando Allahyar	2.6
11.	Naushahro Feroze	2.4
12.	Kambar Shahdat Kot	2.2
13.	Sukkur	1.7

[Source: (11)]

From Table 5, Thatta District had the highest API of 27.0 among the Global Fund-supported Sindh Province Districts.

According to one reference, there were 7420 cases of Malaria in Thailand of which 61% were due to *Plasmodium vivax* and 23% were due to *P. falciparum*.⁷ The distribution in the country is as follows (Figures 4 and 5).¹²

Fig.-4: Distribution of Malaria in Thailand caused by *P. falciparum* [Source: (12)]

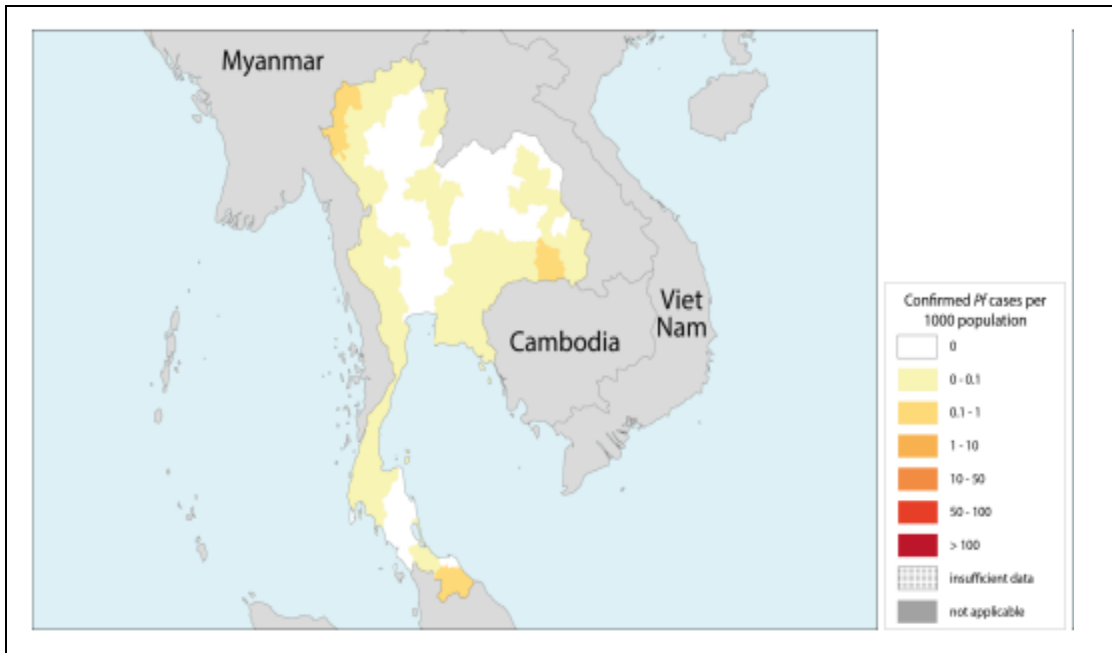
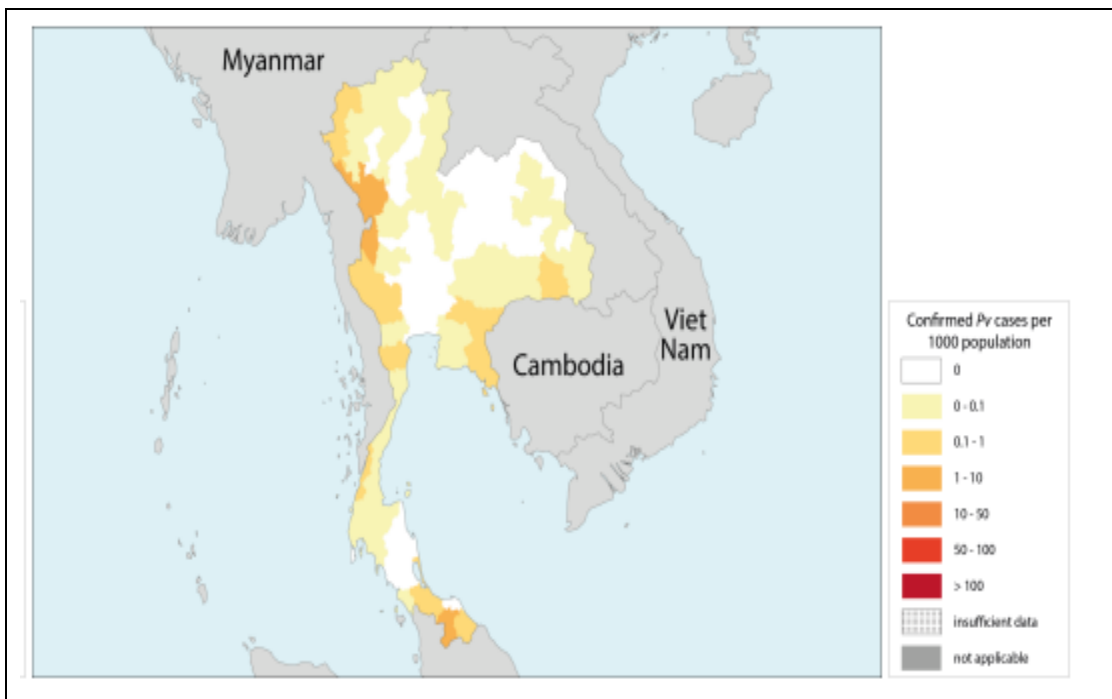


Fig.-5: Distribution of Malaria in Thailand caused by *P. vivax* [Source: (12)]



Discussion

The Government of Nepal's Malaria Elimination Program has stratified the country into high, moderate, low, and no-risk districts. This has been taken further down to the ward level. The aim is to make Nepal free from Malaria by 2026.¹³ The Nepal Malaria Strategic Plan spans the period 2014 to 2025. The focus is on Indoor Residual Spraying, use of Long Long-lasting Insecticide-treated Nets (LLINs) and solving of cross-border Malaria issues with India.¹⁴

According to Pakistan's Strategic Plan of the Malaria Control Program (2015-2020), the overall goal was to reduce, by 2020, the Malaria burden by 75% in the high and moderate endemic districts and to eliminate the disease in the low endemic districts.¹¹ Also, the sub-objectives were:

1. To achieve <5 API in high endemic areas of Balochistan, Sindh, Khyber Pakhtunkhwa, and Tribal Districts by 2020.
2. To achieve <1% API within moderate endemic districts of Balochistan, Sindh, Khyber Pakhtunkhwa, and Punjab by 2020.
3. To achieve Zero API within low endemic districts of Sindh, Khyber Pakhtunkhwa, and Punjab by 2020.

Whether the above could be done could not be ascertained since there are no annual reports after 2019. Probably, because the COVID-19 epidemic began in 2020 and continued throughout most of 2021, it is likely that the targets may have to be moved forward.

Thailand has been identified by the World Health Organization (WHO) as one of the countries having the potential to eliminate Malaria by 2025. This was based on its meeting the following conditions:

1. Having a national goal for Malaria elimination by 2025: - Thailand, through its National Strategic Plan for Malaria Elimination has set the target for 2024,
2. Recording an annual caseload that suggests elimination is feasible by 2025:- Thailand's figure of 2836 Malaria cases for 2020 is considered acceptable,
3. Having a nominated national Malaria programme: In Thailand, this falls under the Division of Vector Borne Diseases which also ensures that Malaria remains a notifiable disease.¹⁵

The Division of Vector Borne Diseases (DVBD), Department of Diseases Control, Ministry of Public Health, Thailand had conducted strategies of Malaria prevention and Malaria control very long time ago, before conducting National Malaria Elimination Strategy, Thailand (2017-2026). The DVBD implemented Malaria elimination operation plan, Thailand (2017-2021), and now aims and aligns with the Government's policy to eradicate Malaria by 2024. The Ministry of Public Health of the Kingdom of Thailand has followed Malaria program phases and milestone to Malaria elimination as defined by World Health Organization in 2007.

Conclusion

Movement of people across the Indo-Nepal border cannot be prevented. However, if anti-Malaria measures are improved in the districts of Uttar Pradesh and Bihar bordering Nepal, then the number of imported cases of Malaria from India to Nepal would decrease. In the same way, if anti-Malaria measures are improved in the districts of Nepal bordering India, then the number of imported cases of Malaria from Nepal to India would also come down.

The main species causing Malaria in Pakistan is *P. vivax*. This will prove a challenge to eliminate because of the hypnozoites that are difficult to treat which remain latent in the liver and cause recurrent attacks of the disease even if the initial phase is apparently cured.

Thailand has just 2 years more to go to meet its national target of Malaria elimination. It must put in all efforts to cover the last mile before the deadline.

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