Vital Surveillances

Epidemiological Characteristics, Risk Factors, and Countermeasures of Imported Malaria — China, 2017–2024

Zhigui Xia[1,&]; Tao Zhang[2,&]; Weidong Li[2]; Deye Meng[1]; Chi Zhang[1]; Boyu Yi[1]; Hejun Zhou[1]; Yuqi Dai[1]; Shizhu Li[1,#]

ABSTRACT

Introduction: This study aimed to analyze the epidemiological characteristics of imported malaria in China, identify transmission risks from the global malaria burden and China's international population exchanges, and propose a two-stage prevention and control strategy for overseas and post-entry periods of outbound personnel.

Methods: A descriptive epidemiological analysis was performed on the National Infectious Disease Surveillance Information System, including the number of patients with imported malaria, *Plasmodium* species distribution, spatiotemporal patterns, demographic characteristics, and countries of infection origin.

Results: Between 2017 and 2024, 16,571 patients with imported malaria, including 75 deaths, were reported, with a U-shaped temporal trend. The annual number of patients with imported malaria remained stable at 2,600–2,800 from 2017 to 2019, dropped to 798 in 2021, and rebounded to 3,155 in 2024. *Plasmodium falciparum* (10,593 patients) and *Plasmodium vivax* (3,288 patients) were the dominant species. *P. falciparum* was imported from Africa, whereas *P. vivax* was from Myanmar. Patients with imported malaria were distributed across China, with Yunnan, Guangdong, and Guangxi emerging as the top three provincial-level adminsitrative divisions (PLADs). The high-risk population was male overseas laborers aged 30–59. Severe illness and fatality rates among individuals with imported malaria remained low with no upward trend.

Conclusion: The global malaria epidemic and China's international exchanges have increased the pressure on malaria importation. Strengthening multisectoral collaboration in health services for outbound personnel and improving targeted surveillance and treatment capacity in key post-entry areas are crucial to prevent severe illness, deaths, and secondary transmission and to consolidate China's malaria elimination achievements.

China was certified malaria-free by the World Health Organization (WHO) in June 2021 after eliminating local mosquito-borne malaria transmission with no indigenous infections reported since 2017 (*1*). However, malaria remains a major global public health challenge, with the WHO reporting continuous growth in infections and deaths in recent years, especially in sub-Saharan Africa, where malaria transmission remains severe and uncontrolled. In 2024, the global infections exceeded 282 million, with an estimated 610,000 deaths, reflecting stagnant progress in elimination (*2*).

Meanwhile, China's opening-up and the Belt and Road Initiative have significantly expanded international population mobility, including overseas laborers, cross-border traders, and project personnel. This intensified international exchange has brought persistent and increasing import pressure on China, making imported malaria the main threat to its elimination achievements (*3*). Malaria vectors are still widely distributed in former endemic areas, especially in southern border provincial-level administrative divisions (PLADs), such as Yunnan (*4*). Delayed diagnosis and treatment of imported malaria infections increase severe illness and death risk, leading to introduced transmission if mosquito-borne transmission conditions are met (*5*).

In this context, analyzing the epidemiological characteristics of imported malaria in China from 2017 to 2024 based on national surveillance data is crucial for identifying key risk points, formulating scientific and targeted prevention strategies, and blocking reestablishment risk. This study aimed to systematically determine the temporal, spatial, and demographic distributions of imported malaria infections, providing evidence-based support for

national malaria surveillance and prevention.

METHODS

Data Source

Surveillance data, including imported malaria infections in China from January 2017 to December 2024, were collected from the National Infectious Disease Surveillance Information System. An imported malaria infection was defined as contracted outside the country where the diagnosis was made, including Chinese residents infected overseas and repatriated and foreign nationals who entered China with malaria. Induced infection: traced to blood transfusion or parenteral inoculation of the parasite but not natural mosquito-borne transmission. Introduced infection: contracted locally, linked to an imported infection (first-generation local transmission). Clinical infection: suspected infection with consistent clinical and epidemiological features, without laboratory parasitological confirmation. The collected variables included the number of infections, *Plasmodium* species, patient age, sex, occupation, country of infection, and reporting PLAD in China. All data were reported and verified in accordance with relevant guidelines and regulations ("the National Malaria Elimination Action Plan (2010–2020)" and "the Management Measures for Preventing Re-establishment of Malaria Transmission"), ensuring data accuracy and completeness.

Statistical Analysis

Descriptive epidemiological methods were used to analyze the temporal trend, spatial distribution, population demographics, *Plasmodium* species distribution, and origin of imported malaria infections. The severity rate was calculated as the proportion of severe malaria infections among total reported imported infections. All statistical analyses and data visualizations were performed using R (version 4.5.1; R Foundation for Statistical Computing, Vienna, Austria).

RESULTS

China reported no indigenous malaria infections between January 2017 and December 2024. Besides 8 induced, 5 recurrent long incubation periods, and 4 introduced infections (in 2018), 16,571 imported infections, including 75 deaths, were reported. The epidemiological characteristics of imported infections showed distinct temporal, species, spatial, and population distribution regularities, with overall low severe infections and fatality rates.

Temporal Trend of Imported Infections, Severe Infection Rate and Fatality Rate

The number of patients with imported malaria in China presented a U-shaped trend over 8 years

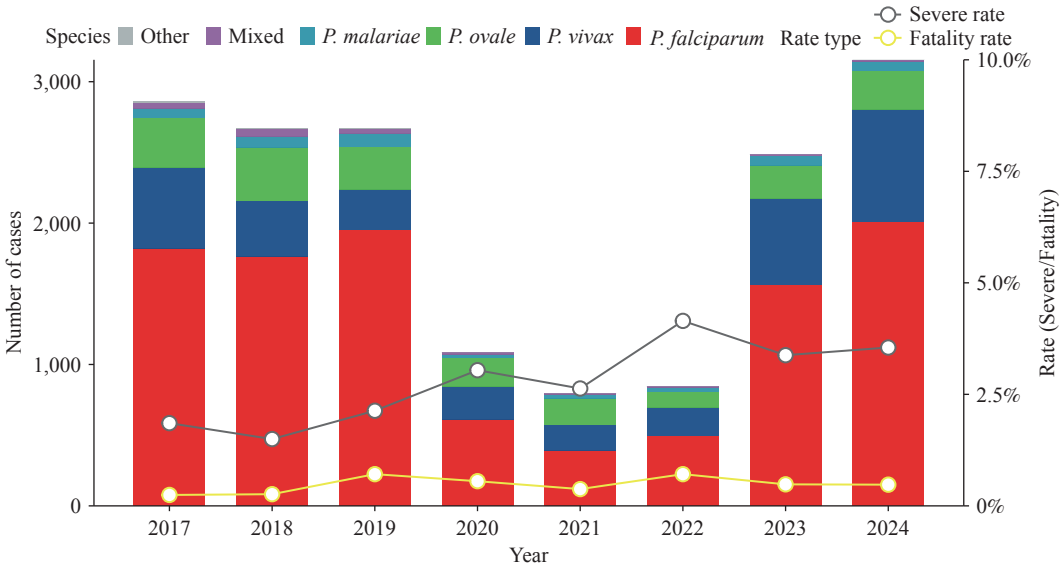


FIGURE 1. Temporal trends of imported malaria infections by *Plasmodium* species and in severe infection rate and fatality rate in China, 2017–2024.

(Figure 1). Annual infections were stable at 2600–2800 during 2017–2019, and subsequently dropped to 798 in 2021 (a 70.15% reduction from 2019). A rebound was observed, with the number of patients increasing to 3,155 in 2024, surpassing 2017–2019 levels. Severe imported malaria remained low at approximately 5% with no apparent upward trend; however, sporadic deaths were recorded each year, and most severe and fatal infections were caused by *Plasmodium falciparum*. From 2017 to 2024, 75 deaths were reported, with an average fatality rate of 0.45%. The number of deaths fluctuated, peaking at 19 in 2019 and dropping to 3 in 2021, then rising again (12 in 2023 and 15 in 2024).

Plasmodium Species Distribution

Imported malaria infections in China were dominated by two *Plasmodium* species: *P. falciparum* was the most prevalent species, followed by *P. vivax* (Figure 1). The total number of *P. falciparum* infections was 10,593 (63.92%), *P. vivax* 3288 (19.84%), *P. ovale* 2033 (12.27%), *P. malariae* 457 (2.76%), mixed infections 180 (1.09%), *P. knowlesi* 1, and 19 infections by clinical diagnosis in 2017–2019 (Table 1).

Geographic differentiation was evident in the species origin of the imported infections: *P. falciparum* was mainly from African countries, accounting for 75.27%

TABLE 1. Demographic characteristics of imported malaria infections in China, 2017–2024.

Characteristic	Number of patients	Proportion (%)
Sex		
Male	15,384	92.84
Female	1,187	7.16
Age group		
≤30 years	3,365	20.31
31–40 years	4,691	28.31
41–50 years	5,066	30.57
51–60 years	3,042	18.36
>60 years	407	2.46
Purpose of overseas travel		
Labor work	12,125	73.17
Business	1,495	9.02
Public affairs	761	4.59
Visiting relatives and friends	559	3.37
Tourism	240	1.45
Others/unknown	1,391	8.39
Region of travel		
Africa	13,941	84.13
Asia	2,444	14.75
Americas	42	0.25
Oceania	143	0.86
Species		
P. falciparum	10,593	63.92
P. vivax	3,288	19.84
P. ovale	2,033	12.27
P. malariae	457	2.76
Mixed infection	180	1.09
Clinical diagnosis	19	0.11
P. knowlesi	1	0.01

Abbreviation: *P. falciparum=Plasmodium falciparum*; *P. vivax=Plasmodium vivax*; *P. ovale=Plasmodium ovale*; *P. malariae=Plasmodium malariae*; *P. knowlesi=Plasmodium knowlesi*.

(10,490/13,936) of all malaria infections imported from Africa; *P. vivax* was predominantly from Asia, with Myanmar as the core origin, contributing 86.91% (2,019/2,323) of *P. vivax* infections from Asia.

Spatial Distribution of Imported Infections

Patients with imported malaria were distributed across China, showing substantial regional aggregation (Figure 2). Yunnan Province (2118 patients, 12.78%) had the highest number of patients with imported malaria, followed by Guangdong Province (1,534 patients, 9.22%) and Guangxi Zhuang Autonomous Region (1,308 patients, 7.89%). These high-incidence regions had frequent cross-border mobility (Yunnan, a border province) or many returnees (Guangdong, a coastal province). Other PLADs with high numbers of patients included Shandong, Henan, Sichuan, and Jiangsu, major labor export PLADs. In Yunnan Province, *P. vivax* comprised 89.42% (1,894 of 2,118) of the patients, unlike other PLADs where *P. falciparum* predominated.

Population Demographic Characteristics

Imported malaria infections showed a sex imbalance: male patients were 92.84% (15,384 patients) and female were 7.16% (1,187 patients) (Table 1). Infections were concentrated in the working-age population, with the 30–59 years old group accounting for over 79% of all patients. The 41–50 years old group was the largest (30.57%, 5,066 patients), followed by the 31–40 years old (28.31%, 4,691 patients), and 51–60 years old groups (18.36%, 3,042 patients) (Table 1). Age distribution across *Plasmodium* species showed no significant differences, with all species concentrated in the adult labor age group (Supplementary Figure S1, available at https://weekly.chinacdc.cn/). The ridgeline plot from 2017 to 2024 confirmed the concentration of patients in the 30–59 years old group, with no temporal shifts (Supplementary Figure S2, available at https://weekly.chinacdc.cn/).

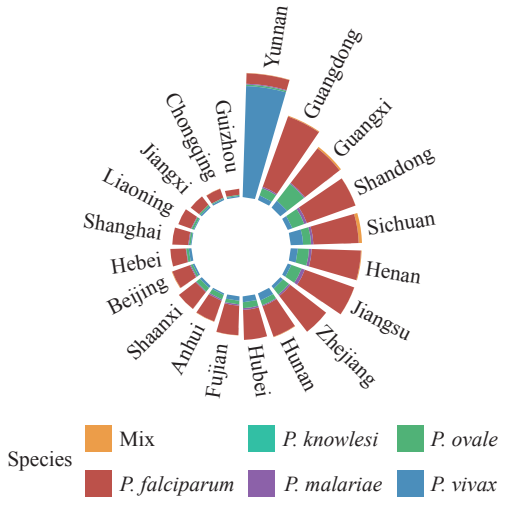


FIGURE 2. Spatial distribution of imported malaria infections in the top 20 PLADs of China, 2017–2024.

Overseas labor was the primary travel purpose for confirmed patients, with laborers accounting for 73.17% (12,125 patients) of the total patients with imported infections, the core high-risk population. Other purposes included business (9.02%, 1,495 patients), public affairs (4.59%, 761 patients), visiting relatives and friends (3.37%, 559 patients), and tourism (1.45%, 240 patients); 8.39% (1,391 patients) were other or unknown (Table 1).

Geographical Origin of Overseas Travel

Africa was the primary source of imported malaria in China, accounting for 84.13% (13,941 patients) of the population. Asia was the second major source, contributing 14.75% (2,444 patients). The Americas and Oceania were minor sources, only 0.25% (42 patients) and 0.86% (143 patients), respectively (Table 1). Among African countries, Nigeria (2,001 patients), the Democratic Republic of the Congo (DR Congo, 1,940 patients) and Guinea (1,147 patients) were top sources; Myanmar was the main source in Asia, with 2,019 *P. vivax* infections, exceeding those of other Asian countries (Figure 3).

DISCUSSION

Given the ongoing global malaria burden and the intensification of China's international population mobility under the Belt and Road Initiative, imported malaria remains a challenge to China's malaria elimination achievements (*6*). Surveillance results from 2017 to 2024 show that imported malaria in China is characterized by *P. falciparum* dominance, African and Southeast Asian sources, border and coastal PLAD aggregation, and overseas labor predominance. The U-shaped trend of imported infections was associated with real-world events, with a sharp decline from 2020 to 2021 mainly caused by strict coronavirus disease 2019 (COVID-19) border controls and reduced travel, whereas the rebound since 2022 reflects the recovery of

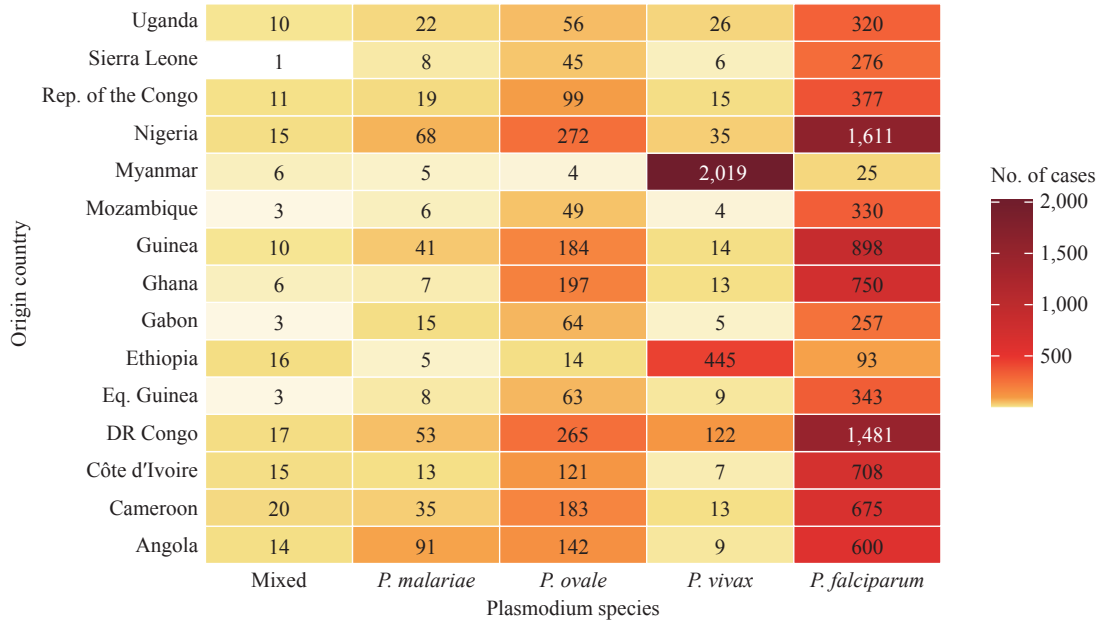


FIGURE 3. Distribution of *Plasmodium* species among imported malaria infections by major origin countries, 2017–2024.

international mobility and ongoing global malaria resurgence in endemic countries. Meanwhile, sporadic severe infections and deaths highlight gaps in imported malaria prevention and control. Based on the epidemiological characteristics and the full process of population outbound and entry, this study proposes a two-stage prevention and control strategy covering the overseas and post-entry periods, emphasizing multi-sector collaboration and precise intervention to establish a closed-loop management system.

Malaria prevention overseas reduces infection risk for outbound personnel in malaria-endemic areas by targeting high-risk population, overseas laborers, and conducting joint interventions with health, commerce, foreign affairs, and labor departments (*7*–*8*). Pre-departure health education and prevention guidance should be strengthened by establishing a training system for outbound laborers visiting malaria-endemic areas, focusing on malaria transmission routes, symptoms, preventive measures, and early treatment (*9*). On-site health services and medical support in overseas projects must be promoted by constructing medical and health service points in Chinese-funded projects in malaria-endemic areas; equipping professional medical personnel with complete diagnosis, treatment equipment, and drugs; and providing timely diagnosis and treatment for personnel with fever and other symptoms to avoid delayed treatment. Cooperation between Chinese overseas medical institutions and local health departments should be strengthened to share epidemic information, diagnoses, and treatment resources. Regular health monitoring and early warning should be conducted by temperature monitoring and symptom screening for outbound personnel in malaria-endemic areas, establishing a symptom reporting mechanism, and conducting rapid malaria testing for personnel with fever to achieve early detection and treatment, reducing the risk of severe illness and cross-border transmission.

The core of malaria prevention and control post-entry is blocking local secondary transmission from imported infections. The key is to focus on important PLADs (border and coastal areas) and populations (overseas laborers returning from malaria-endemic areas) to improve surveillance sensitivity. In China, a sensitive nationwide surveillance system should be maintained for timely detection, reporting, and investigation of all imported infections. Strengthening laboratory capacity for species identification and confirmation of *Plasmodium* infections is critical to reduce misdiagnosis and delayed treatment. Integrated monitoring covering patient detection, epidemiological investigation, vector surveillance, and response should be implemented to block potential secondary transmission and sustain a malaria-free status.

Targeted post-entry surveillance and screening should be strengthened by establishing a health declaration and malaria screening system for returnees from malaria-endemic areas, especially overseas laborers from Nigeria, the DR Congo, Myanmar, and other high-risk countries; conducting voluntary malaria testing at ports and designated medical institutions;

and monitoring for 30 days after entry for high-risk groups to detect patients with latent infection in a timely manner. This system should rely on facility-based malaria infection detection, supported by rapid investigation and public health responses from local Centers for Disease Control and Prevention.

Malaria diagnosis and treatment capacity of medical institutions in key areas should be improved by strengthening the training of medical staff in primary and secondary medical institutions in border PLADs such as Yunnan and coastal PLADs such as Guangdong and Shandong, improving early identification, differential diagnosis, standardized treatment of malaria, and equipping (*10*–*11*). Rapid diagnostic tests and first-line anti-malarial drugs are used to ensure imported infections are diagnosed and treated first (*12*). Severe malaria rescue capacity and emergency response should be enhanced by establishing a hierarchical rescue system for severe malaria, designating tertiary hospitals in each PLAD as designated hospitals for severe malaria rescue, equipping professional rescue teams, and complete rescue equipment (*13*). For confirmed imported infections, focus disposal in surrounding areas should be conducted to reduce the risk of local secondary transmission (*14*–*15*).

This study has certain limitations. First, the data are based on reported infections in the national infectious disease surveillance system, and some asymptomatic or mild imported infections may be underreported due to lack of medical treatment, mainly attributed to the high mobility of high-risk populations and their possible possession of anti-malarial drugs obtained overseas, leading to underestimation of the actual number of imported infections; Second, a comprehensive semi-quantitative and quantitative assessment of secondary transmission risk of imported malaria in key PLADs was not conducted, which involves integration and systematic analysis of multisource heterogeneous data, including vector distribution and primary medical care capacity. This exceeds the research scope and data acquisition limits and will be the focus of follow-up research. Third, the surveillance data lacked follow-up information on some patients with imported infections, limiting in-depth analysis of the latent period and transmission risk of different *Plasmodium* species.

The 8-year surveillance results from 2017 to 2024 confirm that China's malaria elimination achievement is stable and sustainable; however, increasing importation pressure indicates that malaria prevention and control work cannot be relaxed. The two-stage prevention and control strategy proposed for overseas and post-entry periods aligns with the epidemiological characteristics of imported malaria in China and the actual needs of international population mobility, and has important guiding significance for consolidating malaria elimination achievements. In the context of the ongoing global malaria burden and the deepening of the Belt and Road Initiative, malaria prevention and control in China has shifted from original elimination of local transmission to prevention of imported infections and secondary transmission. The surveillance results provide a scientific basis for revising national malaria prevention and control technical guidelines, and help optimize allocation of public health resources in key areas and populations.

China should maintain a sensitive malaria surveillance system, optimize detection and follow-up of at-risk populations, strengthen multi-sector and cross-regional collaboration (e.g., coordination between health and labor departments for pre-departure training, and between border PLADs for cross-regional infection tracking), and implement two-stage precise prevention and control measures comprehensively. Simultaneously, deepening international cooperation with malaria-endemic countries in epidemic information sharing, joint vector control, and drug resistance monitoring is crucial for reducing the global malaria burden. Only through such a comprehensive approach can China alleviate the import pressure of malaria and consolidate its malaria elimination achievements long term.

Conflicts of interest: No conflicts of interest.

Funding: Supported by the Anhui Provincial Health Commission Research Project (grant no: AHWJ2024Aa20278).

doi: 10.46234/ccdcw2026.124

[#] Corresponding author: Shizhu Li, lisz@chinacdc.cn.

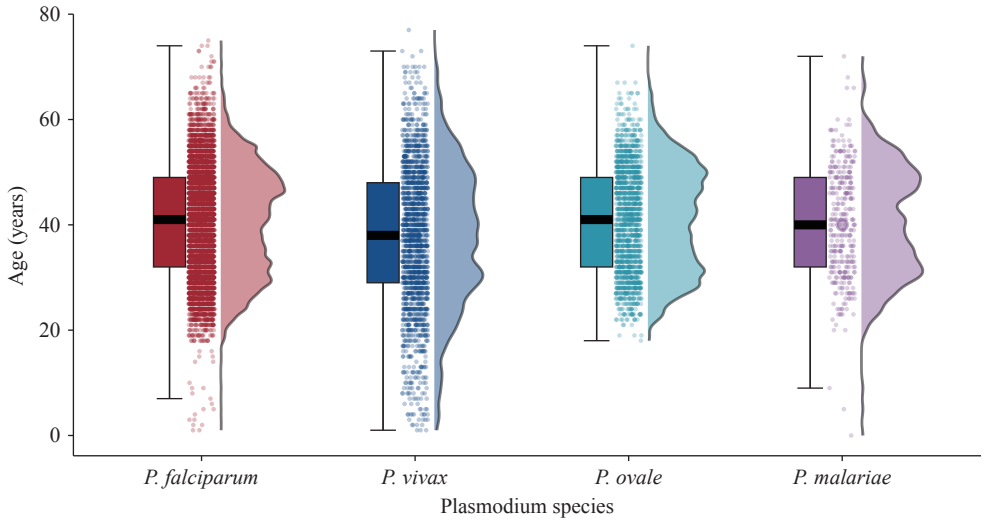
[1] National Key Laboratory of Intelligent Tracking and Forecasting for Infectious Diseases, National Health Commission Key Laboratory on Parasite and Vector Biology, WHO Collaborating Centre for Tropical Diseases, National Center for International Research on Tropical Diseases, Ministry of Science and Technology, National Institute of Parasitic Diseases, Chinese Center for Disease Control and Prevention (Chinese Center for Tropical Diseases Research), Shanghai, China; [2] Anhui Provincial Center for Disease Prevention and Control, Hefei City, Anhui Province, China.
[&] Joint first authors.

Submitted: March 10, 2026
Accepted: April 15, 2026
Issued: June 19, 2026

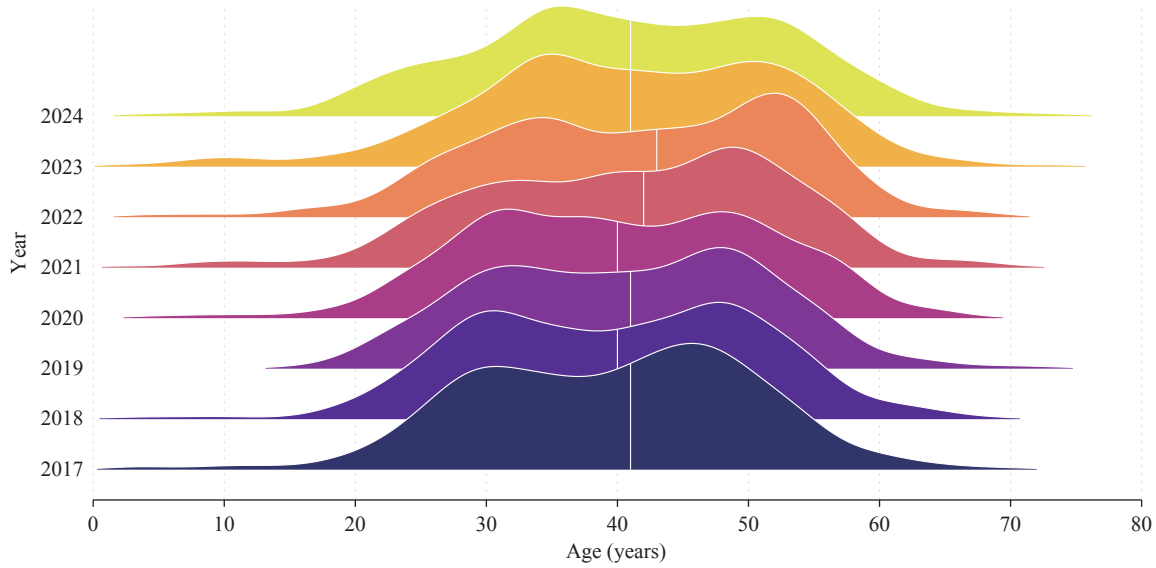
REFERENCES

1. Zhou XN. China declared malaria-free: a milestone in the world malaria eradication and Chinese public health. Infect Dis Poverty 2021;10(1):98. https://doi.org/10.1186/s40249-021-00882-9.
2. World Health Organization. World malaria report 2025: addressing the threat of antimalarial drug resistance. 2025. https://www.who.int/publications/i/item/9789240117822. [2025-12-4].
3. Yi B Y, Xia Z G. Risk factors for imported severe malaria cases — China, 2019-2023. China CDC Wkly 2025;7(18):602 – 8. https://doi.org/10.46234/ccdcw2025.100.
4. Zheng DS, Tian P, Yan GY, Lin ZR, Zhou HN, Liu XB, et al. Stratified vector control and proactive cross border collaboration for sustaining malaria elimination in Yunnan, China. BMJ 2025;389:e082300. https://doi.org/10.1136/bmj-2024-082300.
5. Zhang T, Wang DQ, Qian YJ, Ruan W, Liu Y, Xia J, et al. Profile and determinants of delayed care-seeking and diagnosis among patients with imported malaria: a retrospective study in China, 2014-2021. Infect Dis Poverty 2022;11(1):125. https://doi.org/10.1186/s40249-022-01050-3.
6. Yang S, Li RY, Yan SN, Yang HY, Cao ZY, Zhang L, et al. Risk assessment of imported malaria in China: a machine learning perspective. BMC Public Health 2024;24(1):865. https://doi.org/10.1186/s12889-024-17929-9.
7. Wang Y, Fang F, Li CY, Wang JJ, Lu GY, Huang YZ. Understanding international travelers' intentions to adopt protective behaviors against malaria during staying abroad: insights from a study of Chinese international travelers. Global Health 2025;21(1):39. https://doi.org/10.1186/s12992-025-01132-5.
8. Naing C, Whittaker MA, Tanner M. Inter-sectoral approaches for the prevention and control of malaria among the mobile and migrant populations: a scoping review. Malar J 2018;17(1):430. https://doi.org/10.1186/s12936-018-2562-4.
9. Zhang T, Xu X, Liu BW, Wang DQ, Ye XG, Jiang JJ, et al. Establishing and applying an adaptive framework for imported malaria: a field practice in Anhui Province, China from 2012 to 2022. BMC Public Health 2024;24(1):695. https://doi.org/10.1186/s12889-024-18239-w.
10. Yin JH, Zhang L, Yi BY, Zhou SS, Xia ZG. Regional heterogeneity of malaria healthcare seeking and diagnosis in China (2017-2022): implications in preventing re-establishment of malaria transmission. J Infect Public Health 2025;18(1):102601. https://doi.org/10.1016/j.jiph.2024.102601.
11. Yan H, Li M, Xia ZG, Yin JH. Competency of malaria laboratory diagnosis at national and provincial levels at the beginning of malaria post-elimination phase, China. Malar J 2024;23(1):58. https://doi.org/10.1186/s12936-024-04883-5.
12. Li WD, Zhang XZ, Feng J, Zhang T, Xu X, Jiang JJ, et al. Evaluation of the combination of rapid diagnostic tests and microscopy for imported malaria surveillance in Anhui Province, China. Acta Trop 2021;222:106042. https://doi.org/10.1016/j.actatropica.2021.106042.
13. Zhang L, Tu H, Zhou SS, Xia ZG, Feng J. Malaria deaths — China, 2011-2020. China CDC Wkly 2021;3(17):360 – 5. https://doi.org/10.46234/ccdcw2021.098.
14. Borton D. Preventing malaria spread in the US. Nursing 2024;54(3):21 – 8. https://doi.org/10.1097/01.NURSE.0001006264.42321.ff.
15. Yi BY, Zhang L, Yin JH, Zhou SS, Xia ZG. 1-3-7 surveillance and response approach in malaria elimination: China's practice and global adaptions. Malar J 2023;22(1):152. https://doi.org/10.1186/s12936-023-04580-9.

SUPPLEMENTARY MATERIAL



SUPPLEMENTARY FIGURE S1. Age distribution profiles of imported malaria infections by *Plasmodium* species in China, 2017–2024.



SUPPLEMENTARY FIGURE S2. Temporal evolution of age distribution for imported malaria infections in China, 2017–2024.