Preplanned Studies

Epidemiologic Characteristics and Spatial Dynamics of Severe Fever with Thrombocytopenia Syndrome in a High-Incidence Region — China, 2015–2024

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Summary

What is already known about this topic?

Severe fever with thrombocytopenia syndrome (SFTS) is an emerging tick-borne disease with a high mortality risk; however, long-term evidence on cross-provincial epidemiological and spatial patterns is limited.

What is added by this report?

Of the 20,210 cases in Anhui, Henan, and Hubei, the infections showed marked seasonal concentrations and spatial clustering, predominantly affecting older farmers. The spatial distribution expanded over time, with persistent high–high (H–H) clusters concentrated in the central portion of the study area; the spatial center shifted successively from Xin County to Shangcheng and Jinzhai Counties.

What are the implications for public health practice?

Cross-provincial surveillance and targeted prevention should prioritize high-risk corridors and adjacent expanding areas.

ABSTRACT

Introduction: Severe fever with thrombocytopenia syndrome (SFTS) is an emerging, tick-borne disease associated with a high mortality risk. Long-term epidemiological patterns and cross-provincial spatial dynamics are poorly characterized.

Methods: SFTS case data from 2015–2024 were obtained from the China Information System for Disease Control and Prevention. Anhui, Henan, and Hubei Provinces were selected as the study areas. Spatial autocorrelation, standard deviational ellipses, and mean center analyses were conducted to characterize the epidemiological features and spatial evolution of SFTS.

Results: A total of 20,210 SFTS cases were included, corresponding to a mean annual incidence of 0.93 cases per 100,000 population. Cases occurred predominantly from April to July, primarily among persons aged ≥50 years and farmers, accounting for 87.46% (17,676/20,210) and 86.51% (17,484/20,210), respectively. A strong, positive spatial autocorrelation was observed every year (Moran's I >0; P<0.001). High–high (H–H) clusters were concentrated in the central portions of the study area, spanning adjacent counties across the three provinces, and exhibited dynamic expansion and contraction over time. The spatial center shifted successively from Xin to Shangcheng and Jinzhai Counties.

Conclusion: The SFTS cases exhibited strong spatial clustering and geographic expansion. Enhanced surveillance and risk-stratified prevention and control should prioritize persistent H–H clusters and their expansion margins.

Severe fever with thrombocytopenia syndrome (SFTS) is an emerging, tick-borne, infectious disease caused by severe fever with thrombocytopenia syndrome virus (SFTSV) and is characterized by fever and thrombocytopenia. First reported in rural areas of Hubei and Henan Provinces in 2009 (*1*), SFTS has since imposed an increasing disease burden in China and has also been reported in other East Asian countries (*2*). As of April, 2026, SFTS has been managed as a Class B infectious disease in China (*3*).

Pronounced spatial heterogeneity has been reported in the distribution of SFTS; however, most studies have focused on individual provinces or localized areas (*4*–*5*). Tick vectors, animal hosts, environmental conditions, and human activities are not necessarily constrained by provincial boundaries, and analyses limited to individual provinces may overlook the spatial relationships between adjacent cross-border areas.

Accordingly, this study considered the nationwide distribution of SFTS cases and focused on Anhui,

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Henan, and Hubei provinces, which form a geographically-contiguous, high-burden region centered on the Dabie Mountains. The epidemiological characteristics and spatiotemporal dynamics of SFTS were examined to characterize province-specific and cross-provincial spatial patterns to provide evidence for more targeted prevention and control strategies.

The SFTS case and population data for January 1, 2015, through December 31, 2024, were obtained from the China Information System for Disease Control and Prevention. The administrative boundary data were obtained from the National Platform for Common Geospatial Information Services. The cases were assigned according to their current residential address. Seven major, high-incidence provinces were compared; Anhui, Henan, and Hubei were selected as the study areas.

County-level administrative units served as the units for spatial analysis. Global and local Moran's I statistics were calculated using a row-standardized, queen-contiguity spatial weight matrix. For the local Moran's I analysis, statistical significance was assessed using 999 permutations, and a false discovery rate (FDR) correction was applied to account for multiple testing. Standard deviational ellipse and mean center analyses, weighted by annual case counts, were used to characterize the spatial extent, predominant orientation, and movement of the spatial center of SFTS case distribution. Spatial analyses and data visualization were conducted using ArcMap (version 10.3; ESRI, Redlands, CA, USA).

From 2015–2024, 33,395 SFTS cases were reportedly increasing in China. Cases were concentrated in Shandong, Anhui, Henan, Hubei, Liaoning, Jiangsu, and Zhejiang. The mean annual incidence was highest in Anhui, followed by Hubei, Shandong, and Henan. The peak incidence occurred in May in five provinces, in June in Shandong, and July in Liaoning. Cases predominantly affected farmers; most were 70–79 year-age group in Anhui and 60–69 year-age group elsewhere; females predominated, except in Liaoning, Jiangsu, and Zhejiang (Supplementary Table S1, available at https://weekly.chinacdc.cn/).

From 2015–2024, Anhui, Henan, and Hubei provinces reported 20,210 cases, 60.52% (20,210/33,395) of the national count. Given their geographic contiguity and shared location around the Dabie Mountains, these three provinces were selected as the study area because of their broadly-similar topographic and ecological characteristics.

Within the study area, the mean annual incidence was 0.93 cases per 100,000 population and increased

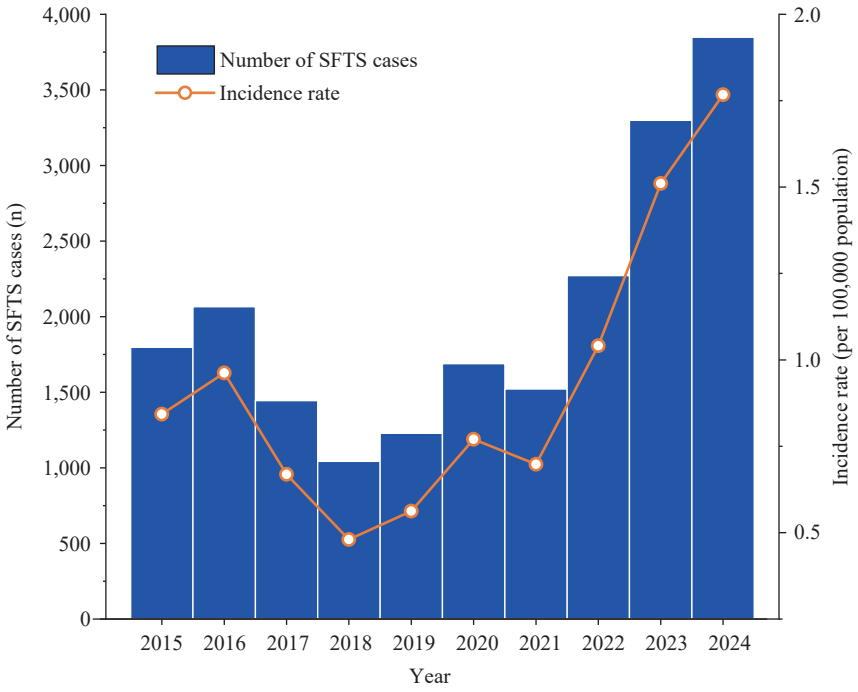

FIGURE 1. Annual severe fever with thrombocytopenia syndrome (SFTS) case counts and incidence in Anhui, Henan, and Hubei Provinces, China, 2015–2024.

over time (χ^2_{trend}=1,578.15, P<0.001; Figure 1). Females accounted for 55.00% (11,115/20,210) of cases, persons aged ≥50 years for 87.46% (17,676/20,210), and farmers for 86.51% (17,484/20,210); cases occurred mainly from April–July and peaked in May.

These cases were reported in 44 prefecture- and 228 county-level units. The highest cumulative case counts were recorded in Xinyang, Huanggang, Chuzhou, Suizhou, Hefei, and Lu'an. The number of affected counties increased from 101 in 2015 to 165 in 2024.

Province-specific spatial autocorrelation analyses using cumulative cases from 2015–2024 showed a strong, positive spatial autocorrelation in Anhui, Henan, and Hubei (Moran's I >0, P<0.001). High–high (H–H) clusters were identified in Anhui and Henan but not in Hubei, whereas analysis of the combined study area showed a more spatially-continuous H–H pattern.

Annual analyses indicated strong, positive spatial autocorrelation throughout 2015–2024, with global Moran's I of 0.47–0.58 (P<0.001). The H–H clusters persisted in the central portion of the study area, expanding from 2015–2018, contracting from 2019–2022, and rapidly expanding after 2023. Low-high (L–H) and high-low (H–L) outliers occurred intermittently, whereas low-low (L–L) clusters were observed only in 2024 in the northern portion of the study area (Figure 2).

From 2015–2024, the annual mean center of the SFTS case distribution shifted between Xin, Shangcheng, and Jinzhai Counties (Figure 3). The major semi-axis of the standard deviational ellipse increased from 155.73 km to 224.59 km, whereas the minor semi-axis increased from 85.28 km to 116.29 km, and the ellipse area increased from 41,718.76 km^2 to 82,039.36 km^2. The major-to-minor semi-axis ratio increased from 1.83 to 2.01, and the rotation angle decreased from 89.00° to 74.01°, indicating a shift toward a more northeast–southwest orientation.

DISCUSSION

From 2015–2024, the number of cases increased,

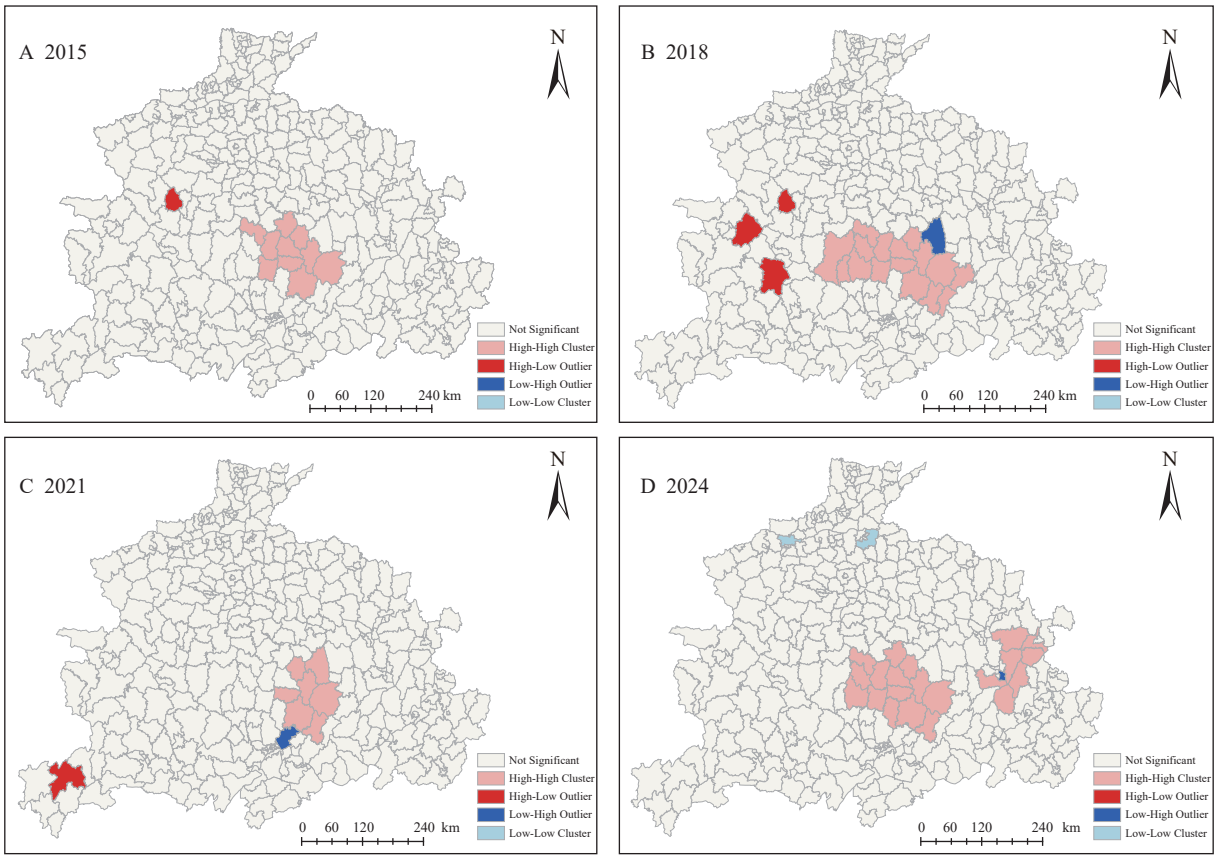

FIGURE 2. Local spatial autocorrelation analysis of severe fever with thrombocytopenia syndrome (SFTS) cases in Anhui, Henan, and Hubei Provinces, China, (A) 2015, (B) 2018, (C) 2021, and (D) 2024.
Map approval number: GS 京 (2026)2351 号.

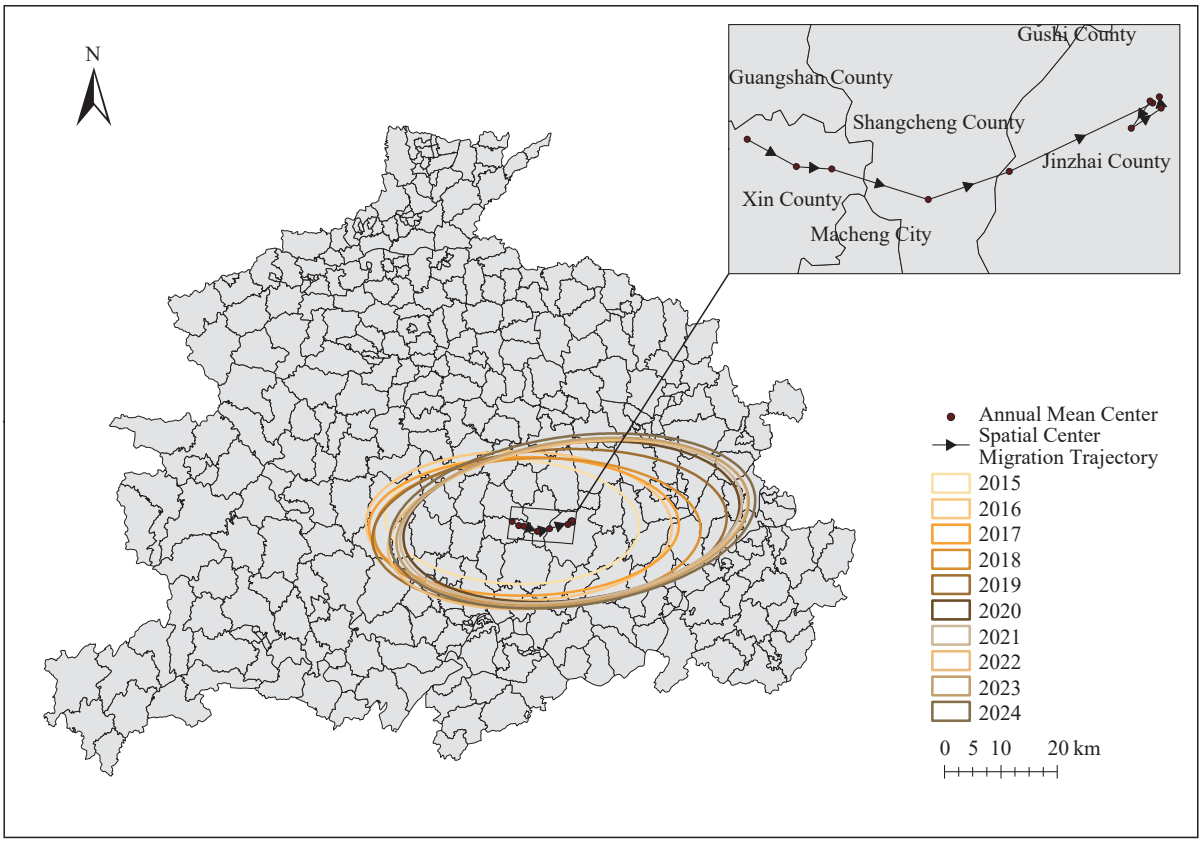

FIGURE 3. Standard deviational ellipses and spatial center migration trajectories of severe fever with thrombocytopenia syndrome (SFTS) cases in Anhui, Henan, and Hubei Provinces, China, 2015–2024.
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with year-to-year fluctuations. Most cases occurred among farmers aged ≥50 years and were concentrated in April–July. A similar predominance of older adults and farmers was observed across the seven high-incidence provinces, although the peak month, age group, and sex distributions varied. The cases were concentrated in Xinyang, Huanggang, Suizhou, and Lu'an, consistent with previous studies (*5*–*6*).

Province-specific analyses showed a strong, positive spatial autocorrelation in all three provinces, although the local clustering patterns differed. H–H clusters were identified in Anhui and Henan but not in Hubei. The combined three-province study area indicated a more spatially-continuous H–H pattern across the central cross-provincial area, likely because the spatial relationships between adjacent cross-border counties were retained. These findings highlight the complementary value of province-specific and cross-provincial analyses.

Annual spatial autocorrelation analysis showed persistent county-level clustering, with H–H clusters concentrated in the central portion of the study area. This pattern reflects the ecological characteristics of the Dabie Mountains, where a warm, humid climate and vegetated hilly terrain are favorable for ticks and their animal hosts. Climate, land cover, terrain, and habitat suitability of *H. longicornis* are important factors associated with the spatiotemporal distribution of SFTS (*7*); nonlinear and lagged effects of hydrological conditions on SFTS dynamics have been reported in China (*8*). SFTSV can be maintained in *H. longicornis* through transovarial and transstadial transmission (*9*), and parthenogenetic reproduction may facilitate the establishment and spread of tick populations. Livestock and wildlife may disperse attached ticks across adjacent areas, linking local transmission cycles (*9*). These mechanisms may contribute to the observed clustering, but were not directly assessed in the current study.

The standard deviational ellipse and mean center analysis showed a shift from a near-east–west orientation to a northeast–southwest orientation, together with geographic expansion and movement of the spatial center between Xin, Shangcheng, and Jinzhai Counties. This differed from the northwest–southeast orientation reported by Qu et al. in Henan Province (*10*), possibly reflecting differences

in spatial scale. The province-specific heterogeneity observed in the present study supports this interpretation.

Strengthened cross-provincial coordination and risk-stratified control is needed. Persistent H–H clusters should receive priority, with integrated surveillance of human cases, ticks, and animal hosts, targeted vector control in high-exposure settings, cross-provincial information sharing, and joint epidemiologic investigation. Counties at the expanding margins of H–H clusters should focus on early warnings, rapid verification of newly-emerging cases, and strengthened clinical recognition in primary-care facilities. Areas without persistent clustering should maintain routine surveillance, reporting capacity, and periodic training. Under the current Class B infectious disease management framework, these tiered measures should be integrated with standardized case reporting, epidemiological investigations, and health education for populations with frequent outdoor exposure.

This study had three limitations. First, county-level administrative units were used as spatial analysis units; differences between counties may have introduced potential scale-related effects on the observed spatial patterns. Second, meteorological, vegetation, and livestock-related variables were not included in quantitative attribution models, limiting assessment of the factors underlying the observed spatial patterns. Finally, the lack of animal surveillance data precluded linked analyses of animal infection and human cases.

The SFTS cases in the study area exhibited clear temporal and demographic patterns, strong spatial clustering, and continued geographic expansion. Persistent H–H clusters were concentrated in the central portion of the study area, whereas the annual mean center shifted between counties in the Dabie Mountain region, reflecting dynamic changes in the spatial distribution of cases. These findings identify priority areas for surveillance and provide evidence to support more targeted prevention and control measures for SFTS.

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SUPPLEMENTARY MATERIALS

SUPPLEMENTARY TABLE S1. Demographic and epidemiological characteristics of severe fever with thrombocytopenia syndrome (SFTS) cases in seven provinces of China, 2015–2024.

Province	Cases (*n*)	Mean annual incidence(10^{-5})	Peak month	Predominant age group (%)	Farmers (%)	Male/Female ratio
Shandong	8,599	0.86	Jun	60–69 (33.61)	83.72	0.97:1
Anhui	7,679	1.24	May	70–79 (30.16)	82.48	0.87:1
Henan	6,363	0.66	May	60–69 (30.98)	95.69	0.71:1
Hubei	6,168	1.05	May	60–69 (34.14)	82.05	0.88:1
Liaoning	1,796	0.42	Jul	60–69 (32.74)	63.25	1.11:1
Jiangsu	1,326	0.16	May	60–69 (32.35)	63.80	1.03:1
Zhejiang	1,036	0.17	May	60–69 (31.18)	76.16	1.10:1

Note: Mean annual incidence is expressed per 100,000 population. Age groups were categorized as 0–9, 10–19, 20–29, 30–39, 40–49, 50–59, 60–69, 70–79, and ≥80 years. Peak month refers to the month with the highest number of cases.