Research Square

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Brucellosis infection increasing in Southwest China

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Abstract

Background

Brucellosis is a global zoonotic disease that has been traditionally prevalent in the northern pastoral regions of China. In recent years, with the development of animal husbandry and other contributing factors, the epidemic in southwestern China has shown rapid growth and spread, becoming a major public health concern.

Methods

This study retrospectively analyzed 188 hospitalized brucellosis cases at Chengdu Public Health Clinical Medical Center from 2017 to 2024 and 1453 registered cases at the Sichuan Provincial Center for Disease Control and Prevention from 2020 to 2024. Data were statistically analyzed using SPSS and R software.

Results

The number of brucellosis cases in Sichuan Province increased from 129 in 2020 to 452 in 2024. Hospitalized cases rose from 5 in 2017 to 61 in 2024, and the number of affected counties expanded from 53 to 110. The peak incidence occurred from February to August. Hospitalized cases were predominantly young and middle-aged males, with a male-to-female ratio of 3:1. Common symptoms included lower back pain and fever. Double and triple antibiotic regimens were the main treatments.

Conclusions

The incidence of brucellosis in southwestern China has been increasing and spreading in recent years, showing distinct epidemiological characteristics. A targeted prevention and control system is needed.

Background

Brucellosis is a global zoonosis. In China, it is managed as a Class B infectious disease. In recent years, the reported incidence has shown a clear upward trend [1]. Brucellosis was traditionally prevalent in northern pastoral regions, such as Inner Mongolia and Xinjiang [2, 3]. However, recent epidemiological data indicate that in southern regions, particularly the southwestern provinces, with the expansion of animal husbandry and the acceleration of animal and product circulation, the number of reported cases of brucellosis have markedly increased and have become a major public health concern [4].

Although there have been relevant reports on human brucellosis in northern China and some southern regions, however, there are still many uncertainties regarding the incidence and prevalence of brucellosis

in the southwestern region of China, as well as in terms of clinical diagnosis and treatment. The epidemic in southwestern China has shown a rapid increase and spatial spread in recent years. Multi-source surveillance data indicate that the incidence growth rate in this region is much higher than the national average, and the affected areas are expanding from traditional high-incidence zones to surrounding regions [4]. Studies on this topic in the southwestern region of China, which is the frontier area where brucellosis spreads from pastoral areas to agricultural areas, are relatively scarce. This article aims to systematically review the epidemiological characteristics, trends, and clinical features of brucellosis in southwestern China, providing data support for further research.

Methods

Study Design and Population

The Public Health Clinical Center of Chengdu (PHCC) is a tertiary infectious disease hospital with 26 clinical departments and 1200 beds. As a key referral center, it serves as the designated hospital for infectious diseases in Chengdu, the most representative central city in Southwest China. This study was based on discharge records of brucellosis cases from PHCC and the annual registration data of brucellosis from the Sichuan Provincial Center for Disease Control and Prevention (CDC). A total of 1453 cases registered with the Sichuan CDC from 2020 to 2024 and 188 inpatients with clinically diagnosed or laboratory-confirmed brucellosis admitted to PHCC between 2017 and 2024 were included in this retrospective analysis.

Variables and outcomes

For the 188 inpatients with brucellosis in PHCC, data were extracted from the hospital information system (HIS), including sociodemographic, brucellosis-related, and outcome variables. Sociodemographic variables included sex, age (It is divided into four groups: <18, 18–39, 40–60 and > 60 years old), ethnicity, and habitual residence. Brucellosis-related variables included exposure history (In the past six months, there has been contact with animals; Eating raw meat or unprocessed dairy products; History of contact with a confirmed brucellosis patient and other routes include veterinarian, animal trade, animal product processing and sheep clipping, etc.), medical history, clinical and laboratory findings, antibiotic treatment, and focal involvement (focal bone destruction, involving the cervical vertebrae, lumbar vertebrae, etc.). Outcome variables included treatment results and length of hospital stay. From the Sichuan CDC, the number of registered cases, months of onset, and number of counties involved were collected for the past five years.

Diagnostic criteria

Brucellosis cases were classified as probable (clinically diagnosed) or confirmed (laboratory confirmed) according to the guidelines for human brucellosis diagnosis issued by the Chinese national health

authorities in 2007 (Diagnostic Criteria for Brucellosis, WS 269–2007 / WS 269–2019) [5]. Probable cases were diagnosed by experienced physicians based on anamnesis, epidemiologic exposure, clinical manifestations, and/or positive results from presumptive laboratory tests, including the plate agglutination test and intradermal allergic reaction test. Confirmed cases were defined as probable cases with one positive result from the following: standard tube agglutination test, complement fixation test, Coombs test, cysteine test for serologic diagnosis, or isolation of Brucella spp.

Treatment and follow-up

Inpatients received different combinations of antibiotics according to China's Practice Guideline for brucellosis diagnosis and treatment [6]. Treatment regimens included doxycycline (100 mg every 12 h), rifampin (600–900 mg every 24 h), intramuscular streptomycin (15 mg/kg every 24 h), levofloxacin (200 mg every 12 h), ciprofloxacin (750 mg every 12 h), and cotrimoxazole (960 mg every 12 h). For children under 8 years of age and pregnant women, rifampin (600–900 mg every 24 h) was the only antibiotic prescribed.

Data analysis

Two heat maps and annual incidence trend charts were generated (Time series of monthly cases, 2017 to 2024, standardized by the annual number of cases reported by Sichuan province and registered cases of hospitalization at PHCC), showing the number of brucellosis cases hospitalized in PHCC from 2017 to 2024 and cases registered by the Sichuan CDC over the past five years, to explore incidence trends and seasonal patterns in southwestern China.

Information on habitual residence was collected for all hospitalized cases, coded according to geographic location, and matched to a 1:100,000 digital map of China using Python 3.7. Geographic distribution charts were created for both China and Sichuan Province.

Statistical Analysis

Data were analyzed using SPSS Statistics 19.0 (SPSS Inc., IL, USA). Quantitative variables were described as mean ± SD. Kolmogorov Smirnov is used to test the normality of the data and analysis of variance was applied for intergroup comparisons when the distribution was normal, while Mann-Whitney U nonparametric tests were used when it was not. Categorical variables were described as frequency (percentage), and intergroup comparisons were performed using the chi-square test or Fisher's exact test. The type of antibiotic treatment plan to the length of hospital stay and the outcome of the case use survival curve Log-rank test. A P value < 0.05 was considered statistically significant. R statistical software (version 4.4.2, R Foundation for Statistical Computing, Vienna, Austria) with the ggplot2 package (version 3.5.1) was used to generate graphs and heat maps, and to conduct statistical analyses and predictions.

Results

Disease incidence trend and geographical distribution

A total of 1,453 human brucellosis cases were reported in the Sichuan province during 2020 to 2024, the annual incidence rate from 0.15 /100,000 in 2020 to 0.54/100,000 in 2024 (P = 0.0034) (Fig. 1, panel B), with an annual average incidence rate of 0.35/100,000. The annual case numbers were 2020, 129 cases; 2021: 199 cases; 2022: 256 cases; 2023: 417 cases; 2024: 452 cases. The number of affected counties rose from 53 in 2020 to 110 in 2024 (P = 0.0056) (Fig. 1, panel B).

The peak incidence occurred between February and August, accounting for 74.12% (1077/1453) of all cases (Fig. 1, panel A). Between 2017 and 2024, 188 probable (clinically diagnosed) or confirmed (laboratory confirmed) inpatients with brucellosis were admitted to PHCC (median 13/year, IQR 10–61). The annual number of cases fluctuated during the 8 years studied (Fig. 2, panel B). Before 2020, inpatient numbers remained relatively stable, but after 2020, hospitalizations began to rise steadily, from 5 cases in 2017 to 61 in 2024 (P = 0.002) (Fig. 2, panel B). This suggests that case inpatient numbers will likely continue to increase in the coming years. Among hospitalized patients, 81.4% (153/188) were admitted between March and October (Fig. 1, panel A).

Geographically, most hospitalized cases originated from Xinjiang, Tibet, and other regions outside Sichuan Province (Fig. 3, panel A). Within Sichuan, cases were mainly concentrated in Liangshan Yi Autonomous Prefecture, Chongzhou City of Chengdu, and surrounding areas including Jintang, Meishan, and Ziyang (Fig. 3, panel B) (Fig. 4) (Fig. 5).

Demographic and clinical characteristics of brucellosis inpatients

Among the 188 hospitalized patients, 75.0% (141/188) were male and 25.0% (47/188) were female, with a male-to-female ratio of 3:1. The mean age was 49.07 ± 13.51 years (IQR 43–58 years). Of these, 2.1% (4/188) were < 18 years, 18.6% (35/188) were 18–39 years, 62.8% (118/188) were 40–60 years, and 16.5% (31/188) were > 60 years. By ethnicity, the Han group accounted for the highest proportion (84.0%, 158/188), followed by Yi (8.0%, 15/188) and Tibetan (5.9%, 11/188) (Table 1). Regarding exposure, 88.3% of patients had a history of animal contact or were engaged in animal-related occupations, 4.8% had consumed raw meat or unprocessed dairy products, and 3.7% reported contact with a confirmed patient. The most common clinical symptoms were low back pain (65.4%, 123/188), fever (63.8%, 120/188), and joint pain (23.9%, 45/188). The most frequent comorbidities were liver dysfunction (38.3%, 72/188), lumbar spine lesions (29.8%, 56/188), and chronic gastritis (10.6%, 20/188). The mean length of hospital stay was 21.5 ± 9.82 days (range, 2–50 days). Among all patients, 98.9% (186/188) were discharged after improvement, while 1.1% (2/188) requested early discharge for personal reasons (Table 1).

Laboratory testing revealed increased erythrocyte sedimentation rate (69.15%, 130/188) and C-reactive protein (56.91%, 107/188). Elevated GGT and ALT were observed in 39.36% (74/188) and 28.19%

(53/188) of patients, respectively. The serum agglutination test was positive in 90.43% (170/188) of cases, with a high proportion showing strong positivity (Table 2).

Treatment and outcomes

Different antibiotic regimens were used among patients. Of the 188 hospitalized cases, treatments included single, dual, triple, and quadruple therapy, with dual and triple regimens being the most common. The most frequent dual regimen was doxycycline plus rifampicin (23.40%, 44/188), used in 20 patients (45.45%). The next most common was doxycycline plus ceftriaxone, used in 4 patients (18.18%). Triple therapy was the predominant regimen (71.28%, 134/188), including doxycycline combined with rifampicin and ceftriaxone (45.52%, 61/134), doxycycline with rifampicin and levofloxacin (29.85%, 40/134), and doxycycline with rifampicin and ciprofloxacin (13.43%, 18/134). A complete list of regimens is shown in Table 3. The type of antibiotic treatment plan has no statistical significance in relation to the length of hospital stay and the outcome of the case ($P = 0.8408$). Patients receiving dual therapy had the shortest mean hospital stay (16.97 days), while those on monotherapy had the longest (25.2 days).

Discussion

In this study, the epidemiological characteristics of brucellosis in Southwest China were dynamically described based on big data analysis. The analysis included the number of registered cases reported to the Sichuan Provincial CDC over the past 5 years, as well as cases diagnosed and treated at PHCC, the most representative central hospital in the region, over the past 8 years. These findings provide a theoretical basis for the clinical diagnosis, treatment, and epidemiological assessment of brucellosis in the population of Southwest China.

Traditionally, brucellosis has been prevalent in the northern pastoral areas of China, such as Inner Mongolia and Xinjiang. However, recent epidemiological data show that the epidemic growth trend is particularly evident in the southern regions, especially the southwestern provinces [4]. This indicates that the epidemic pattern of brucellosis in China is undergoing major changes, with the southwest becoming a new hotspot, requiring urgent strengthening of surveillance, prevention, and control. The present study also shows that case numbers are increasing and spreading annually. In addition to inpatients from other provinces, mainly Xinjiang and Tibet, cases within Sichuan were concentrated in Liangshan Yi Autonomous Prefecture, Chongzhou in Chengdu, and surrounding areas such as Jintang, Meishan, and Ziyang. Sporadic cases were also observed in other regions, showing the characteristics of both wide distribution and local clustering. Cases were spread across multiple cities and prefectures, while also being concentrated in specific breeding areas, which complicates the coverage of prevention and control measures. Transmission differs significantly from the large-scale grazing seen in northern pastoral areas [3, 7]. Registered cases in Sichuan were mainly reported from February to August (1077/1453, 74.12%), while 81.4% of inpatient cases occurred between March and October. This may be due to the prolonged disease course after early infection and longer hospital stays compared with registered cases. The seasonal distribution differs slightly from that in northern pastoral areas, where cases are mainly

reported from March to August [3]. This difference may be related to variations in local farming practices and climate.

Brucellosis is primarily transmitted through contact with secretions or excreta of infected animals (such as cattle, sheep, and pigs) or through consumption of undercooked meat and unpasteurized milk. In this study, hospitalized cases in Southwest China were mainly young and middle-aged males, accounting for 75.0% of patients (male-to-female ratio 3:1). Most cases occurred between 18–60 years of age (81.4%). Young and middle-aged males, who are the main workforce in grazing, breeding, slaughtering, and fur processing, are at higher risk due to frequent occupational exposure. These differences in gender and age distribution are likely due to occupational roles and labor patterns rather than gender-related susceptibility [8, 9]. A total of 88.3% of patients reported animal exposure or animal-related occupations, mostly involving contact with sheep. This may be linked to the expansion of animal husbandry, especially sheep and cattle farming, and increased circulation of animals and animal products in recent years. Many cases were associated with occupations such as veterinary work, animal trading, animal product processing, and sheep shearing, suggesting that live animal trade, mobility, and meat processing are critical links in the spread of brucellosis [10]. In addition, research from Punjab, Pakistan reported a higher detection rate of Brucella in raw milk (16.7%) compared with animal feces (7.5%) [11]. In some ethnic minority communities in Southwest China, raw milk consumption is common, representing an important transmission risk. Although human-to-human transmission of brucellosis is extremely rare, isolated reports exist [12, 13]. In this study, 7 patients (3.7%) reported contact with confirmed cases, suggesting that their infection may be due to shared environmental exposures or repeated exposure to contaminated materials from patients. To reduce exposure risk and prevent bloodborne infections, public awareness and protective measures should be strengthened when in contact with animals or contaminated materials.

Clinical manifestations of brucellosis are complex and diverse. Early assessment is mainly based on clinical examination and laboratory testing. Common symptoms include undulating fever, excessive sweating, fatigue, and joint pain. These nonspecific features often lead to misdiagnosis as other febrile illnesses, resulting in chronic disease and complications such as spondylitis and arthritis [14–16]. In this study, clinical characteristics of hospitalized cases in Southwest China were consistent with those reported in other regions [2, 17]. The most frequent symptoms were fever (63.8%), low back pain (65.4%), and joint pain (23.9%), while sweating and night sweats were less common (6.4%). Laboratory findings showed marked increases in erythrocyte sedimentation rate and C-reactive protein, reflecting acute inflammatory responses. These indicators are useful for monitoring disease progression. The liver, as the largest organ in the reticuloendothelial system, plays a key role in resistance to Brucella. Liver involvement is common in human brucellosis and often presents as diffuse lesions [18]. In this study, elevations of GGT (39.36%) and ALT (28.19%) were observed.

The cornerstone of brucellosis treatment is to eradicate the pathogen, relieve symptoms, and prevent complications. Antibiotics remain the mainstay. Because Brucella is an intracellular pathogen, single-agent therapy is often insufficient for eradication. Combination regimens are preferred as they target

both intracellular and extracellular bacteria and reduce drug resistance. Multi-drug therapy (2–3 agents in combination) improves efficacy, lowers recurrence, and prevents resistance. The preferred regimen for acute adult cases is doxycycline plus rifampicin. In this study, this dual therapy (23.40%) was the most common combination. For chronic or relapsed cases, additional agents are required. WHO and national guidelines recommend triple therapy [19–21], usually doxycycline and rifampicin combined with an aminoglycoside (e.g., gentamicin), a quinolone (e.g., levofloxacin), or a third-generation cephalosporin (e.g., ceftriaxone). In this study, triple therapy (71.28%) was the most frequent regimen, with doxycycline-rifampicin-ceftriaxone and doxycycline-rifampicin-levofloxacin as the main combinations. This may reflect the fact that PHCC, as the largest infectious disease referral hospital in the region, mainly treats severe cases.

This study has several limitations. First, it included case registrations from the Sichuan CDC over the past 5 years and hospitalization data from PHCC over the past 8 years. Although both institutions are representative of infectious disease prevention and treatment in Southwest China, some data were incomplete, including county information and demographic details. Second, brucellosis treatment usually lasts at least 6 weeks, with complex cases requiring 3–6 months. Hospital stay varied greatly, and some patients were lost to follow-up. In future research, full follow-up will be strengthened to avoid delayed diagnosis and improve outcomes.

Conclusions

The incidence of brucellosis in Southwest China has been rising and spreading in recent years. Hospitalized cases were mainly young and middle-aged males, reflecting occupational exposure. The most common symptoms were fever and lower back or joint pain. The main transmission risks are linked to animal husbandry, with direct contact with infected animals (especially sheep) and animal products being the primary route. Compared with northern pastoral areas, the epidemic in the southwest has three distinctive features: (1) coexistence of wide dispersion and local clustering; (2) predominance of small-scale free-range farming rather than large ranching; and (3) seasonal concentration in spring and summer (February–August). As an emerging epidemic region, awareness of brucellosis remains low among grassroots medical staff and farmers, leading to delayed diagnosis and underreporting. Prevention and control therefore face unique challenges, and it is urgent to establish a scientific prevention and control system adapted to the characteristics of the region.

Declarations

Ethics approval and consent to participate

The study protocol was reviewed and approved by the Medical Ethics Committee of Chengdu Public Health Clinical Center (Approval No. YJ-K2023-08-01) and adhered to the Declaration of Helsinki. As all patients data were obtained through routine clinical care and the mandatory national tuberculosis reporting system, the requirement for individual informed consent was waived by the ethics committee.

Consent for publication

Not applicable.

Availability of data and materials

All data generated or analyzed during this study are included in this article. Further enquiries can be directed to the corresponding author.

Competing interests

The authors declare that they have no competing interests.

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Author contributions

YL is the corresponding author. DMW: first draft writing, review, editing, conceptualization, methodology, data acquisition; SFX: data acquisition, figures, review and editing; QA: data acquisition, review and editing; CHL data acquisition, resources YL: conceptualization, review, editing, methodology and supervision.

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Tables

Tables 1 to 3 are available in the Supplementary Files section.

Figures

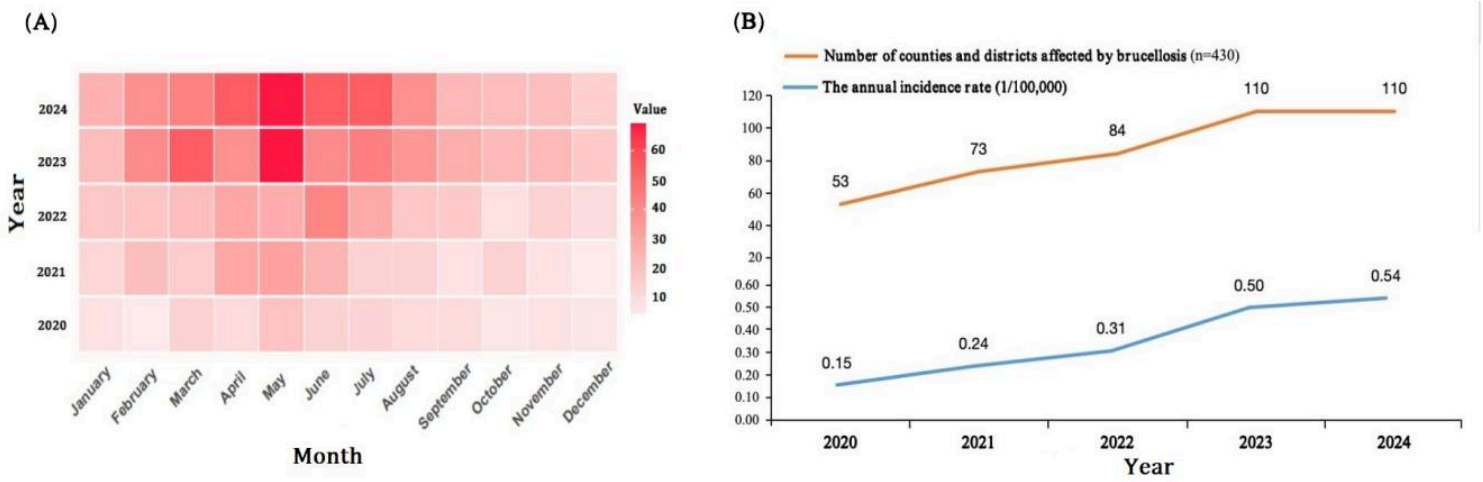


Figure 1

Analysis of the annual incidence rate and counties with brucellosis incidence in Sichuan Province. **(A)**The number of cases in every month from 2020 to 2024. **(B)** The counties and annual incidence rate in each year from 2020 to 2024.

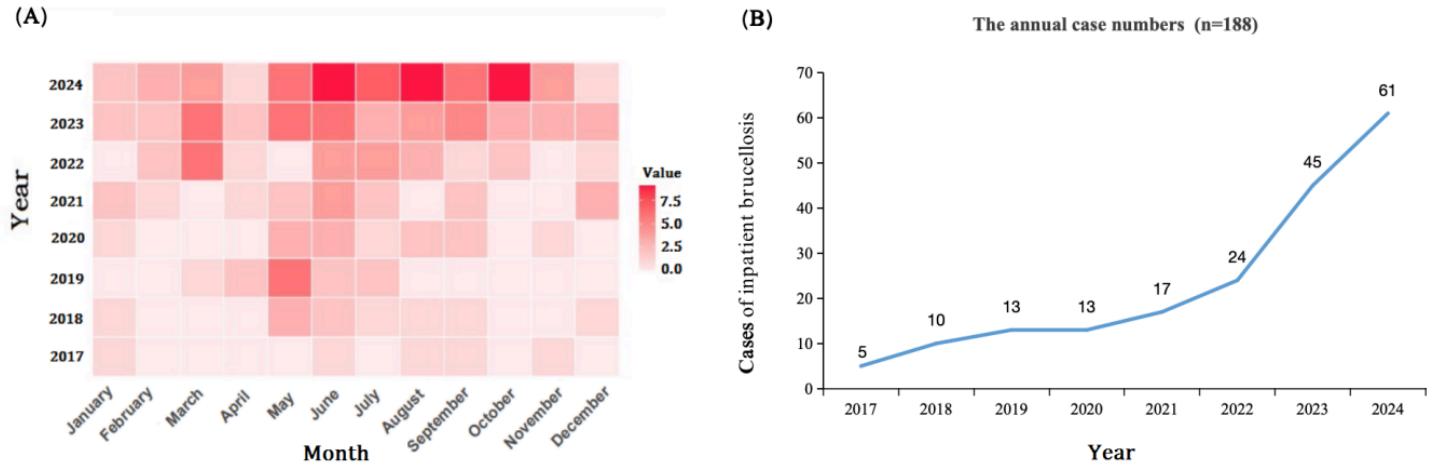


Figure 2

Analysis of the annual incidence rate with hospitalized brucellosis incidence in Southwest China. **(A)**The number of cases in every month from 2017 to 2024. **(B)** The

number of cases in each year from 2017 to 2024.

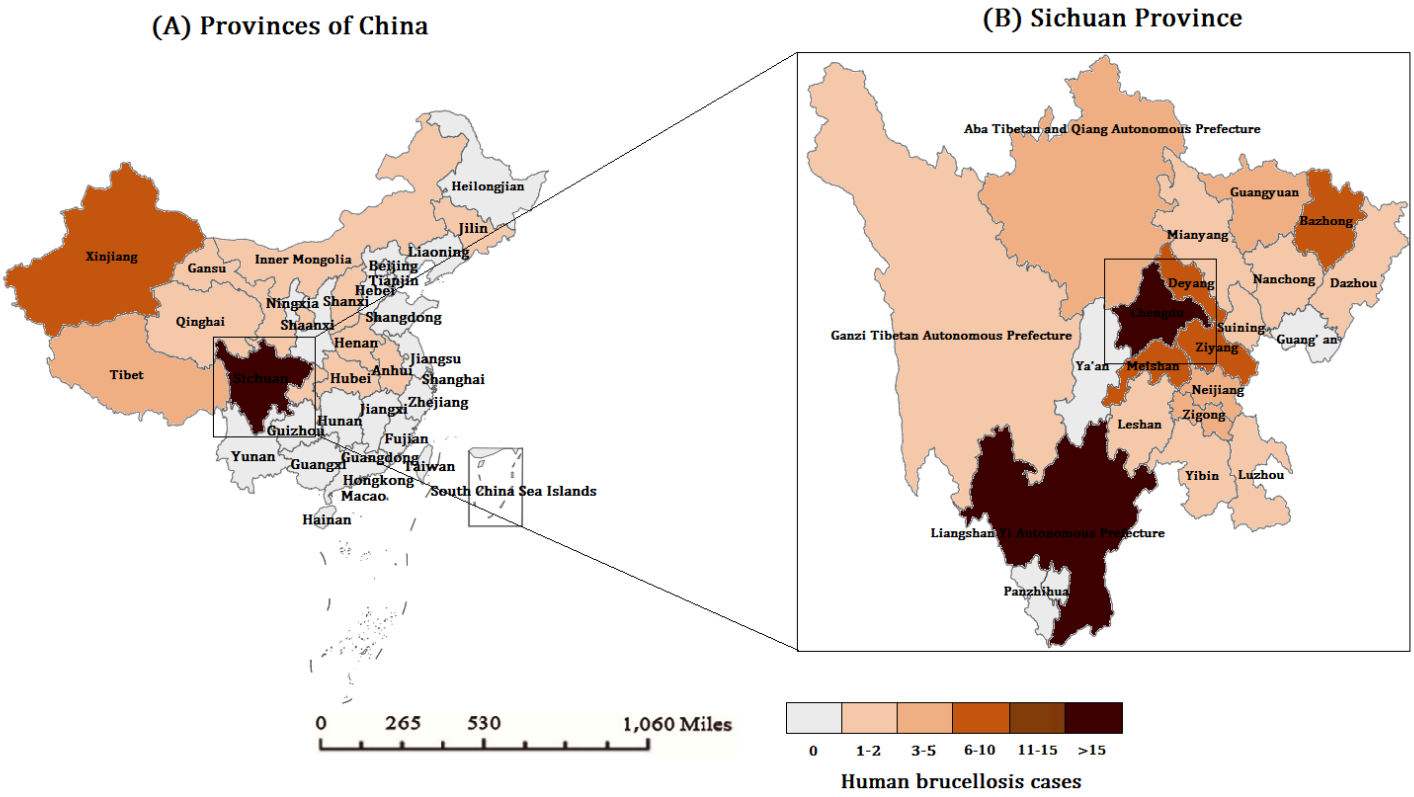


Figure 3

Geographical distribution of hospitalized human bruceliosis cases in our study. **(A)** The geographical distribution of hospitalized bruceliosis cases in China. **(B)** The geographical distribution of hospitalized bruceliosis cases in Sichuan province.

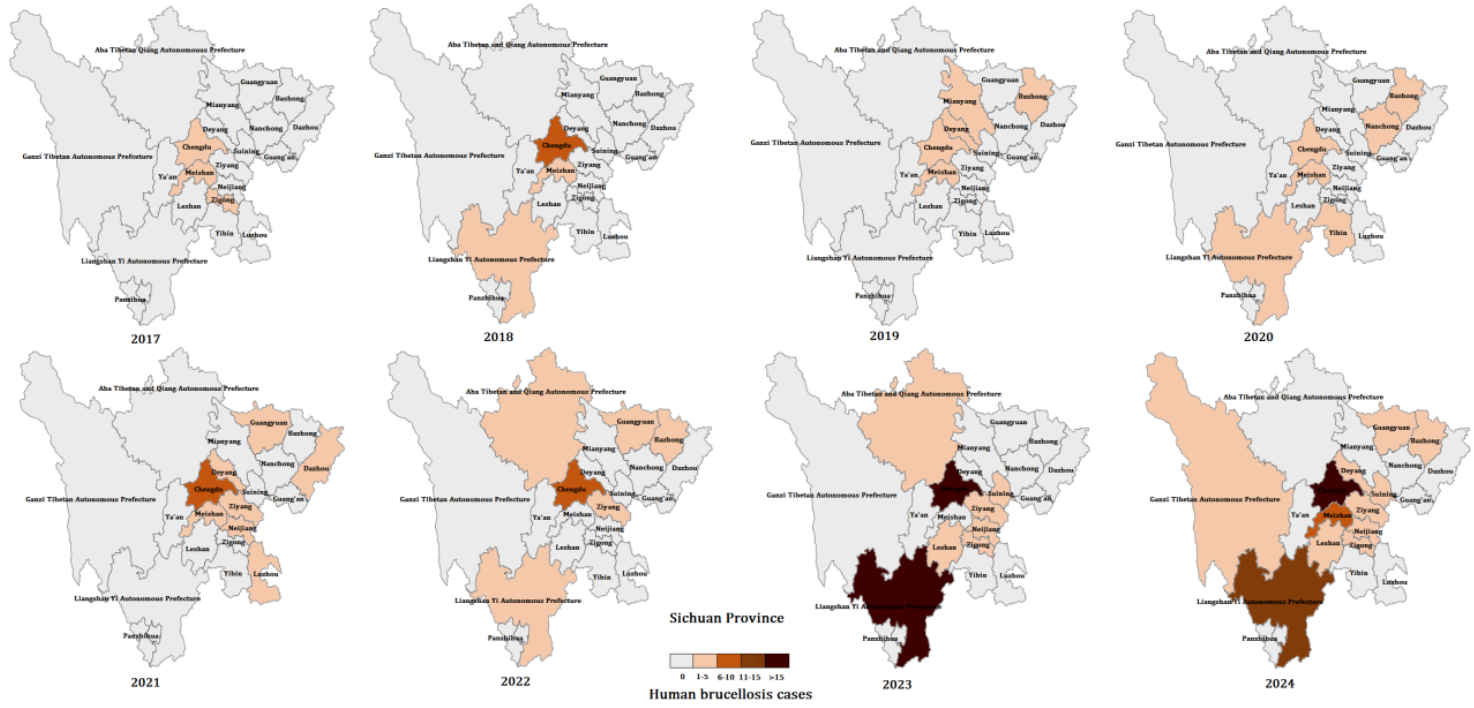


Figure 4

Spatial and temporal distributions of hospitalized human brucellosis in Sichuan, 2017–2024.

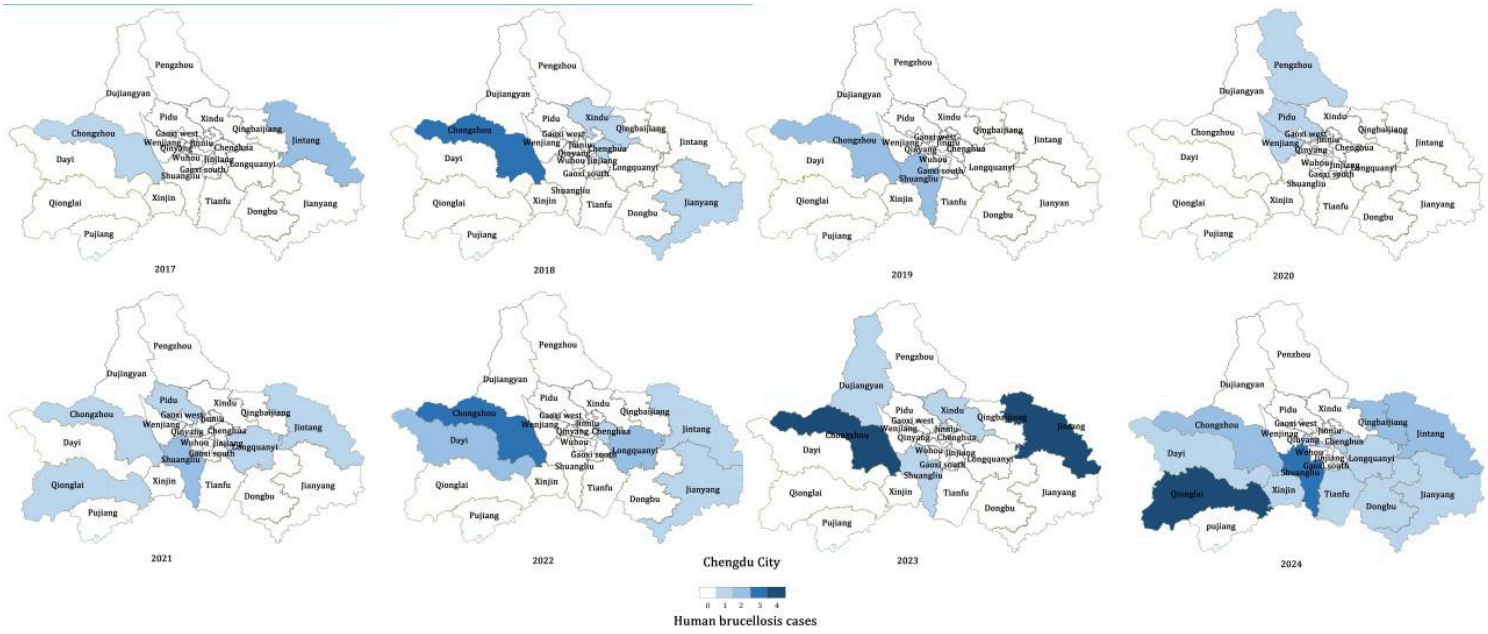


Figure 5

Spatial and temporal distributions of hospitalized human brucellosis in Chengdu, 2017–2024.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Table1.png
- Table2.png
- Table3.png