

Epidemiological trends and clinical characteristics of human brucellosis in Sichuan, China

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Abstract

Background

This study aimed to exploring the epidemiological trends, and clinical characteristics of brucellosis in Sichuan China.

Methods

This study retrospectively analyzed 228 hospitalized brucellosis cases at Public Health Clinical Center of Chengdu and 1,942 registered brucellosis cases at the Sichuan Provincial Center for Disease Control and Prevention from 2020 to 2025. Data were statistically analyzed using SPSS and R software.

Results

The number of brucellosis cases in Sichuan Province increased from 129 in 2020 to 489 in 2025. Hospitalized cases rose from 13 in 2020 to 56 in 2025, and the number of affected counties expanded from 53 to 112. 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. The dual and triple antibiotic regimens are the main treatment methods used by referral medical institutions.

Conclusions

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

Background

Brucellosis, a global zoonosis caused by bacteria of the *Brucella* genus, is listed as a priority disease for prevention and control by the World Health Organization (WHO). Approximately 500,000 cases are reported globally each year, with the actual number of infections estimated to be significantly higher, primarily concentrated in the Middle East, Central Asia, and Africa [1–3]. In China, the disease is managed as a Class B statutory infectious disease, and the reported incidence rate has shown a significant upward trend in recent years [4].

The traditional epidemic pattern is centered around the northern pastoral areas. However, epidemiological data reveals that the epidemic has rapidly spread to non-traditional agricultural regions such as Southwest China. Due to the large-scale expansion of animal husbandry, frequent cross-regional livestock circulation, and a climate environment conducive to the survival of pathogens, the incidence

rate in Southwest China has increased at a faster rate than the national average [5, 6]. The main transmission routes include contact with infected animals, ingestion of unpasteurized raw milk and meat products. The clinical characteristics include long-term fever, joint pain, and are prone to chronicity and severe complications, posing serious threats to patients' health and labor capacity [7]. At the same time, the disease causes huge economic losses to the livestock industry and poses a threat to the livelihoods of farmers and herdsmen as well as regional industrial security [8, 9].

Despite extensive research on brucellosis both domestically and internationally, studies focusing on the epidemiological landscape and clinical characteristics of this "transmission frontier" area of Sichuan Province in southwest China are still relatively scarce. This article aims to systematically review the epidemic trends, epidemiological characteristics, and prevention and control challenges of brucellosis in this region, with the hope of providing a scientific basis for precise prevention and control in Sichuan China.

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 Sichuan Province, 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 1,942 cases registered with the Sichuan CDC from 2020 to 2025 and 228 inpatients (Excluding cases that do not belong to Sichuan Province) with laboratory-confirmed brucellosis admitted to PHCC between 2020 and 2025 were included in this retrospective analysis.

Variables and outcomes

For the 228 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 six years.

Diagnostic criteria

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) [10]. The diagnosis of brucellosis cases primarily involves screening and confirmation tests. Suspected cases are initially screened by experienced doctors based on medical history, epidemiological exposure history, clinical manifestations, and/or presumptive laboratory tests, including plate agglutination test and intradermal hypersensitivity reaction. Subsequently, cases are confirmed through confirmatory tests, which require at least one positive result from the following tests: standard tube agglutination test, complement fixation test, Coombs test, cysteine test for serodiagnosis, or *Brucella* species isolation.

Treatment and follow-up

Inpatients received different combinations of antibiotics according to China's Practice Guideline for brucellosis diagnosis and treatment [11]. 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

Heat maps and annual incidence trend charts were generated (Time series of monthly cases, 2020 to 2025, 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 2020 to 2025 and cases registered by the Sichuan CDC, 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 $\pm$ SD. The trend changes of brucellosis incidence were analyzed through linear regression. 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

From 2020 to 2025, 1,942 brucellosis cases were reported in Sichuan Province. The annual incidence increased significantly from 0.155/100,000 in 2020 to 0.588/100,000 in 2025 ($P < 0.0001$), with an average annual incidence of 0.385/100,000. Annual cases numbered 129, 199, 256, 417, 452 and 489 from 2020 to 2025, respectively ($P = 0.0007$). Meanwhile, affected counties expanded from 53 to 112 ($P = 0.0044$) (Fig. 1, panel B). The epidemic peaked from February to August, covering 74.12% of total cases (Fig. 1, panel A). During this period, a total of 228 patients with brucellosis were hospitalized at PHCC. Since 2020, the number of brucellosis cases has also shown a continuous upward trend, increasing from 13 cases in 2020 to 56 cases in 2025 ($P = 0.0093$). According to the geographical distribution map, the cases of brucellosis between 2020 and 2025 were mainly concentrated in Liangshan (mainly in Ya'an, Xichang, Mianning and Huidong) and Chengdu (mainly in Jianyang and Jinchuan), as well as in neighboring areas such as Mianyang, Guangyuan and Dazhu (Fig. 2).

Sichuan Province. (A) The number of cases in every month from 2020 to 2025. (B) The annual incidence rate in each year from 2020 to 2025.

The geographical distribution of hospitalized brucellosis cases in China. (B) (C) The geographical distribution of hospitalized brucellosis cases in Sichuan province.

Demographic and clinical characteristics of brucellosis inpatients

Among the 228 hospitalized patients, 75.0% (171/228) were male and 25.0% (57/228) were female, with a male-to-female ratio of 3:1. The mean age was 51.2 ± 12.57 years (IQR 43–58 years). The majority of cases are middle-aged Han Chinese (Table 1). Regarding exposure, 88.3% of patients had a history of animal contact or were engaged in animal-related occupations. The most common clinical symptoms were low back pain (65.4%, 149/228), fever (63.6%, 145/228), and joint pain (23.7%, 54/228). The most frequent comorbidities were liver dysfunction (38.2%, 87/228), lumbar spine lesions (29.8%, 68/228), and chronic gastritis (10.5%, 24/228). The mean length of hospital stay was 23.8 ± 10.47 days (range, 3–67 days). Among all patients, 98.2% (224/228) were discharged after improvement. (Table 1). Laboratory testing revealed increased erythrocyte sedimentation rate (69.3%, 158/228) and C-reactive protein (57.0%, 130/228). Elevated GGT and ALT were observed in 39.0% (89/228) and 28.1% (64/228) of patients respectively. (Table 2).

Treatment and outcomes

Different antibiotic regimens were used among patients. Of the 228 hospitalized cases, treatments included single, dual, triple, and quadruple therapy, with dual and triple regimens being the most common. The most frequent dual regimen (23.2%, 53/228) was doxycycline plus rifampicin (45.2%, 24/53). The next most common was doxycycline plus ceftriaxone. Triple therapy was the predominant regimen (71.0%, 162/228), including doxycycline combined with rifampicin and ceftriaxone (45.1%,

73/162), doxycycline with rifampicin and levofloxacin (29.6%, 48/162), and doxycycline with rifampicin and ciprofloxacin (13.5%, 22/162).

Discussion

This study, based on big data analysis, dynamically described the epidemiological characteristics of brucellosis in Sichuan region of China. The analysis covered the number of registered cases reported to the Sichuan Provincial CDC over the past 6 years, as well as the cases diagnosed and treated at the most representative central hospital in the region - PHCC. These findings provided a theoretical basis for the clinical diagnosis, treatment and epidemiological assessment of brucellosis in the population of southwestern China.

Globally, brucellosis remains a neglected zoonosis endemic in the Middle East, Mediterranean, South Asia, and parts of Africa, with an estimated 1.6–2.1 million new annual cases [12, 13]. High-incidence countries include Yemen, Syria, and Iran, where incidence rates exceed 18/100,000 [7]. In China, brucellosis is mainly prevalent in northern pastoral areas, 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 [14]. In neighboring Yunnan Province, a similar rising trend was observed, with cases clustered in prefectures with developed livestock breeding [15]. 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.

In this study, from 2020 to 2025, the number number of cases, hospitalizations, counties and districts of brucellosis cases in Sichuan China, affected by the epidemic, and the incidence rate all continued to rise, indicating that the scope and severity of the epidemic were continuously expanding. Brucellosis 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 [16, 17]. Registered cases in Sichuan were mainly reported from February to August (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 [16]. 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 the Middle East and South Asia, consumption of unpasteurized milk and dairy products is a major

transmission route, with raw milk contamination rates reaching 16.7% in Pakistan [2]. This parallels the risk among some ethnic communities in Southwest China with traditional raw milk consumption. However, our study found that direct animal contact accounted for 88.3% of infections, primarily with sheep, reflecting the region's rapid expansion of sheep farming and cross-regional livestock trade. 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 [18]. In addition, research from Punjab, Pakistan reported a higher detection rate of *Brucella* in raw milk (16.7%) compared with animal feces (7.5%) [19]. In some ethnic minority communities in Sichuan China, raw milk consumption is common, representing an important transmission risk. Although human-to-human transmission of brucellosis is extremely rare, isolated reports exist [20, 21]. In this study, 8 patients (3.5%) 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.

In this study, hospitalized cases in Sichuan 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 (79.3%). This is consistent with the fact that male predominance (sex ratio ~ 2.5:1) and occupational risk among farmers and herders are consistent across regions, reinforcing the occupational nature of brucellosis in China[3]. 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 [22, 23].

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 [24–26]. In this study, clinical characteristics of hospitalized cases in Sichuan China were consistent with those reported in other regions [27, 28]. The most frequent symptoms were fever (63.6%), low back pain (65.4%), and joint pain (23.7%), while sweating and night sweats were less common (6.6%). 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 [29]. In this study, elevations of GGT (39.0%) and ALT (28.1%) 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 (23.2%) was the most common combination. For chronic or relapsed cases, additional agents are required. WHO and national guidelines recommend triple therapy [30–32], 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 (71.0%) 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 and hospitalization data from PHCC over the past 6 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 Sichuan 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 Sichuan 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.

Clinical trial number

Not applicable

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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Author Contribution

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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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.

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Tables

Tables are available in the Supplementary Files section.

Figures

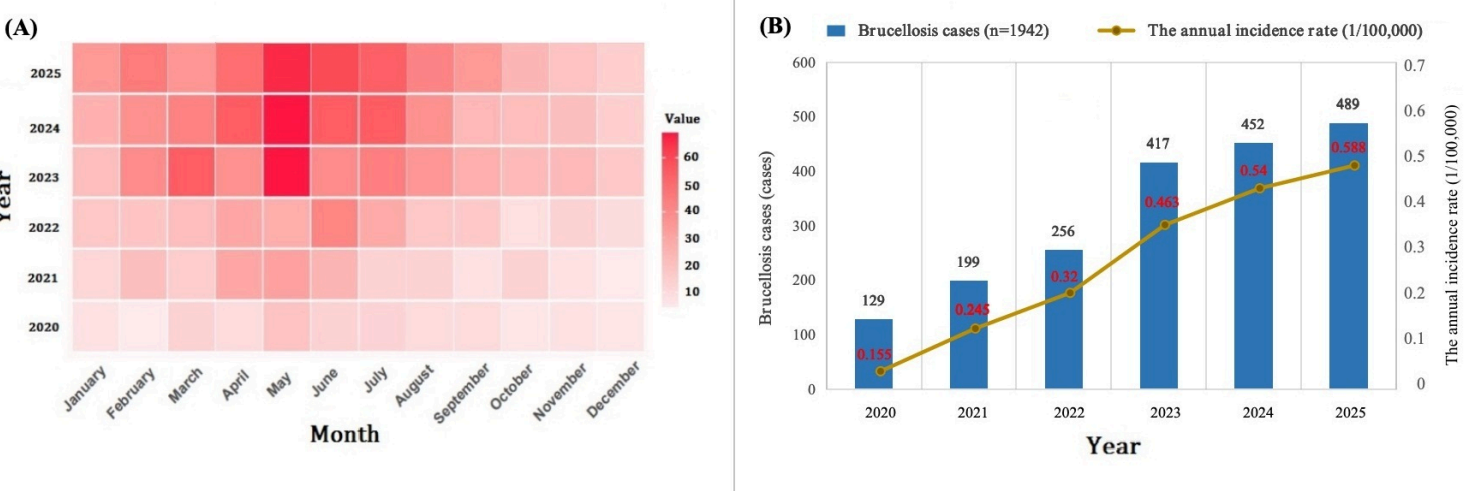


Figure 1

Analysis of the annual incidence rate with brucellosis incidence in Sichuan Province. **(A)**The number of cases in every month from 2020 to 2025. **(B)**The

annual incidence rate in each year from 2020 to 2025.

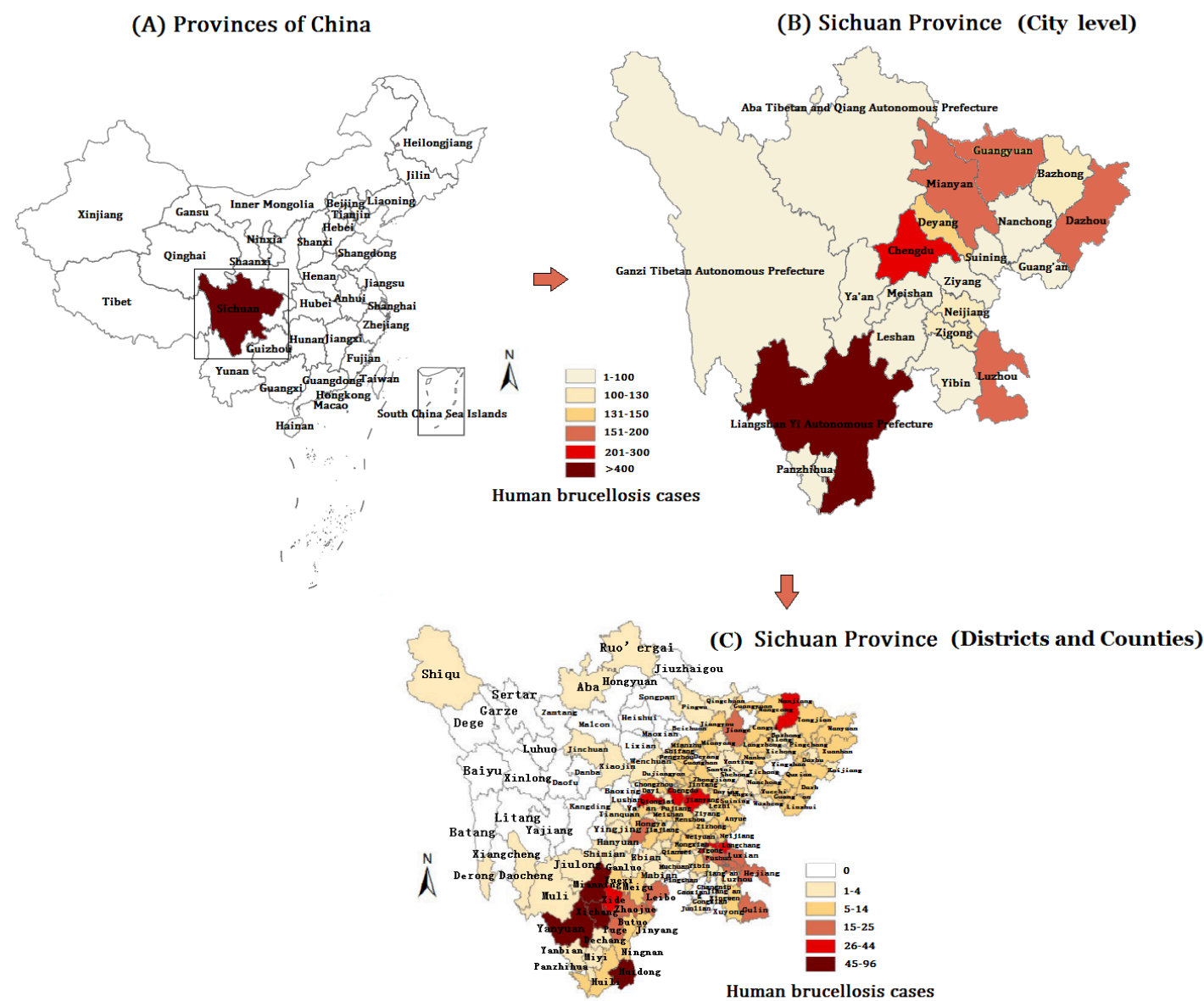


Figure 2

Geographical distribution of human brucellosis cases in our study. **(A)**

The geographical distribution of hospitalized brucellosis cases in China. **(B)** **(C)** The geographical distribution of hospitalized brucellosis cases in Sichuan province.

Supplementary Files

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