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Brazilian Spotted Fever

Febre Maculosa no Brasil

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Abstract

Rocky Mountain spotted fever (RMSF) is a rare febrile disease caused by gram-negative bacteria of the genus Rickettsia, transmitted to humans through the bite of ticks, commonly known as the star tick (Amblyomma genus), which feed on blood and use various animals, such as capybaras and horses, as hosts. Initially described in North America in the late 19th century, RMSF in Brazil is more prevalent during winter and early spring, primarily affecting individuals residing near dense vegetation and habitats of wild animals that host ticks. Aiming to enhance understanding of the disease and contribute to the development of control strategies, this study conducted a literature review on RMSF, addressing etiological agents, predominant vectors, clinical manifestations, diagnosis, treatment, preventive measures, and epidemiological data provided by the Ministry of Health for the period from 2010 to 2024. The search was conducted in databases such as PubMed, LILACS, SciELO, and Google Scholar using Portuguese and English keywords, including "Brazilian Spotted Fever," "Rickettsia sp," "Infection by Rickettsia rickettsii," "Diagnosis," and "Treatment." Original studies, reviews, and official documents were included. The results of this review indicate that RMSF requires early diagnosis and immediate treatment, preferably with doxycycline, to reduce mortality and prevent severe complications. Prophylactic measures, such as avoiding tick-infested areas and performing frequent body inspections, are essential for prevention. This study highlights the need for further research to expand knowledge of RMSF and improve control and prevention strategies for the disease in Brazil.

Keywords: Brazilian Spotted Fever. Star Tick. Rickettsioses. Public Health.

Resumo

A febre maculosa (FM) é uma doença febril rara causada por bactérias gram-negativas do gênero *Rickettsia*, transmitidas ao ser humano pela picada de carrapatos, popularmente conhecidos como carrapato-estrela (gênero *Amblyomma*), que se alimentam de sangue e utilizam diversos animais, como capivaras e equinos, como hospedeiros. Descrita inicialmente na América do Norte no final do século XIX, a FM no Brasil é mais prevalente durante o inverno e início da primavera, afetando principalmente indivíduos que residem próximos a áreas de vegetação densa e habitats de animais silvestres que abrigam carrapatos. Com o objetivo de aprimorar a compreensão sobre a doença e contribuir para o desenvolvimento de estratégias de controle, neste estudo foi realizado uma revisão da literatura sobre FM, abordando os agentes etiológicos, vetores predominantes, manifestações clínicas, diagnóstico, tratamento, medidas preventivas e dados epidemiológicos fornecidos pelo Ministério da Saúde para o período de 2010 a 2024. As buscas foram realizadas nas bases de dados PubMed, LILACS, SciELO e Google Acadêmico, utilizando descritores em português e inglês, como "Febre Maculosa Brasileira", "*Rickettsia* sp", "Infecção por *Rickettsia rickettsii*", "Diagnóstico" e "Tratamento. Foram incluídos estudos originais, revisões e documentos oficiais. Os resultados desta revisão indicam que a FM exige diagnóstico precoce e tratamento imediato, preferencialmente com doxiciclina, para reduzir a letalidade e prevenir complicações graves. Medidas profiláticas, como evitar áreas infestadas por carrapatos e realizar inspeções corporais frequentes, são essenciais para a prevenção. Este estudo destaca a necessidade de mais pesquisas para ampliar o conhecimento sobre FM e aprimorar estratégias de controle e prevenção da doença no Brasil.

Palavras-chave: Febre Maculosa Brasileira. Carrapato Estrela. Riquetsioses. Saúde pública.

1 Introduction

Zoonoses are infectious diseases caused by pathogenic agents present both in domestic environments and in wild animals, and they represent an important source of emerging diseases. Among them, spotted fever (SF) stands out as an endemic, neglected, and notifiable zoonosis caused by bacteria of the genus *Rickettsia* (order Rickettsiales, family Rickettsiaceae). The main species associated with human infection are *Rickettsia rickettsii* and *Rickettsia parkeri* (Moraes-Filho, 2017; Nogueira *et al*., 2023; Oliveira *et al*., 2022; Raoult; Roux, 1997). These bacteria are Gram-negative and exhibit a coccobacillary morphology (Brasil, 2009; Walker *et al*., 1996).

Transmission occurs predominantly through ticks, with equids, rodents—especially capybaras—and marsupials, such as opossums, being important hosts and reservoirs responsible for maintaining the pathogen in the environment (Fiol *et al*., 2010). The presence and abundance of vectors and hosts, combined with ecological factors, directly influence the epidemiological dynamics of rickettsioses (Parola *et al*., 2013).

With high lethality, which can exceed 50% in untreated cases (Ministry of Health, 2022), SF represents a significant public health problem. In Brazil, the disease has been reported since the 1920s and has shown growth in recent decades, especially among men aged 20 to 49 years, frequently exposed to ticks during outdoor activities. Approximately 10% of cases occur in children under nine years of age, highlighting the vulnerability of different age groups. The incidence is higher between September and November, the period of greatest vector activity (Oliveira *et al*., 2016).

Diagnosis is challenging, since the initial signs of fever, severe headache, and myalgia are nonspecific and similar to those of leptospirosis, dengue, meningoencephalitis, and Zika (Ministry of Health, 2022). When present, the rash usually appears between the third and fifth day, but its absence in some patients hinders early recognition (Moraes-Filho, 2017).

Treatment is based on the use of doxycycline, recommended for all age groups, and should be initiated as soon as there is clinical suspicion. The identification of endemic areas and professional training for rapid diagnosis are essential to reduce mortality (Brasil, 2022; Moraes-Filho, 2017).

Given its epidemiological relevance, this study presents a literature review on the epidemiological, clinical, diagnostic, therapeutic, and preventive aspects of SF, aiming to support strategies for control and protection of the population.

2 Material and Methods

This study consists of an integrative literature review focused on SF in the Brazilian context. The objective was to synthesize evidence on etiological agents, vectors, clinical manifestations, diagnosis, treatment, preventive measures, and epidemiological data.

The research was conducted in the PubMed, LILACS, SciELO, and Google Scholar databases, using the descriptors in Portuguese and English: "Brazilian Spotted Fever," "*Rickettsia sp*.," "*Rickettsia rickettsii* infection," "Diagnosis," and "Treatment." No restriction was applied regarding the year of publication.

To ensure the quality of the included studies, the selection criteria were original articles, systematic reviews, and clinical guidelines published in peer-reviewed journals that addressed epidemiological, clinical, or therapeutic aspects of SF in Brazil. Isolated case reports, expert opinions, and non–peer-reviewed publications were excluded to maintain the reliability and consistency of the analyzed data.

The selection of studies was carried out in two stages. Initially, reviewers independently assessed the titles and abstracts of the articles to identify those fulfilling the predefined inclusion criteria. Subsequently, the full texts of the selected studies were evaluated. Any divergences were discussed and resolved by consensus.

In addition to the literature review, official documents and epidemiological reports from the Brazilian Ministry of Health published between 2010 and 2024 were included to ensure the national data updating.

3 Results and Discussion

3.1 Etiological Agents

The genus *Rickettsia* belongs to the alpha-1 subgroup of the class *Proteobacteria* and comprises more than 25 described species. These bacteria exhibit tropism for endothelial cells, where they multiply and cause lesions mainly in small- and medium-caliber blood vessels in vertebrate hosts. In tick vectors, they can be detected in structures such as intestinal cells, hemolymph, and Malpighian tubules, which favors their persistence and transmission to new hosts (Azad; Beard, 1998; Fournier; Raoult, 2009; Yu; Walker, 2006). This ability to persist in arthropods, combined with the biological cycle of the vectors and their ecological interactions with reservoirs and incidental hosts, directly influences the epidemiology of SF.

Phylogenetic analyses, such as those by Weinert *et al*. (2009), classify the genus *Rickettsia* into five main groups: (i) Typhus Group (*R. prowazikii* and *R. typhi*), (ii) Spotted Fever Group (including *R. rickettsii*, *R. conorii*, and *R. sibirica*), (iii) Transitional Group (*R. felis*, *R. akari*, and *R. australis*), (iv) Canadian Group (*R. canadensis*), and (v) *bellii* Group (*R. bellii* and related genotypes found in insects). In Brazil, *R. rickettsii* is the main etiological agent of SF, predominating in the South and Southeast regions, where transmission is strongly associated with the tick *Amblyomma sculptum*, formerly referred to as *A. cajennense* (Spolidorio *et al*., 2010; Nogueira *et al*., 2023).

Although knowledge about *Rickettsia* has expanded, aspects such as the possible underestimation of other potentially pathogenic species, the influence of coinfections on disease severity, and the impact of environmental changes on their geographic distribution still require further investigation.

3.2 Vectors of Spotted Fever

The genus *Amblyomma* is the main vector of SF in Brazil, standing out for its wide geographic distribution, aggressiveness, and efficiency in transmitting *Rickettsia* (Muchon *et al*., 2021; Parola *et al*., 2013; Szabó; Pinter; Labruna, 2013). Among the species of greatest epidemiological importance are *A. sculptum*, *A. aureolatum*, and *A. ovale*, each associated with specific habitats and hosts. Other ticks, such as *Rhipicephalus sanguineus* sensu lato, *R. microplus*, and *Haemaphysalis leporispalustris*, may participate in transmission, but play a secondary role (Barros-Battesti *et al*., 2006; Cunha *et al*., 2009; Luz *et al*., 2019; Nava *et al*., 2009).

A. sculptum, the “star tick,” predominates in tropical areas of the Cerrado, Pantanal, and parts of the Atlantic Forest. Its three-host cycle involves large hosts such as horses and capybaras, and a wide range of wild animals during immature stages (Brites-Neto *et al*., 2015; Estrada-Peña *et al*., 2014; Labruna, 2009). Environmental alterations and climate variations favor its population growth, increasing the risk of *R. rickettsii* transmission to humans and animals (Ferreira De Paula *et al*., 2022; Guglielmone *et al*., 2006; Martins *et al*., 2016; Szabó; Pinter; Labruna, 2013).

A. aureolatum, the “yellow dog tick,” prefers humid and cool areas of the Atlantic Forest, being associated with wild and domestic canids. The movement of infested dogs between rural and urban zones creates a critical link for human transmission (Pinto *et al*., 2018; Luz *et al*., 2019).

A. ovale is widely distributed in Neotropical regions and transmits *R. parkeri*, which causes a milder clinical form. Predominantly sylvatic, it infests armadillos and other forest mammals, but may also reach urban areas through dogs moving between ecosystems (Brasil, 2019; Guglielmone *et al*., 2003; Scinachi *et al*., 2016).

Even with the current knowledge of vector tick ecology, it is still not possible to accurately predict how climate variations, habitat fragmentation, and urbanization may modify the dynamics of SF transmission.

3.3 Hosts and Transmission Cycle

The SF transmission cycle results from the interaction between ticks and vertebrates that act as hosts at different stages of the vector's development and, in some cases, as amplifiers of *Rickettsia*. Among the most relevant reservoirs are capybaras (*Hydrochoerus hydrochaeris*), equids, and marsupials such as the opossum (*Didelphis* spp.), which are able to sustain tick populations and maintain the bacterium in circulation during periods of rickettsemia (Brasil, 2019, 2022; Faccini-Martínez *et al*., 2018; Luz *et al*., 2019).

The ectoparasites' life cycle comprises four stages (egg, larva, nymph, and adult), with most development occurring in the environment. The abundance and availability of hosts exert direct influence on vector population density (Estrada-Peña *et al*., 2014; Muchon *et al*., 2021; Szabó; Pinter; Labruna, 2013).

In Brazil, different ecological arrangements define the maintenance and dissemination of SF. In the Southeast region, *R. rickettsii* is mainly transmitted by *A. sculptum*, with capybaras and horses playing a central role in the enzootic cycle. In Atlantic Forest areas near urban centers, *A. aureolatum* stands out as a vector, with domestic dogs acting as a link between sylvatic environments and households—a situation associated with human cases, including in children. There is also evidence of the participation of *R. sanguineus* sensu lato in certain urban contexts. *R. parkeri*, on the other hand, presents a distinct pattern, predominating in the South and in parts of the Southeast and Northeast, transmitted by *A. ovale* in forest environments, often involving dogs that circulate between the forest and residential areas (Brasil, 2022; Spolidorio *et al*., 2010; Szabó; Pinter; Labruna, 2013).

Human infection occurs predominantly through the bite of infected ticks, usually after a period of attachment ranging from a few hours to more than a day. Although less common, improper handling of the vector—such as crushing it during removal—may also result in transmission due to contact with contaminated body fluids (Chen; Sexton, 2008; Muchon *et al*., 2021; Saraiva *et al*., 2014).

3.4 Clinical Aspects, Treatment, and Diagnosis of Spotted Fever

The treatment of SF in Brazil has been studied since the 1920s, but its effectiveness increased with the introduction of tetracyclines, especially after the discovery of chlortetracycline by Benjamin Duggar in 1945 (Pereira-Maia *et al*., 2009). Without treatment, the mortality rate may reach 70%, dropping to around 30% when antimicrobial therapy is properly administered (Fiol *et al*., 2010;

Moraes-Filho, 2017).

Doxycycline is the first-choice drug, administered orally at a dose of 100 mg every 12 hours for adults and children weighing over 45 kg. When administered promptly, fever tends to subside within 24–72 hours, whereas delays greater than four days after symptom onset are associated with increased severity. In severe cases, and in the absence of intravenous tetracycline, chloramphenicol is recommended (1 g every 6 hours for adults; 50–75 mg/kg/day for children, divided into four doses). Treatment should last at least seven days and continue for 2–3 days after fever remission (Fiol *et al*., 2010; Moraes-Filho, 2017).

Infections caused by *R. parkeri* are usually less severe and present distinct manifestations, such as an eschar at the tick bite site, rash, and lymphadenopathy (Brasil, 2022 ; Spolidorio *et al*., 2010; Szabó; Pinter; Labruna, 2013). In such cases, clarithromycin may be used, especially in pregnant women and children (Faccini-Martínez *et al*., 2018).

The incubation period of SF ranges from 2 to 14 days (average of seven days) (Monteiro et al., 2014). Initial symptoms include fever, headache, myalgia, malaise, and, in about one-third of cases, hepatosplenomegaly (Abramson; Givner, 1999; Muchon *et al*., 2021). The maculopapular rash appears in 49% of cases by the third day and in 91% by the fifth day, but may be absent, particularly in elderly and Black patients, hindering diagnosis and worsening prognosis (Fiol *et al*., 2010; Muchon *et al*., 2021).

The differential analysis between *R. parkeri* and *R. rickettsii* can be based on the presence of a necrotic eschar with an erythematous halo at the bite site, characteristic of the former, with a diameter of 0.5–2 cm (Faccini-Martínez *et al*., 2018). The rash, initially pink, tends to darken and affect extremities, including palms and soles (McCollough, 2018).

According to Nogueira *et al*. (2023), some clinical manifestations should be considered during the anamnesis of patients with suspected SF, as summarized in Table 1.

Table 1- Clinical manifestations in patients with Brazilian Spotted Fever

Category	Main manifestations
Hemorrhagic	Petechiae; mucocutaneous, gastrointestinal, and pulmonary bleeding
Gastrointestinal	Nausea; vomiting; abdominal pain; diarrhea
Renal	Oliguria; acute renal failure
Pulmonary	Cough; pulmonary edema; pneumonia; pleural effusion
Other	Maculopapular rash; lower limb edema; hepatosplenomegaly; neurological manifestations; myalgia; headache; arthralgia; meningoencephalitis

Source: Adapted from Nogueira *et al*. (2023)

The pathogenesis involves progressive lesions in the vascular endothelium induced by the agent, leading to cellular apoptosis and a strong inflammatory response. These alterations result in leukopenia or leukocytosis with a left shift, increased inflammatory mediators, and higher vascular permeability. Plasma extravasation may cause hypovolemia, hypoalbuminemia, pre-renal failure, and hyponatremia. Thrombocytopenia resulting from platelet consumption during intravascular coagulation processes may trigger coagulation disorders and, in severe cases, contribute to the development of cerebral and pulmonary edema (Abramson; Givner, 1999; Faccini-Martínez *et al.*, 2018).

Diagnosis is based on clinical evaluation and laboratory confirmation, with the Indirect Immunofluorescence Assay (IFA) being the gold standard for detecting IgG antibodies. Confirmation requires at least a fourfold increase in antibody titers in paired serum samples (Faccini-Martínez *et al.*, 2018; Muchon *et al.*, 2021).

3.5 Epidemiological Surveillance

The prevention of SF is primarily based on reducing human contact with ticks through restricted access to risk areas and adoption of personal protective measures. When exposure is unavoidable, wearing long sleeves, pants, closed shoes, and performing periodic body inspections (every three hours) are effective strategies for early detection and removal of vectors, minimizing the risk of infection. Tick removal should be performed carefully to avoid crushing the tick and releasing infectious agents (Brasil, 2022 ; Muchon *et al.*, 2021).

The use of antibiotics as post-exposure prophylaxis is not recommended, as it lacks proven efficacy and may delay symptom onset and hinder early diagnosis, compromising treatment (Muchon *et al.*, 2021).

Managing populations of amplifier hosts, such as capybaras, is challenging. For example, culling may create ecological imbalances and paradoxically increase vector dispersion. More promising approaches include physical barriers, environmental management, and biological tick control (Machtinger *et al.*, 2024). However, knowledge regarding the efficacy of each strategy in different ecological contexts remains limited, requiring long-term comparative studies.

Epidemiological surveillance plays a central role in outbreak identification and guiding interventions (Fiol *et al.*, 2010). Since 2011, GM/MS Ordinance No. 104 has mandated the compulsory notification of suspected and confirmed cases via the Notifiable Diseases Information System (SINAN), the Ministry of Health's official platform that compiles confirmed cases, clinical suspicions, and notifications within a defined timeframe (Brasil, 2011; Oliveira; Angelani, 2018). This monitoring enables the tracking of spatial and temporal disease patterns. However, underreporting and delays in laboratory confirmation remain challenges, emphasizing the need to expand access to rapid tests and strengthen healthcare professional training, especially in endemic areas.

In addition to existing measures, future perspectives include vaccine research, new vector control techniques adapted to different biomes, and studies on how climate change and habitat fragmentation affect vector ecology. Therefore, an integrated approach combining surveillance, environmental management, and health education is strategic to contain SF expansion and reduce its population impact (Bestul *et al*., 2022; Ellis; Oliveira *et al*., 2016; Wilcox, 2009).

3.6 National Epidemiological Overview

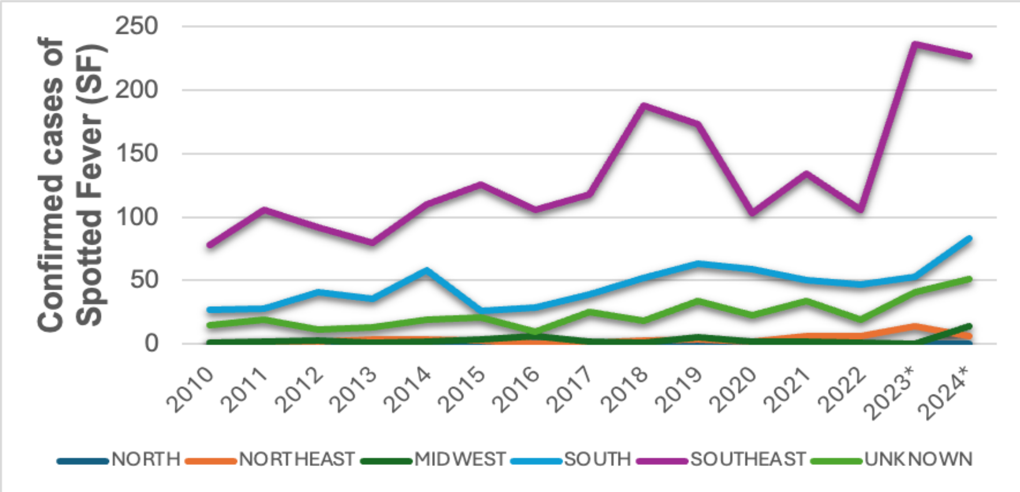
According to data from the Ministry of Health (Brasil, 2025), between 2010 and 2024, 3,135 cases of SF were confirmed in Brazil. The annual number showed an increasing trend, peaking in 2024 with 381 infections—the highest record during the period.

Geographic distribution shows a significant concentration in the Southeast (1,983 cases; 63.3%), followed by the South (691; 22.0%). Other regions reported substantially fewer cases: Northeast (56; 1.8%), Midwest (46; 1.5%), and North (6; 0.2%). In 11.2% of cases (353), the location was not recorded (Table 2 and Figure 1).

Table 2 - Confirmed cases of Spotted Fever. Brazil, Major Regions, and Federative Units (Infection) – 2010 to 2024

Year	North	Northeast	Midwest	South	Southeast	Unknown	Total
2010	0	1	1	27	78	15	122
2011	2	0	2	28	106	19	157
2012	2	2	3	41	92	11	151
2013	0	4	1	36	80	13	134
2014	0	4	2	58	110	19	193
2015	2	3	4	26	126	21	182
2016	0	0	6	29	106	10	151
2017	0	1	2	39	118	25	185
2018	0	3	1	52	188	18	262
2019	0	4	5	63	173	34	279
2020	0	2	2	59	103	23	189
2021	0	6	2	50	134	34	226
2022	0	6	1	47	106	19	179
2023*	0	14	0	53	236	41	344
2024*	0	6	14	83	227	51	381

Source: Brasil (2025).



Source: research data.

The predominance in the Southeast may be associated with the presence of consolidated endemic areas, high population density, and more structured surveillance systems. Environmental factors, such as the abundance of amplifier hosts (capybaras and equids) and the presence of vectors (*A. sculptum* and *A. aureolatum*), reinforce this concentration. The increase in records over the past decade may reflect, simultaneously, improved diagnostic capacity, higher human exposure to vectors due to urban expansion into wild areas, and climatic changes favoring tick survival and dispersion.

These data reinforce the need for targeted preventive strategies in regions of higher incidence, combined with investigations into emerging patterns in non-endemic areas. One hypothesis to explore is the potential adaptation of secondary vectors, such as *R. sanguineus*, to urban environments, which could alter the disease epidemiological profile in the coming years.

4 Conclusion

In Brazil, SF is primarily concentrated in the Southeast and South regions, with different *Amblyomma* tick species acting as vectors of pathogenic agents with varying clinical severities. Changes in vector ecology, land use and occupation, and interactions among humans, domestic animals, and wildlife have facilitated the expansion of the disease, particularly in rural and forested areas.

Although simple preventive measures are effective, their limited adoption reflects weaknesses in health education and epidemiological surveillance, highlighting the need for more robust public policies. Priorities include expanding access to laboratory diagnostics, developing more sensitive and accessible diagnostic tools, and providing continuous training for healthcare professionals to ensure early detection and rapid clinical management.

Persistent challenges include understanding the role of poorly studied hosts, evaluating the influence of environmental and behavioral factors on transmission, and assessing the impact of climate change on the distribution and seasonality of the disease. Future research should integrate systematic monitoring of vectors and hosts, ecological modeling, and evaluation of the effectiveness of prevention and control strategies.

Reducing lethality and containing the expansion of SF depend on an integrated approach that combines continuous entomological surveillance, effective public policies, and timely clinical practices, especially in primary healthcare. Only through the convergence of research, prevention, and care will it be possible to minimize the growing impact of this emerging zoonosis in the country.

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