Original article

Spatiotemporal Dispersion of Dengue Fever in a Municipality of São Paulo State, Brazil

Dispersión espacio-temporal del dengue en un municipio del Estado de São Paulo, Brasil

Nagib Scaff Machado Pontim[1] https://orcid.org/0009-0002-2348-2586

Eduardo Alexandre Rancan[2] https://orcid.org/0000-0003-3636-09088

Eduardo Federichi Baisi Chagas[1] https://orcid.org/0000-0001-6901-9082

Rodrigo Buzinaro Suzuki[3] https://orcid.org/0000-0003-2445-0332

Luciamáre Perinetti Alves Martins[1*] https://orcid.org/0000-0003-1442-7964

[1]Faculdade de Medicina de Marília (FAMEMA). São Paulo, Brasil.

[2]Faculdade de Medicina da Universidade de São Paulo. Brasil.

[3]Universidade de Marília. São Paulo, Brasil.

[*]Corresponding author: luciamarepam@gmail.com

ABSTRACT

Introduction: Dengue is an acute infectious disease with varying severity and clinical presentations. It is the most important arbovirus, exposing nearly one-third of the world population to the risk of infection. From the 1990s to the present day, the state of São Paulo has experienced epidemics of the disease, with the presence of all four serotypes, with small and medium-sized municipalities accounting for the largest share of reported cases.

Objective: To evaluate the epidemiological profile in a medium-sized municipality like Marília city, in the state of São Paulo, Brazil, identifying areas of higher incidence in order to facilitate control and prevention measures.

Esta obra está bajo una licencia: https://creativecomons.org/licenses/by-nc/4.0/deed.es_ES

Methods: Data from SINAN (2000-2006), SINANNET (2007-2013) and SINAN Online (2014-2020) provided by the Municipal Health Secretaria were analyzed and stratified by CNES and year of notification.

Results: The seasonality of the dengue epidemic in Marília was observed, with the years 2007, 2010, 2013, 2015, 2019, and 2020 considered epidemic years, with 2007 and 2015 standing out as having the highest incidence rates. Nevertheless, only 2015 showed a significant difference in relation to the other years. The West macro-region showed a higher incidence without statistical significance between the years 2007, 2013, and 2015.

Conclusions: The West macro-region has greater socio environmental vulnerability and should be prioritized in public actions to improve the control of the arboviral disease. Thus, this macro-region stands out as a possible sentinel area in the municipality.

Keywords: dengue; epidemiology; arboviral disease; incidence.

RESUMEN

Introducción: El dengue es una enfermedad infecciosa aguda con diferentes grados de gravedad y manifestaciones clínicas. Su agente causal es el arbovirus más importante, que expone a casi un tercio de la población mundial al riesgo de infección. Desde la década de 1990 hasta la actualidad, el Estado de São Paulo, Brasil, ha experimentado epidemias de la enfermedad, con presencia de los cuatro serotipos, y los municipios medianos y pequeños concentran la mayor proporción de casos notificados.

Objetivo: Evaluar el perfil epidemiológico en un municipio de tamaño medio como la ciudad de Marília, en el estado de São Paulo, Brasil, para identificar áreas de mayor incidencia para facilitar las medidas de control y prevención.

Métodos: Se analizaron los datos del SINAN (2000-2006), SINANNET (2007-2013) y SINAN Online (2014-2020), proporcionados por la Secretaría Municipal de Salud, y se estratificaron por CNES y año de notificación.

Resultados: Se observó la estacionalidad de la epidemia de dengue en Marília. Los años 2007, 2010, 2013, 2015, 2019 y 2020 se consideraron años epidémicos, destacando 2007 y 2015 por presentar las tasas de incidencia más altas. Sin embargo, solo 2015 mostró una diferencia significativa con respecto a los demás años. La macrorregión Oeste presentó una mayor incidencia, sin significancia estadística, entre los años 2007, 2013 y 2015.

Esta obra está bajo una licencia: https://creativecomons.org/licenses/by-nc/4.0/deed.es_ES

Conclusiones: La macrorregión Oeste presenta una mayor vulnerabilidad socioambiental y debería ser priorizada en las acciones públicas para mejorar el control de las arbovirosis. Por lo tanto, esta macrorregión se destaca como una posible zona centinela en el municipio.

Palabras clave: dengue; epidemiología; arbovirosis; incidencia.

Received: 10/08/2025

Accepted: 22/05/2026

Introduction

The Dengue virus (DENV), belonging to the *Flaviviridae* family, consists of a single-stranded RNA molecule with a positive orientation, being able to appear as four distinct and coexisting serotypes, DENV-1 to DENV-4.[1] Considered the most important arbovirus, dengue fever (DF) is a vector-borne disease transmitted by the bite of female mosquitoes of the *Aedes genus*, which are distributed across tropical and subtropical regions with a remarkable adaptive capacity to the urban environment, exposing almost one third of the world's population to the risk of infection.[2]

From an epidemiological perspective, the 1940s and 1950s were a crucial period for the *Aedes aegypti* mosquito in Brazil, not because of dengue, but because of efforts to eradicate yellow fever.[3] Public health attention focused on vector control, while DF remained secondary at that time. In this scenario, the first clinically documented dengue epidemic occurred in the country between 1981 and 1982 in the state of Roraima, with DENV-1 and DENV-4 acting as etiological agents. Since then, successive epidemics have been recorded, initially in northeastern states and in Rio de Janeiro, and currently throughout Brazil.[4] In the period from 1990 and 2000, autochthonous cases of DENV-2 and DENV-3 were reported, and in 2008, DENV-4 reemerged as a relevant etiological agent in epidemics.[5]

In the state of São Paulo, the three serotypes of the dengue virus (DENV-1, DENV-2, and DENV-3) circulated simultaneously until 2010. In 2011, DENV-4 was reported in the region of the municipality of São José do Rio Preto, expanding to other regions

Esta obra está bajo una licencia: https://creativecomons.org/licenses/by-nc/4.0/deed.es_ES

of the state.[6] In 2015, the state reached its peak incidence, with a rate of 1,640,4 probable cases of dengue per 100,000 inhabitants.[7] In this critical scenario, the importance of small and medium-sized municipalities becomes remarkable, as they proportionally concentrate a greater number of cases. In 2013, for example, 83% of the state of São Paulo presented the risk of dengue transmission, however, 544 municipalities confirmed autochthonous cases, raising this rate to 84.3%.[6]

According to data from the Brazilian Institute of Geography and Statistics (BIGS), up to the year 2022, the municipality of Marília had an estimated population of 237,627 inhabitants, stands out not only for its significant flow of people and goods, but also for its role as an economic hub in western São Paulo. Studies on the epidemiological profile of dengue, especially through spatiotemporal analysis and in axes of dispersal involving small and medium-sized cities, are limited in the literature.

DF is a highly complex disease, particularly in urban areas, where it is well adapted and comprises one of the most important diseases from an epidemiological stand point in Brazil and worldwide. Vector control, whether through directly combating mosquitoes or their breeding sites, is the pillar of DF prevention; however, this measure has proven to be ineffective in endemic countries.[8,9] The disease has recurrence and distribution patterns that require detailed analysis of spatiotemporal factors, as well as environmental and social factors that influence the lifecycle of *Aedes aegypti*, such as:

- Temperature
- Precipitation
- Population density
- Human mobility

This phenomenon, referred to as “epidemic synchrony,” occurs when outbreaks appear at the same time across different areas, following similar seasonal patterns and limiting the isolated use of incidence rates as an epidemiological indicator. Thus, the spatiotemporal study model is capable of identifying risk areas and understanding how human mobility and other of the above mentioned determining factors interfere in the spread of the virus, being progressively valued in public health management[10,11,12,13,14]

Therefore, this study proposed to analyze the spatiotemporal dispersal of dengue in the Municipality of Marília, São Paulo (SP) in the period 2000-2020, outlining an

Esta obra está bajo una licencia: https://creativecomons.org/licenses/by-nc/4.0/deed.es_ES

epidemiological profile of the region and statistical analysis of the incidence of DF among municipal health units per year throughout the study period.

Methods

Study area

The municipality of Marília belongs to the western region of the State of São Paulo and is part of Regional Health Department (RHD-XIX). Geographically, it is located at Latitude -22°12'50" South and Longitude -49º56'45" West, at an altitude of 679 meters, and has an area of 1,170.515 square kilometers. The region has a humid subtropical climate (Köppen-Geiger climate classification: Cfa) with a Human Development Index (HDI) of 0.798, in the "high" level (0.700 to 0.799), and a population of 237,627 inhabitants according to the Brazilian Institute of Geography and Statistics (BIGS) (2022).

Human cases of Dengue

This research consisted of a quantitative study with an observational and longitudinal design. Data provided by the Municipal Health Department of Marília from 2000 to 2020 were used as research instruments, through the epidemiological surveillance notification system for the disease "dengue" from the Brazilian Notifiable Diseases Information System (BNDIS) with the Windows (2000 to 2006), BNDIS NET (2007 to 2013) and BNDIS Online (2014 and 2020) versions, by compiling the data in an Excel spreadsheet. The data were stratified according to the Brazilian National Registry of Health Establishments (BNRHE) and year of notification. The confirmed cases include all clinical presentations of dengue:

- Classic Dengue
- Dengue with complications
- Dengue hemorrhagic fever
- Dengue shock syndrome

Esta obra está bajo una licencia: https://creativecomons.org/licenses/by-nc/4.0/deed.es_ES

Spatial analysis

Georeferencing was performed based on the average incidence to map the risk areas.

Statistical methods

The proportion of cases per year was analyzed by the incidence ratio and its respective 95% confidence intervals (95%CI). The homogeneity of variances was verified by Levene's test. The comparison of incidence means between regions was performed by one-way ANOVA with Brown-Forsythe correction. The comparison of incidence means between years was performed by the repeated measures ANOVA test. Post-hoc comparisons were performed by the Holm-Sidak test. The significance level adopted was 5% ($p \leq 0.05$), and the data were analyzed using SPSS software program, version 23.0.

The statistical analysis of the data was performed using three distinct approaches:

1. Analysis of all dengue cases reported in the municipality of Marília in a year-by-year comparison during the study period.
2. Analysis of dengue cases reported by each macro-region during the study period.
3. Analysis of dengue cases reported by each macro-region year by year during the period studied.

Ethics review

Project approved by the Research Ethics Committee-FAMEMA under CAAE number: 45126715.9.0000.5413.

Results

The database provided by the Marília Municipal Health Department covered the period from 2000 to 2020, with the BNRHE as the guiding unit and, subsequently, the division of the municipality by macro-regions. Nevertheless, the period between

Esta obra está bajo una licencia: https://creativecomons.org/licenses/by-nc/4.0/deed.es_ES

2000 and 2006 and the year 2014 could not be analyzed because they did not include BNRHE data in the information recorded in the database, which did not allow grouping by macro-region in these years. Thus, the study covered the period from 2007 to 2020 except for 2014.

The total number of cases reported on an annual basis throughout the municipality (fig. 1) showed the seasonality of the dengue epidemic in Marília, with the years 2007, 2010, 2013, 2015, 2019, and 2020 considered epidemic years. Similarly, the years 2008, 2009, 2011, 2012, 2016, 2017, and 2018 showed a decrease in the number of cases and were considered non-epidemic, with no statistically significant difference between them.

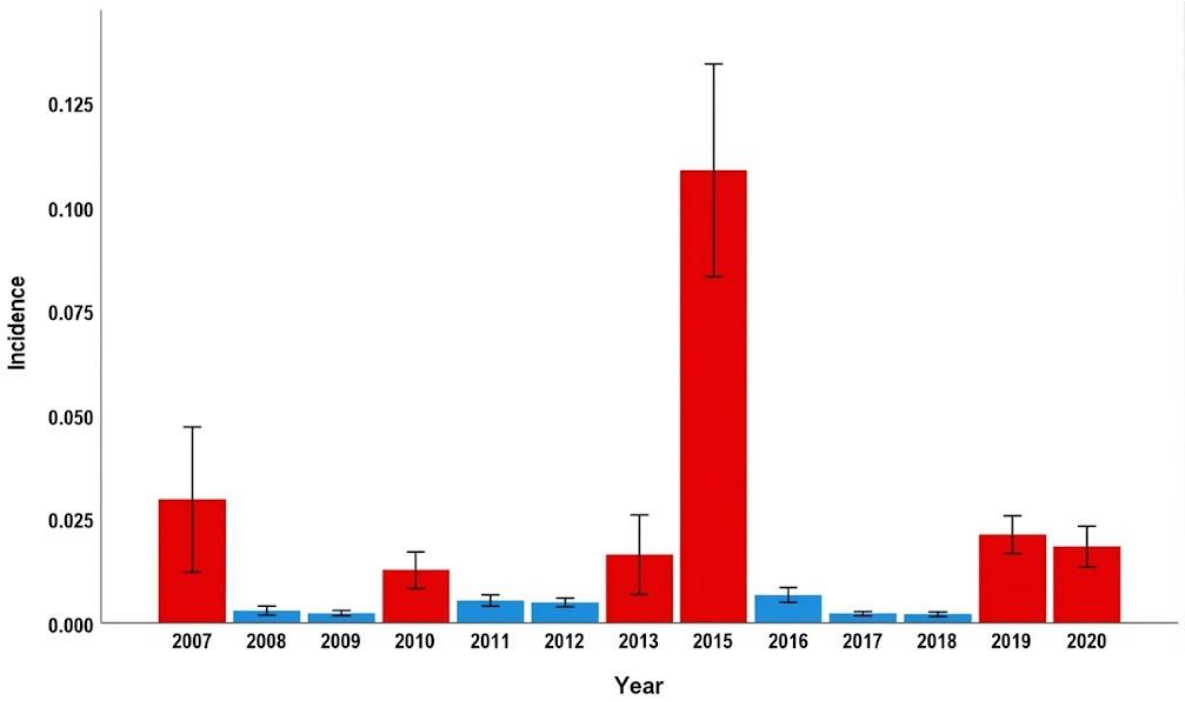


Fig. 1 - Analysis of all dengue cases reported in the municipality of Marília year by year during the period studied. (In red - epidemic years).

Among the epidemic years, the years 2007 and 2015 stand out, in which the highest number of cases occurred. Nevertheless, only 2015 showed a statistically significant difference with all the aforementioned epidemic years (table) and can be considered the year of the worst epidemic in the municipality.

Esta obra está bajo una licencia: https://creativecomons.org/licenses/by-nc/4.0/deed.es_ES

Table - Comparison of dengue cases reported in the municipality of Marília in the years 2007 and 2015 with the other years studied

2007												
(I)Year	2008	2009	2010	2011	2012	2013	2015	2016	2017	2018	2019	2020
p-velue	0,003	0,002	0,514	0,015	0,012	0,963	0	0,036	0,002	0.002	1	0,999
2015												
(I)Year	2007	2008	2009	2010	2011	2012	2013	2016	2017	2018	2019	2020
p-velue	<0,005	<0,005	<0,005	<0,005	<0,005	<0,005	<0,005	<0,005	<0.005	<0,005	<0,005	<0,005

The grouping of the reporting areas delimited by the four macro-regions of the municipality: North, South, East, and West, allowed the spatiotemporal analysis of the distribution of dengue cases and the expansion of territorial knowledge by health services, which provides a basis for the advancement of local health promotion.

Thus, it was observed that the incidence of dengue cases in the period analyzed did not show a statistically significant difference between the four macro-regions of the municipality (fig. 2).

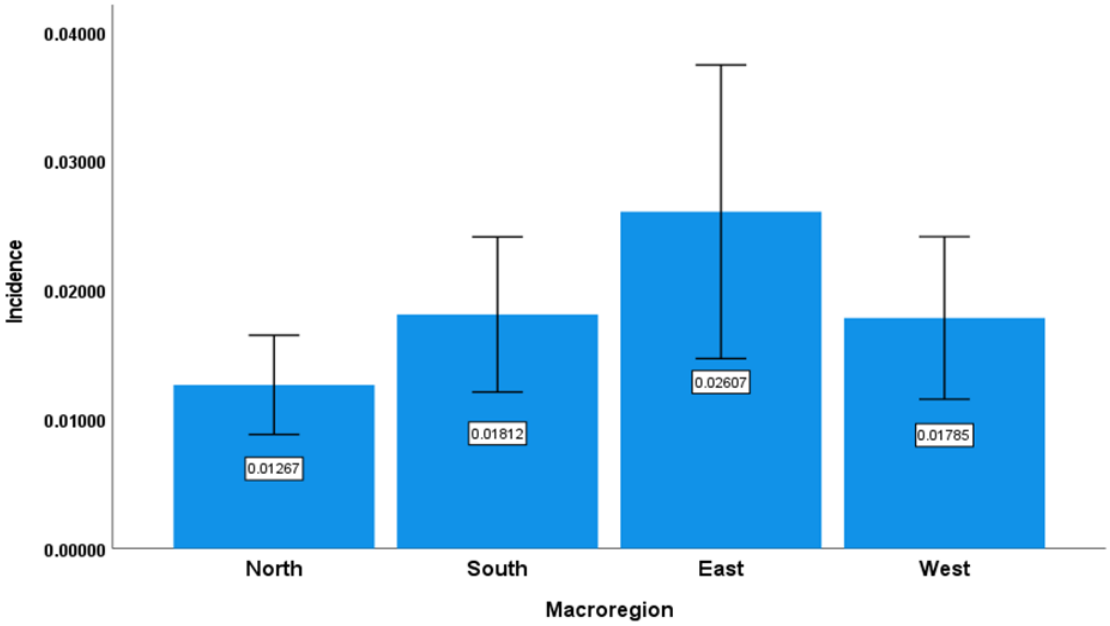


Fig. 2 - Analysis of dengue cases reported by each macro-region from 2000 to 2020.

Esta obra está bajo una licencia: https://creativecomons.org/licenses/by-nc/4.0/deed.es_ES

The figure 3, **Error! Reference source not found.**allows a comparative analysis of the incidence of dengue between the four macro-regions with the years studied, and it is possible to observe the pattern of disease incidence in the North, South, and East macro-regions, which did not present any other year with a statistically significant incidence similar to that of 2015, while the West region presents the incidence of dengue in the year 2015 with statistical similarity in relation to the years 2007 and 2013.

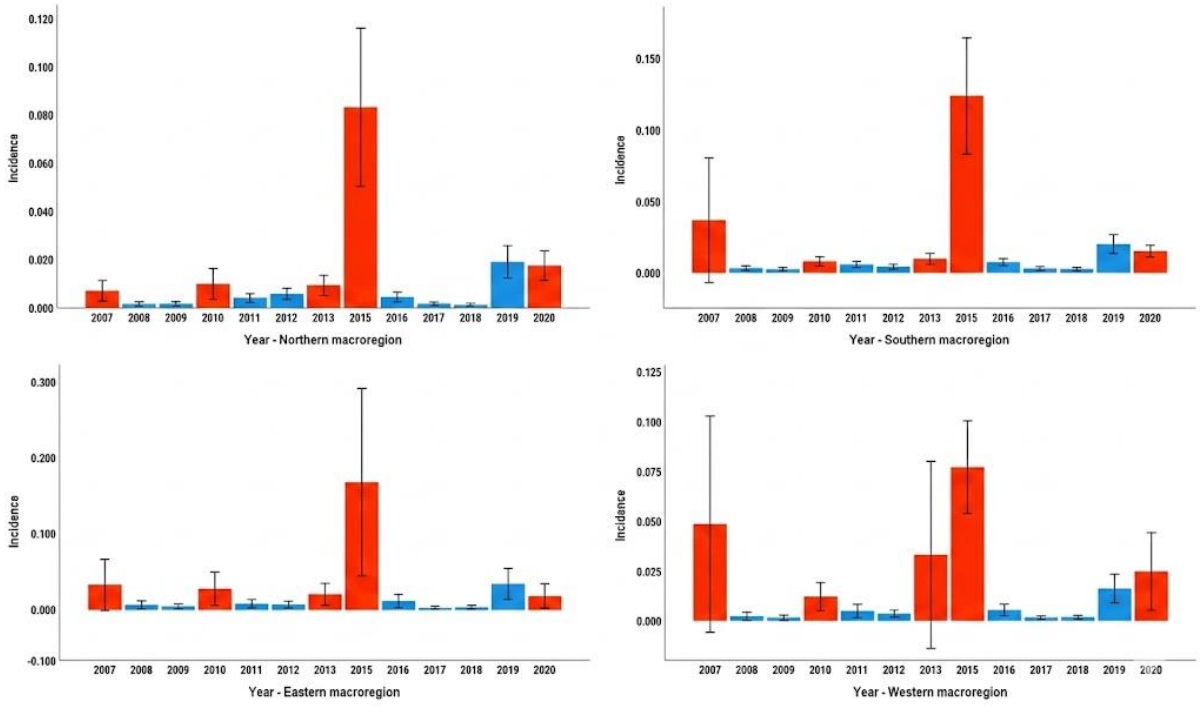


Fig. 2 - Analysis of dengue cases reported in the macro-regions of the municipality of Marília, year by year, in the period from 2000 to 2020. (In red - epidemic years).

The spatial analysis of the dengue cases reported in the macro-regions of the municipality of Marília (fig. 4) demonstrated the aggravating consonance of the epidemic profile of the years 2007 and 2013 when compared with the year 2015 in the West macro-region, while the other macro-regions only showed an epidemic in 2015.

Esta obra está bajo una licencia: https://creativecomons.org/licenses/by-nc/4.0/deed.es_ES

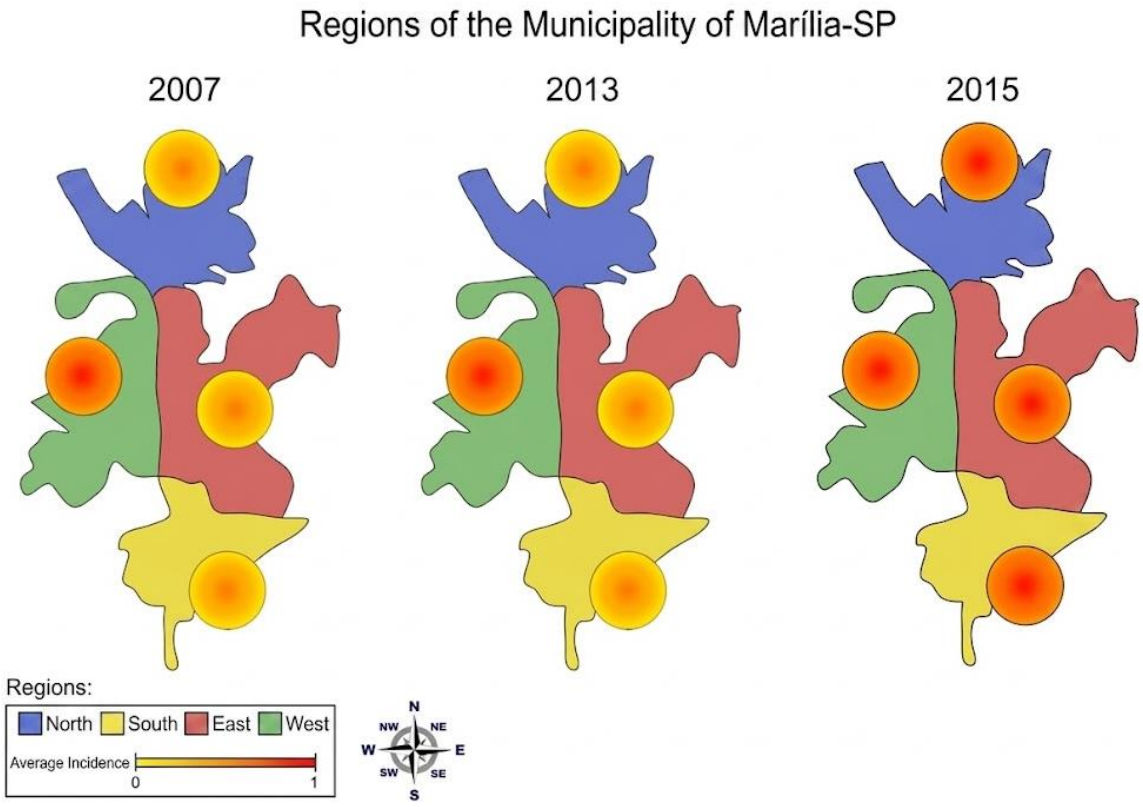


Fig. 4 - Spatial analysis of dengue cases reported in the macro-regions in 2007, 2013, and 2015.

Discussion

Since the reemergence of dengue epidemics that began in the mid-20th century,[3] the control of *Aedes aegypti* continues to represent a challenge for health authorities in Brazil. The disorderly growth of municipalities, the lack of adequate infrastructure, and the accumulation of waste and water favor the proliferation of this vector, while the low involvement of the population in the elimination of breeding sites compromises the effectiveness of preventive actions.

Starting in 2010, the simultaneous circulation of the four types of DENV in Brazil has been associated with epidemic patterns characterized by alternation of the predominant serotype.[15] This phenomenon can lead to hyperendemicity in places with high population density.[5] Although the present study did not investigate the predominance of serotypes in each year of the period analyzed, it should be noted that DENV has lower mutation rates when compared to other ribonucleic acid (RNA) viruses, while still being susceptible to genetic alterations.[16] These changes allow

Esta obra está bajo una licencia: https://creativecomons.org/licenses/by-nc/4.0/deed.es_ES

the recirculation of the same serotype, enabling the occurrence of new epidemics based on the possibility of reinfection of the population, with DENV-1 being the serotype with the highest average mutation rate per site and per year.[17]

In 2015, 1,649,008 cases of dengue were reported in Brazil, of which 62.20% occurred in the Southeast Region, predominantly associated with DENV-1.[18] In the same year, the municipality of Marília reported 20,692 cases, comprising one of the most critical periods of the disease in the municipality. The temporal analysis of the studied period indicated an endemic pattern of dengue, marked by maintenance of the incidence profile of dengue in the municipality, in both epidemic and non-epidemic periods. This behavior suggests a process of endemization of the arboviral disease, as described by *Mondini et al*.,[19] in which the presence of the virus in the current period is sustained by circulation in the previous year.[19]

The spatial analysis of dengue cases in Marília revealed that, during the studied period, there was no statistically significant difference in the incidence of the disease among the four macro-regions of the municipality. This indicates a homogeneous dispersal of the virus throughout the territory, with no predilection for specific areas (fig. 2). In this context, Marília, as a major socioeconomic center and regional hub, plays a key role in the epidemiological dynamics of dengue, influencing the spread of the virus in smaller cities surrounding its territory. The interaction between population flow, urban mobility, and service infrastructure may both favor the introduction of new serotypes and increase the spread of the virus among neighboring municipalities. *Ferreira et al*.[20] described a similar phenomenon in Araraquara, a municipality with a socioeconomic and population profile comparable to that of Marília.[20] In the study, the authors highlight that Araraquara has experienced major dengue epidemics followed by an increase in cases in neighboring cities, reinforcing its role as a hub for the spread and transmission of the disease.

Despite the statistical pattern of incidence found in the North, South, and East macro-regions, the West macro-region stood out for presenting high incidence rates not only in 2015, but also in 2007 and 2013, differing from the other regions, whose highest rates were concentrated exclusively in 2015 (fig. 4). This pattern suggests that the West macro-region may be more vulnerable to outbreaks due to structural and social factors. Municipal regions with annual maintenance in the incidence of cases were also observed by *Júnior et al*.[21] in the municipality of Belos Montes, in the state of Goiás (GO).[21]

When analyzing the socioeconomic conditions, it is observed that the West macro-region concentrates the largest number of precarious settlements listed in the Local

(cc) BY-NC Esta obra está bajo una licencia: https://creativecomons.org/licenses/by-nc/4.0/deed.es_ES

Social Interest Housing Plan (LSIHP-2022), totaling 433 units.[22] Additionally, this macro-region is home to the largest population residing in settlements, with approximately 1,418 inhabitants, followed by the East (1,297 inhabitants), North (1,001 inhabitants), and South (301 inhabitants) regions.[22] This context suggests that social determinants, such as precarious housing and inadequate sanitation, can directly influence the higher incidence of dengue in the region.

According to the São Paulo Social Vulnerability Index (SPSVI), which assesses six minimum items indicated by the Housing Plan of the Municipality of Marília to classify the vulnerability of settlements, the West macro-region is the only one in Marília with a deficit in waste collection, with two precarious settlements in which less than 50% of the homes are served. This lack of infrastructure can favor the proliferation of the vector mosquito, justifying, in part, the high rates of cases registered in the region.

This structural vulnerability of the West macro-region not only favors the spread of the vector, but also highlights the need for differentiated strategies to combat the arboviral disease. The epidemiological analysis of the region suggests that socioenvironmental factors play a key role in the dynamics of the disease. In this context, the active participation of the population becomes a crucial element in the epidemiological surveillance and control of dengue.[23] Although access to information regarding the disease is a fundamental step, it is not, in itself, sufficient to ensure the adoption of effective preventive measures. Studies indicate that, even in regions where educational campaigns are widely disseminated, the population's adherence to preventive practices remains below ideal, due to cultural and economic barriers and the individual perception of risk.[24]

It is important to highlight that the analysis carried out in this study considered only the household of the reported case as a reference for infection with the virus. Therefore, it was not possible to assess potential locations of exposure to DENV that lie outside the residential environment, such as places of work, study or leisure.[24] Future studies can expand this approach, incorporating data on urban mobility and population circulation for more accurate tracking of the spread of dengue in the municipality.

The reliability of epidemiological records also represents a challenge for public health management. The inconsistency in the quality of BNDIS data has already been documented in other scenarios, such as the dengue epidemic in Rio de Janeiro between the years 2001 and 2002, when reporting failures compromised more in-depth epidemiological analyses.[22] Therefore, ensuring the standardization and accuracy of reporting is crucial for efficient epidemiological surveillance and to

Esta obra está bajo una licencia: https://creativecomons.org/licenses/by-nc/4.0/deed.es_ES

support relevant public policies. Continuous surveillance and early detection of epidemics are essential for containing the disease, as noted by Kularatne.[25]

Is concluded with its exceptional dengue incidence profile, the West macro-region appears as a possible early indicator in epidemic years in the municipality of Marília. This pattern suggests its potential as a sentinel area, allowing for more precise monitoring of the spread of dengue and its impact on the local epidemiological panorama. The characterization of this region as a strategic surveillance point can contribute to the early identification of future epidemics, supporting more effective measures to control and mitigate the arboviral disease in Marília.

Acknowledgements

Institutional Program for Scientific Initiation Scholarship/National Council for Scientific and Technological Development: PIBIC/CNPq: No. 147423/2023-6.

Bibliographic references

1. Oliveira GEL, Costa IF, Souza RB, Fernandes LHS, Silva CA. Dengue: uma visão do panorama atual. Doenças Emergentes e Reemergentes: histórico, conceitos e cuidados em pesquisa. Jaguariúna: Faculdade de Medicina de Jaguariúna (UNIFAJ); 2024. DOI: https://doi.org/10.37885/240516582

2. Seixas JBA, Luz KG, Pinto Junior V. Atualização Clínica sobre Diagnóstico, Tratamento e Prevenção da Dengue. Acta Med Port. 2024;37(2):126-35. DOI: https://doi.org/10.20344/amp.20569

3. Braga IA, Valle D. Aedes aegypti: histórico do controle no Brasil. Epidemiol Serv Saúde. 2007;16(2):113-18. DOI: https://doi.org/10.5123/S1679-49742007000200006

4. Medeiros EA. Challenges in controlling the dengue epidemic in Brazil. Acta Paul Enferm. 2024;37:eEDT012. DOI: https://doi.org/10.37689/acta-ape/2024EDT012

5. Villabona-Arenas CJ, de Oliveira JL, Capra CdS, Balarini K, Loureiro M, Fonseca CRTP, *et al*. Detection of four dengue serotypes suggests rise in hyperendemicity in urban centers of Brazil. PLoSNegl Trop Dis. 2014;8(2):e2620. DOI: https://doi.org/10.1371/journal.pntd.0002620

Esta obra está bajo una licencia: https://creativecomons.org/licenses/by-nc/4.0/deed.es_ES

6. Pereira M, Suziki A, Bisordi I, Barleta C, Ferreira ITRN, Fróes MH, Maeda AY, *et al.* Dengue no Estado de São Paulo: situação epidemiológica e ações desenvolvidas em 2013. BEPA. 2013 [access 01/06/2024];10(119):3-14. Available from: https://periodicos.saude.sp.gov.br/BEPA182/article/view/38284?articlesBySameAuthorPage=2
7. Brasil. Ministério da Saúde. Secretaria de Vigilância em Saúde. Balanço dengue janeiro a setembro de 2007. Brasília (DF): Ministério da Saúde; 2007 [access 01/06/2024]. Available from: http://portal.saude.gov.br/portal/arquivos/pdf/balanco_dengue_setembro.pdfAcessoem 01 jun. 2024
8. Teixeira MDG, Costa MCN, Barreto ML, Mota E. Dengue and dengue hemorrhagic fever epidemics in Brazil: what research is needed based on trends, surveillance, and control experiences? Cad Saúde Pública. 2005;21(5):1307-15. DOI: https://doi.org/10.1590/S0102-311X2005000500002
9. Simmons CP, Farrar JJ, van Vinh Chau N, Wills B. Dengue. N Engl J Med. 2012;366(15):1423-32. DOI: https://doi.org/10.1056/NEJMra1110265
10. Lima-Camara TN. Activity patterns of Aedes aegypti and Aedes albopictus (Diptera: Culicidae) under natural and artificial conditions. Oecologia Australis. 2010;14(3):737-44. DOI: https://doi.org/10.4257/oeco.2010.1403.11
11. Morais MM, Morais N, Ribeiro MC, Ribeiro MPD, Cordeiro MT. Spatio-temporal dynamics of dengue in Brazil: Seasonal travelling waves and determinants of regional synchrony. PLoSNegl Trop Dis. 2013;7(4). DOI: https://doi.org/10.1371/journal.pntd.0002216
12. Carabali M, Hernandez LM, Arauz MJ, Villar LA, Ridde V. Why are people with dengue dying? A scoping review of determinants for dengue mortality. BMC Infect Dis. 2015;15(1):301. DOI: https://doi.org/10.1186/s12879-015-1058-x
13. Xu L, Stige LC, Chan KS, Zhou J, Yang J, Sang S, *et al*. Climate variation drives dengue dynamics. Proc Natl Acad Sci U S A. 2017;114(1):113-8. DOI: https://doi.org/10.1073/pnas.1701415114
14. Messina JP, Brady OJ, Golding N, Kraemer MUG, Wint GRW, Ray SE, *et al*. The current and future global distribution and population at risk of dengue. Nat Microbiol. 2019;4(9):1508-15. DOI: https://doi.org/10.1038/s41564-019-0476-8
15. Ortiz-Baez AS, Cunha MP, Vedovello D, Colombo TE, Rocco IM, dos Santos CL, *et al*. Origin, tempo, and mode of the spread of DENV-4 Genotype IIB in São Paulo, Brazil. Mem Inst Oswaldo Cruz. 2019;114:e180251. DOI: https://doi.org/10.1590/0074-02760180251
16. McCloud TG, Cardiff RD, Brandt WE, Chiewsilp D, Russell PK. Separation of dengue strains on the basis of a nonstructural antigen. Am J Trop Med Hyg. 1971;20:964-8. DOI: https://doi.org/10.4269/ajtmh.1971.20.964

Esta obra está bajo una licencia: https://creativecomons.org/licenses/by-nc/4.0/deed.es_ES

17. Twiddy SS, Holmes EC, Rambaut A. Inferring the rate and time-scale of dengue virus evolution. Mol Biol Evol. 2003;20(1):122-9. DOI: https://doi.org/10.1093/molbev/msg010
18. Araújo VEM. Aumento da carga de dengue no Brasil e unidades federadas, 2000 e 2015: análise do Global Burden of Disease Study 2015. Rev Bras Epidemiol. 2017:205-16. DOI: https://doi.org/10.1590/1980-5497201700050017
19. Mondini A, Chiaravalloti Neto F. Variáveis socioeconômicas e a transmissão de dengue. Rev Saúde Pública. 2007;41(6):923-30. DOI: https://doi.org/10.1590/S0034-89102007000600006
20. Ferreira AC, Chiaravalloti Neto F, Mondini A. Dengue em Araraquara, SP: epidemiologia, clima e infestação por Aedes aegypti. Rev Saúde Pública. 2018;52:18. DOI: https://doi.org/10.11606/S1518-8787.2018052000414
21. Júnior MAP, Giongo PR, Cardoso RL, Coelho KO, Ponciano IM, Corioletti NSD, *et al*. Sistema de informação geográfico aplicado na espacialização da ocorrência de dengue em São Luís de Montes Belos-GO. Cad Pedagógico. 2024;21(1):98-118. DOI: https://doi.org/10.54033/cadpedv21n1-006
22. Marília. Prefeitura Municipal. Plano local de habitação de interesse social: produto 02 – diagnóstico do setor habitacional. Marília: Prefeitura Municipal; 2022 [access 03/07/2024]. Available from: https://www.marilia.sp.gov.br/plano-local-habitacao
23. Zaparoli ICVB, Kozusny-Andreani DI, Vazquez GH, Zaparoli RE, Ramos EB, Vanzela LS. Resposta dos casos de dengue em função do clima no estado de São Paulo. Brazilian Journal of Development. 2021;7(3):28572-87. DOI: https://doi.org/10.34117/bjdv7n3-529
24. Silva TR, Costa AKA, Alves KAN, Santos AN, Cota MF. Tendência temporal e distribuição espacial da dengue no Brasil. Cogitare enferm. 2022;27:e84000. DOI: https://doi.org/10.5380/ce.v27i0.88192
25. Kularatne SA. Dengue fever. BMJ. 2015;351:h4661. DOI: https://doi.org/10.1136/bmj.h4661

Conflict of interest

The authors declare no conflict of interests.

Authorship contribution

Conceptualization: Luciamáre Perinetti Alves Martins, Rodrigo Buzinaro Suzuki, Nagib Scaff Machado Pontim and Eduardo Alexandre Rancan.

Esta obra está bajo una licencia: https://creativecomons.org/licenses/by-nc/4.0/deed.es_ES

Data curation: Nagib Scaff Machado Pontim, Eduardo Alexandre Rancan, Eduardo Federichi Baisi Chagas, Rodrigo Buzinaro Suzuki and Luciamáre Perinetti Alves Martins.

Formal analysis: Eduardo Federichi Baisi Chagas.

Research: Nagib Scaff Machado Pontim and Eduardo Alexandre Rancan.

Methodology: Rodrigo Buzinaro Suzuki and Luciamáre Perinetti Alves Martins.

Original draft: Luciamáre Perinetti Alves Martins, Rodrigo Buzinaro Suzuki, Nagib Scaff Machado Pontim and Eduardo Alexandre Rancan.

Revision and editing: Luciamáre Perinetti Alves Martins and Rodrigo Buzinaro Suzuki.

Esta obra está bajo una licencia: https://creativecomons.org/licenses/by-nc/4.0/deed.es_ES