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Epidemiology of dengue in Rio Grande do Sul, Brazil, in 2023: regional analysis and clinical outcomes

Epidemiologia da dengue no Rio Grande do Sul, Brasil, em 2023: análise regional e desfechos clínicos

Epidemiología del dengue en Rio Grande do Sul, Brasil, en 2023: análisis regional y resultados clínicos

Eduarda Schreiber[1], **Ana Paula Hentges**[1], **Evelise Moraes Berlezi**[1], **Eliane Roseli Winkelmann**[1]

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[1] Universidade Regional do Noroeste do Estado do Rio Grande do Sul- UNIJUÍ, Núcleo da Saúde, Programa de Pós-graduação Mestrado e Doutorado Associado (UNICRUZ, URI-Erechim, UNIJUI) em Atenção Integral à Saúde - PPGAIS. Ijuí, Rio Grande do Sul, Brazil

ABSTRACT

Introduction: Dengue is one of the most significant viral diseases in the national landscape and constitutes a serious public health problem. **Aim:** To analyze the incidence and outcomes of dengue cases by macro-regions and Health Coordinators in the state of Rio Grande do Sul in 2023. **Outlining:** An observational ecological study examining the epidemiological scenario of dengue across the macro-regions and Regional Health Coordinators (RHC) of the state of Rio Grande do Sul (RS) in 2023. Data collection was conducted through the State Health Surveillance Center portal and the Brazilian Institute of Geography and Statistics. **Results:** RS experienced an infestation situation, with 88.9% of cases being autochthonous and 54 deaths recorded. The most prevalent cases were among individuals aged 20 to 59 years (62%), females (53.2%), and deaths were concentrated in those over 60 years old (70.37%). The highest concentration of cases occurred in the Centro-Oeste and Missioneira regions, particularly in the 4th and 17th RHCs. The Serra region recorded the highest lethality rate (0.5%), while the Missioneira region reported the highest number of deaths (n = 16). **Implications:** This study provides an overview of the epidemiological scenario of dengue in Rio Grande do Sul and can serve as a basis for developing public policies aimed at controlling the disease.

DESCRIPTORS

Dengue; Incidence; Arbovirus Infections; Disease Notification; Health Information Systems.

Corresponding Author:
Eliane Roseli Winkelmann
Address: Rua do Comércio 3000, Bairro Universitário. Ijuí, Rio Grande do Sul, Brazil.
ZIP Code: 98700-000 - Ijuí, RS, Brazil.
Phone: +55 9 922-4402
E-mail: elianew@unijui.edu.br

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INTRODUCTION

Dengue is the arbovirus disease that most affects humans.[1] Characterized as a major public health problem, it is the most important viral disease transmitted by arthropods, specifically by the bite of the female Aedes aegypti mosquito.[1-3] Worldwide, it is estimated that nearly half of the global population (3.9 billion people) living in 120 different countries are at risk of infection by dengue, zika, and chikungunya viruses, all transmitted by the same vector.[4] Each year, the global number of dengue infections ranges between 284 to 528 million, of which 96 million are symptomatic. The incidence data are most significant in Southeast Asia, which also records the highest mortality rates.[4]

In 2019, the World Health Organization (WHO) included dengue as one of the top ten public health priorities, with the goal of reducing deaths by 50% by 2020 (WHO, 2019). Brazil, where dengue is endemic, is one of the countries most affected by this viral disease.[3,5] According to an epidemiological bulletin released by the Ministry of Health in January 2023, 1,450,270 probable cases of dengue (incidence rate of 679.9 cases per 100,000 inhabitants) were reported in 2022, a 162.5% increase compared to the same period in 2021.[6]

The virus is transmitted from arthropod to arthropod via transovarian transmission, or by "biological transmission between susceptible vertebrate hosts and hematophagous arthropods".3 There is a distinction between autochthonous transmission (when the infection occurs in the same location where the disease is reported) and allochthonous transmission (when the case develops outside the territory where the infection occurred).[3]

The Dengue Arbovirus (DENV) has four main serotypes (DENV-1, DENV-2, DENV-3, and DENV-4),[2,3,5] which develop a broad clinical spectrum5 and are genetically related, although antigenically distinct.[2,3] Its clinical manifestation includes both severe and non-severe cases, and it can range from asymptomatic infection to multiple organ failure, as it can affect the heart, liver, kidneys, muscles, and brain.[5,7] The most severe manifestations can lead to complications such as Dengue Hemorrhagic Fever (DHF) or Dengue Shock Syndrome (DSS),[2,5] with a mortality rate of 10% for hospitalized patients and 30% for non-hospitalized patients.[5] For treatment, whether patients are hospitalized or not, early detection of the critical phase of the disease is essential, as therapy consists of symptom management, given that there is still no specific antiviral for dengue and the developed vaccines still have limitations.[3,5,7]

Geographically, due to favorable environmental conditions, dengue is distributed along the Equator.[3] The first recorded dengue epidemics in Brazil occurred between the second and third decades of the last century, although the first laboratory-confirmed DENV case was reported in 1981.[2] Since the 1990s, the Americas have accounted for more than half of the global dengue cases, with Brazil significantly contributing in 1998, when DENV-1 and DENV-2 spread to 20 of Brazil's 27 states.[2,3,8] Currently, all four dengue serotypes circulate throughout the country, and dengue is a notifiable disease.[2]

In Rio Grande do Sul, the first dengue report dates back to 1996, while the first autochthonous case in the state was recorded in 2007.[8] Currently, the pattern of DENV circulation in Rio Grande do Sul is similar to that of the rest of Brazil, although in smaller proportions.[8] Since 2017, the state has seen an annual increase in confirmed dengue cases, peaking in 2022 with over 67,000 cases reported between the tenth and twentieth epidemiological weeks. By June 2023, 22,177 dengue cases had been confirmed.[9]

The disease's progression in the country, coupled with the difficulty in managing affected patients, highlights the importance of investing in related research. Epidemiological surveillance plays a fundamental role in monitoring the vector density of Aedes aegypti and recording human cases of the

disease, the latter through the Notifiable Diseases Information System (SINAN).[1] In Rio Grande do Sul (RS), these secondary data are available through the dengue case data panel on the virtual platform of the State Health Surveillance Center (CEVS- RS).[9] However, the mere publication of these secondary data does not constitute the dissemination of health information, underscoring the need to process these data through epidemiological and statistical research, which can guide the development of public health policies aimed at controlling the disease.[3]

Therefore, this study aims to analyze the incidence of dengue cases by macro-region and Health Coordinators in the state of RS in 2023, as well as the outcomes of reported and confirmed dengue cases in the macro-regions of RS in 2023.

METHOD

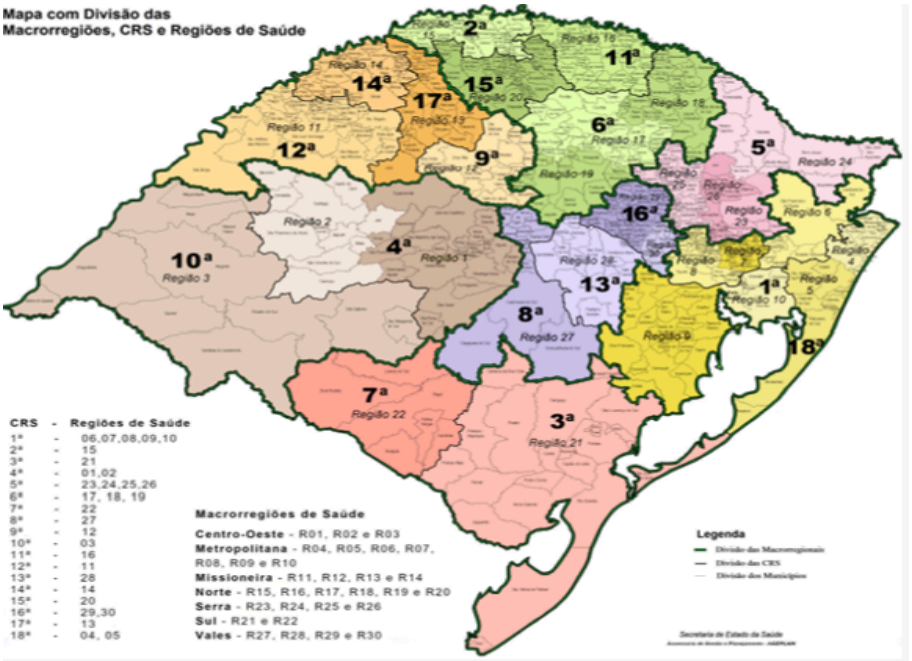
This exploratory ecological study utilized publicly available data provided by the State Health Surveillance Center of Rio Grande do Sul (CEVS-RS) via the website https://saude.rs.gov.br/inicial and the Ministry of Health's Database (DATASUS) via the website https://datasus.saude.gov.br/informacoes-de-saude-tabnet. Data from the CEVS/RS and DATASUS databases were collected on February 27, 2024.

This study is part of an institutional research project conducted under an agreement between the University and the Municipality of Ijuí titled: "Analysis of information systems for diagnosing the health status of the population of the municipality of Ijuí/RS-Brazil," approved by the Human Research Ethics Committee (CAAE: 51638321.0.0000.5350 Opinion: 5.019.922/2021).

The unit of analysis was the territory of the state of RS (Figure 1), and the study population included dengue cases reported from January to December 2023 by the health services of the municipalities in the state of RS. These cases were recorded by municipal, state, and federal health surveillance services. The analysis was conducted considering the seven macro-regions that comprise the state: Central-West, Metropolitan, Missioneira, North, Serra, South, and Vales, which include the state's 30 health regions.

The variables of interest were the number of reported cases, the number of confirmed cases, autochthonous cases, deaths, recoveries, and hospitalizations.

Figure 1. Map showing the division of macro-regions, RHC, and health regions of Rio Grande do Sul



Source: State Department of Health.

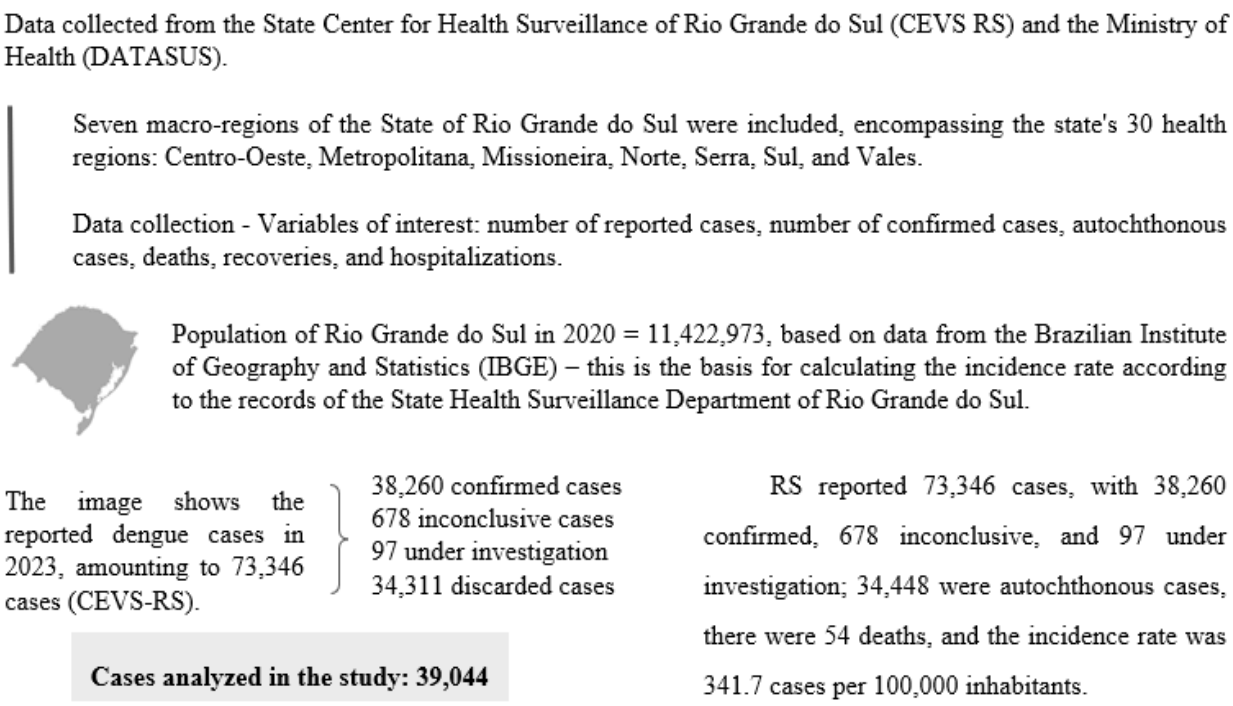
For the comparison of regions, the incidence coefficient was used as a measure. This was calculated by dividing the number of reported cases, excluding discarded cases, by the estimated population according to the IBGE 2020 (the year used for calculation by CEVS/RS), according to the region and year of interest, and then multiplying by 100,000 inhabitants.

RESULTS

RS reported 73,346 cases, with 38,260 confirmed, 678 inconclusive, and 97 under investigation; 34,448 were autochthonous cases. There were 54 deaths, and the incidence rate was 341.7 cases per 100,000 inhabitants (calculated by excluding discarded cases from the reported cases). The majority of those infected were female (53.2%) and in the 20 to 59 age group (62%). Regarding the deaths, there was a higher concentration among those aged 60 and above (70.37%), particularly in the 80+ age group (21 deaths, 38.9%) (Figure 2).

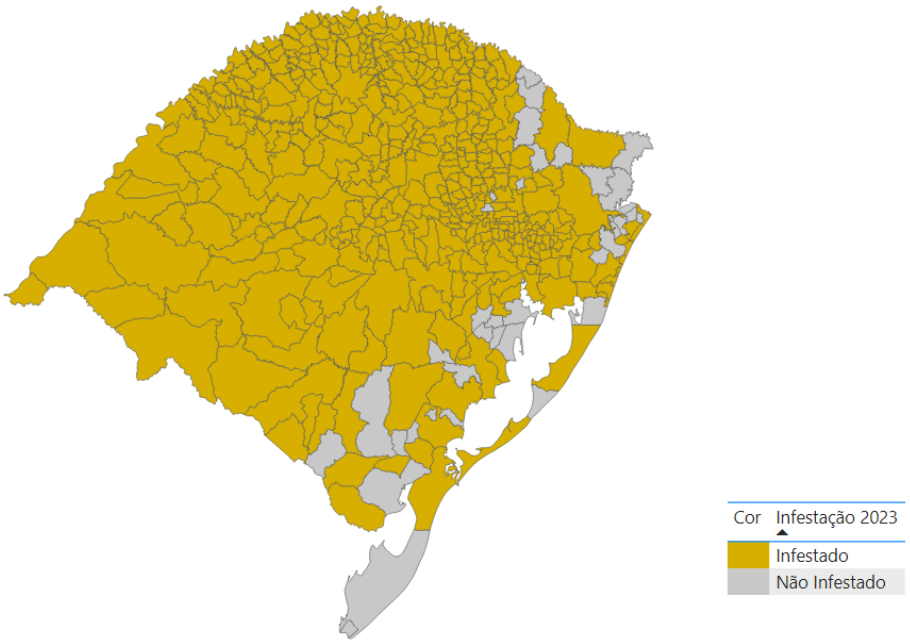
RS has been among the Brazilian states with the highest number of dengue cases. Unfortunately, the efforts made were not sufficient to control the epidemic in 2023, as shown in Figure 3, where the largest geographic area of the state was in an infected status. Figure 3 indicates a Level 3 public health alert infestation in most of the territory of RS with only a few municipalities located in the Southern macro-region (health regions 21 and 22), Metropolitan (regions 4, 5, 6, and 9), and Serra (region 24) not experiencing infestation.

Figure 2. Flowchart of the study



Source: The authors (2023).

Figure 3. Map of infection status in the state of RS in 2023



Source: State Health Surveillance Center of RS - CEVS.

In Table 1, we can observe the incidence by macro-regions of the state, where it is evident that there was a higher concentration of cases in the Central-West and Missioneira regions. Within these macro-regions, the 4th and 17th Regional Health Coordinators (RHC) stand out. This incidence characterizes a public health emergency. Additionally, regardless of the region analyzed, the majority of cases were autochthonous (88.9% in RS), meaning the problem was acquired in the individual's municipality of origin.

Table 1. RIncidence and incidence coefficient of reported dengue cases by macro-region and Health Coordinators in the state. Rio Grande do Sul, Brazil, 2023. (n = 73,346)

Macro-region	Number of reported cases	Incidence coefficient by Macro-region*	RHC	IC per RHC †
Vales	9.395	466.4	8th Cachoeira do Sul	16.8
			13th Santa Cruz do Sul	89.2
			16th Lajeado	1092.5
South	427	6.8	3rd Pelotas	7.5
			7th Bagé	3.7
Serra	1.102	34.6	5th Caxias do Sul	34.6
North	9.508	276.3	2nd Frederico Westphalen	296.8
			6th Passo Fundo	370.9
			11th Erechim	58.4

			15th Palmeira das Missões	175.4
Missioneira	12.499	879.0	9th Cruz Alta	866.2
			12th Santo Ângelo	85.1
			14th Santa Rosa	293.1
			17th Ijuí	2.418.9
Metropolitan	26.744	267.4	1st Porto Alegre	288.6
			18th Osório	22.6
Central-West	13.776	951.2	4th Santa Maria	1642.1
			10th Alegrete	66.4

*CI per macro-region = incidence coefficient per 100,000 inhabitants of the macro-region of the state of Rio Grande do Sul; † CI per RHC = incidence coefficient per 100,000 inhabitants of the Regional Health Coordinators.
Source: Ministry of Health/SVSA - Notifiable Diseases Information System - Sinan Net / own elaboration (2024).

Table 2 shows the outcome of dengue cases by macro-region of the state. It is possible to observe that the Metropolitan and Missioneira regions stand out regarding hospitalizations when analyzing absolute numbers. However, when this data is analyzed by the proportion of dengue cases, the Serra (13% of hospitalized cases) and North (9.1% of hospitalized cases) regions stand out. The virulence, which indicates the degree of pathogenicity of a disease, was higher in the Missioneira (21.4%) and Vales (17.8%) regions, which were also the regions with the most recorded deaths (16 and 13, respectively). Statewide, the virulence reached 58.5%. Additionally, Table 2 presents the dengue lethality coefficient, calculated by the number of deaths divided by the total number of cases, demonstrating a greater severity of the disease in the Serra region.

Table 2. Outcome of dengue cases regarding recovery, death, and hospitalizations by macro-regions of the state. Rio Grande do Sul, Brazil, 2023. (n = 38,494)

Macro-region	Number of cases	Recovery	Death from the notifiable disease	Hospitalization	V (%)*	LC (%) †
Vales	4262	2331	13	206	17.8	0.3
South	55	51	0	2	3.6	0
Serra	400	383	2	52	15	0.5
North	3295	2900	8	303	17.1	0.2
Missioneira	7497	7365	16	409	21.4	0.2
Metropolitan	12964	10481	9	524	13	0.06
Central-West	10021	3173	6	271	8.7	0.05
Total	38494	26684	54	1767	58.5	0.1

*V = virulence; † CL = lethality coefficient.
Source: Ministry of Health/SVSA - Notifiable Diseases Information System - Sinan Net / own elaboration (2024).

DISCUSSION

The dengue situation in the RS in 2023 represented an alarming scenario, with 460 municipalities (92.6%) in an infestation status. However, the dengue situation in 2023 saw a decline compared to 2022, which followed six years of increasing numbers.[9] From 2017 to 2022, the annual cumulative confirmed cases were 24, 28, 1,346, 3,632, 10,597, and 67,319 cases, respectively.[9] The year 2023 shows a break in this progression, as the number of confirmed cases was 38,260, about 56.8% of the total recorded in 2022. Regarding total notifications, 2019 recorded 4,248 cases, followed by 2020 with 6,671 notifications, 2021 (16,607 notifications), 2022 (98,748 notifications), and 2023 with 73,346 notifications,[9-13] revealing a pattern of DENV progression until 2022 and containment of the disease in 2023, despite the infestation status in most of the state's territory. The number of deaths recorded each year supports this claim, as in 2019 the state did not record any deaths, followed by 2020 (6 deaths), 2021 (11 deaths), 2022 (66 deaths), and 2023 (54 deaths).[9-13]

According to a study by Daros et al.,[14] which investigated epidemiological data on dengue by macro-regions of the state from 2017 to 2021, the epidemiological profile of individuals affected in 2023 remained the same as in previous years. The authors found a predominance of women (53.2%) and individuals aged 20 to 59 years (65.8%), indicating a trend of maintaining the epidemiological profile of dengue in the state. Additionally, the cited study reveals a predominance of dengue notifications in self-declared white individuals (85%), a variable not analyzed in this study. This data is notable but understandable, considering that the majority of the RS population self-declared as white (79% in 2019).[15]

The analysis of dengue incidence by macro-regions of the state and regional health coordinators allows us to observe the behavior of the disease in a regionalized manner. In 2023, the Central-West and Missioneira macro-regions stood out, with incidence coefficients (951.2 and 879.0, respectively) significantly higher than the third place (Vales region, with an incidence coefficient of 53.06% of that recorded in the Missioneira region). In 2022, the Vales region had the highest incidence coefficient (1055.3 per 100,000 inhabitants). During this period, the Missioneira region also showed high incidence (CI = 951.2), while the Central-West region had the second lowest incidence in the state (CI = 24.7). In 2019, the North region had the highest incidence (CI = 33.8), while the Central-West region recorded only 2.0. The study by Daros et al.[14] reinforces the lack of a distribution pattern for dengue in RS, showing the percentage variation in dengue cases from 2017 to 2021 by macro-region, with variation ranging from 100% (South region) to 92,916.7% (Vales region).[14]

Additionally, the joint investigation of dengue case outcomes by macro-region in RS reveals the severity with which dengue spread across the state in 2023. The Central-West region, despite having the highest incidence coefficient in RS, had low virulence and lethality rates, reflected in the number of deaths compared to other macro-regions. This indicates that although it had a high number of dengue notifications, these cases were milder. On the other hand, the Missioneira macro-region, which also had a high incidence coefficient, showed the highest virulence and lethality rates in the state, bearing the burden of the highest number of deaths during this period. These indicators highlight the severity of the dengue epidemiological scenario in this region, as it concentrated many dengue cases with more severe outcomes. It is worth noting that this macro-region includes the 17th RHC of RS, which had by far the highest incidence coefficient among the RHC, reaching approximately 2,500 cases per 100,000 inhabitants. Conversely, the Vales and South macro-regions are noteworthy due to their significant number of deaths and lethality coefficient, respectively, despite having less impressive incidence coefficients. These indicators suggest that although

these macro-regions had fewer dengue cases, the cases were more severe.

Limitations

This study has some limitations that should be considered when interpreting the results. Firstly, the analysis was based on secondary data recorded in health surveillance systems, which may be subject to underreporting and inaccuracies. The quality of the data depends on the accuracy and consistency of the information provided by healthcare professionals, which can introduce biases in the results. Furthermore, the lack of detailed data on sociodemographic variables, such as race/color and socioeconomic status, limits the understanding of factors that may influence the incidence and outcomes of dengue in different populations.

Implications for Practice

The findings of this study can serve as a valuable tool for health managers by providing a temporal and regional analysis of dengue in the state of Rio Grande do Sul in 2023. This allows for targeted efforts in the most affected areas and investments in prevention and control in regions with higher incidence and severity of cases. By identifying regional patterns of transmission and outcomes, the study can support the development of more effective public policies for the prevention and management of dengue, contributing to reducing the disease burden and improving public health in the state.

CONCLUSION

The seriousness of the dengue epidemiological scenario recorded throughout the state of RS in 2023 is evident, with the exception of a few municipalities. The analysis of dengue incidence in the state highlights the public health emergency, especially in the Central-West and Missioneira regions, with particular emphasis on the 4th and 17th RHC. The high proportion of autochthonous cases in the state, as well as the differing outcomes by macro-region, underscores the need for an individualized analysis of each municipality in addressing and managing its epidemic. This is crucial for identifying gaps that need to be addressed for the implementation of public policies aimed at resolving this issue and preventing similar epidemiological scenarios in subsequent years.

RESUMO

Introdução: A dengue é uma das mais importantes doenças virais do cenário nacional e configura um grave problema de saúde pública. Objetivo: Analisar a incidência e desfechos dos casos de dengue por macrorregiões e Coordenadorias de Saúde do estado do Rio Grande do Sul em 2023. **Delineamento:** Estudo ecológico observatório acerca do cenário epidemiológico da dengue por macrorregiões e Coordenadorias Regionais de Saúde (CRS) do estado do Rio Grande do Sul (RS) em 2023. Coleta realizada no portal do Centro Estadual de Vigilância em Saúde e do Instituto Brasileiro de Geografia e Estatística. **Resultados:** RS esteve em situação de infestação, 88,9% de casos autóctones e 54 óbitos registrados, sendo mais prevalentes na faixa de 20 a 59 anos (62%), sexo feminino (53,2%) e óbitos acumularam nas faixas acima de 60 anos (70,37%). Houve maior concentração de casos nas regiões Centro-Oeste e Missioneira, destaque 4ª e 17ª CRS. A região da Serra registrou maior coeficiente de letalidade (0,5%) e a região Missioneira registrou maior número de óbitos (n = 16). **Implicações:** O estudo oferece um panorama geral acerca do cenário epidemiológico da dengue no Rio Grande do Sul, e pode servir de base para elaboração de políticas públicas voltadas ao controle da doença.

DESCRITORES

Dengue; Incidência; Infecções por Arbovirus; Notificação de Doenças; Sistemas de informação em saúde.

RESUMEN

Introducción: El dengue es una de las enfermedades virales más importantes del escenario nacional y constituye un grave problema de salud pública. **Objetivo:** Analizar la incidencia y los resultados de los casos de dengue por macrorregiones y Coordinaciones de Salud del estado de Rio Grande do Sul en 2023. **Delineación:** Estudio ecológico observacional sobre el escenario epidemiológico del dengue por macrorregiones y Coordinaciones Regionales de Salud (CRS) del estado de Rio Grande do Sul (RS) en 2023. La recolección de datos se realizó en el portal del Centro Estatal de Vigilancia en Salud y del Instituto Brasileño de Geografía y Estadística. **Resultados:** RS estuvo en situación de infestación, con un 88,9% de casos autóctonos y 54 muertes registradas, siendo más prevalentes en el grupo de edad de 20 a 59 años (62%), mujeres (53,2%), y las muertes se acumularon en los grupos mayores de 60 años (70,37%). Hubo una mayor concentración de casos en las regiones Centro-Oeste y Missioneira, destacando las 4.ª y 17.ª CRS. La región de la Serra registró la mayor tasa de letalidad (0,5%) y la región Missioneira registró el mayor número de muertes (n = 16). **Implicaciones:** El estudio ofrece una visión general del escenario epidemiológico del dengue en Rio Grande do Sul y puede servir como base para la elaboración de políticas públicas orientadas al control de la enfermedad.

DESCRIPTORES

Dengue; Incidencia; Infecciones por Arbovirus; Notificación de Enfermedades; Sistemas de Información en Salud.

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COLLABORATIONS

ES, BEM, and ERW: contributions to the study conception. ES and APH: contributions to data collection. ES, APH, EMB, and ERW: contributions to data analysis and interpretation. ES: contributions to the discussion of results. ES, APH, BEM, and ERW: contributions to writing and/or critically revising the content, and reviewing and approving the final version of the manuscript. **All authors agree and are responsible for the content of this version of the manuscript to be published.**

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AVAILABILITY OF DATA

All data used for the analysis in the article are available from the State Health Surveillance Center of Rio Grande do Sul (CEVS/RS) at https://saude.rs.gov.br/inicial and the Ministry of Health's Database (DATASUS) at https://datasus.saude.gov.br/informacoes-de-saude-tabnet.

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CONFLICTS OF INTEREST

There are no conflicts of interest to declare.