

EPIDEMIOLOGICAL ANALYSIS OF DENGUE IN THE STATE OF MINAS GERAIS IN 2023

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Abstract: Dengue is an infectious disease transmitted by the *Aedes aegypti* mosquito, which can cause serious symptoms and even lead to death. In recent years, an epidemiological worsening of dengue has been observed in the country, and to this end, federal entities are applying measures to combat this scenario. This study aimed to carry out an epidemiological survey of dengue in Minas Gerais during the year 2023, evaluating the incidence, associated risk factors and geographic distribution of the disease. Dengue case notification data from all municipalities in Minas Gerais were analyzed, with a population-based descriptive analysis, using secondary data from official public health sources, using the TABNET tool from the Information Department of the Unified Health System (DATASUS). Fourteen macro-regions of the state of Minas Gerais were evaluated, including the South, West, East, Southeast, North, Center South, Center and Jequitinhonha regions. The data collected were on disease classification criteria, its evolution, patient hospitalization and death. The results showed that the incidence of dengue in Minas Gerais was 392,265 reported cases, including cases of dengue with warning signs and severe dengue. The South region had the highest number of notifications, with a total of 46,884 cases of hospitalization for dengue, being stratified into Ignored/White, hospitalized and non-hospitalized. It is concluded that understanding the incidence, associated risk factors and geographic distribution of dengue are crucial to inform prevention and control strategies for the disease.

Keywords: Epidemiology. Disease prevention. Severe dengue. Hospitalization. Death.

INTRODUCTION

Aedes aegypti, initially called *Culex aegypti*, was transported to the “new world” in the holds of ships bringing people from

Africa. These mosquitoes, which until then were little known to 16th century scholars, quickly spread to Asia and the Americas. Therefore, *Aedes aegypti* spread throughout the world through the transport of people and goods (Powell, 2018, p. 854).

Despite having evolved over time, resisting combat measures, it was only in 1981 that the first clinically and laboratory-proven dengue epidemic was recorded in Brazil, specifically in the city of Boa Vista, in Roraima (Nunes, 2019, p. 1).

Since then, the country has faced two patterns of the disease: one endemic, which manifests itself with recurrences in specific areas without a significant increase in cases, and another epidemic, which appears every four to five years and is characterized by a substantial increase in cases in different regions (Guzman, 2015, p. 453).

Dengue is an acute disease and a serious public health problem throughout the world, especially in tropical countries, where environmental conditions favor the proliferation of the mosquito vector.

Transmission occurs through the bite of the *Aedes aegypti* mosquito infected with the dengue virus (CDC, 2020). After a meal of infected blood, the mosquito is able to transmit the virus, after 8 to 12 days of incubation. Mechanical transmission is also possible, when the meal is interrupted and the mosquito immediately feeds on a nearby susceptible host. There is no transmission through direct contact between a sick person or their secretions with a healthy person, nor from sources of water or food (Bhatt, 2013, p. 504).

Symptoms of dengue include high fever, headache, pain behind the eyes, muscle and joint pain, nausea, vomiting, tiredness and red spots on the skin (WHO, 2014).

Dengue can present itself in two forms: the classic form, which is benign and has a

self-limiting evolution, and the hemorrhagic form, which is serious and can lead to death. The hemorrhagic form is characterized by bleeding, a drop in blood pressure, an increase in the size of the liver and shock (Halstead, 2007, p. 1644).

The diagnosis of dengue is made through laboratory tests, such as the rapid test and serology. The rapid test is an exam that detects the presence of antibodies against the dengue virus in the patient's blood. Serology is a test that detects the presence of antibodies against the dengue virus in the patient's blood. In situations not characterized as an epidemic, serology must be requested for epidemiological tracking, as well as the laboratory tests necessary to establish the diagnosis of dengue (GUZMÁN, 2004, p.69).

Dengue treatment is symptomatic and includes hydration and control of fever and pain. There is no specific treatment for classic dengue. The medication is only symptomatic, with analgesics and antipyretics (paracetamol and dipyrone). Salicylates and non-steroidal anti-inflammatory drugs must be avoided, as their use can favor the appearance of hemorrhagic manifestations and acidosis (CDC, 2020). In the hemorrhagic form, treatment is more intensive and may include blood transfusion and hospital admission. It is important that the patient is instructed to remain at rest and begin oral hydration. Parenteral hydration is preferred and can be done with isotonic saline solution (SF 0.9%). Treatment must be monitored by health professionals and laboratory reassessment must be carried out after hydration (CDC, 2020).

Dengue is considered a neglected disease because there is no administrative interest in actually combating it, either because it does not offer political returns or because it generates a large economic movement. Furthermore, the lack of investment in research and

development of new technologies to combat mosquitoes and the disease also contributes to negligence (Horstick, 2015, p. 3632).

Challenges to combating dengue include the population's lack of awareness about the importance of prevention, the difficulty in controlling mosquito proliferation in urban areas, the lack of financial and human resources to implement preventive and control measures, and the lack of coordination between public bodies and the population (WHO, 2012).

There is a need to reinforce the importance of combating mosquitoes becoming a year-round habit and not just something seasonal (Bhatt, 2013, p. 504).

When observing the evolution of dengue fever in the city of Uberlândia, a constant annual trend is noted, with a significant increase in cases after the rainy season between January and April. Furthermore, there is a worrying growth trend from one year to the next. For example, in 2022, the number of cases was seven times higher than in the previous year (DATASUS, 2023).

The specific objectives of the Contingency Plan for Arboviruses in Uberlândia are to avoid deaths and guide the municipal public administration in responding to diseases such as Dengue, Zika virus and Chikungunya and other arboviruses, given the need to enhance the necessary actions. The Municipal Arbovirus Contingency Plan in Uberlândia is prepared every year and is the result of collective and cooperative work from different areas of the Municipal Health Department. It is pre-planning that follows the scenario and serves as a subsidy for the preparation of the Action Plan following pre-defined alert levels (BRAZIL, 2022).

After epidemiological surveillance has been carried out, it is analyzed and alert levels must take into consideration: infestation rate, number of reported and/or confirmed cases,

serious cases and those with warning signs and deaths (WHO, 2012).

To deal with the epidemiological problem of dengue, the City Hall has adopted measures such as the use of smoke trucks to eliminate mosquitoes, together with the organization of cleaning efforts in the most affected areas, an action called: “*Mutirão Cidade Limpa*”, which eliminated more of 130 thousand breeding sites for the mosquito that transmits dengue fever in the 1st half of 2023 (UBERLÂNDIA, 2023).

However, despite these actions, the disease continues to return annually. This fact may be a consequence, among others, of the frequent use of tobacco, which can lead to mosquito resistance to the poison over time, requiring more aggressive formulas to combat it. Even though it is one of the most popular measures to combat the dengue vector, the insecticide does not completely solve the problem, as it only kills mosquitoes in the adult stage, not eliminating eggs and larvae. Oliveira explains that this practice affects bees and other insects, in addition to *Aedes aegypti*, and can generate environmental problems (Moreira Neto, 2010, p. 1).

Therefore, it is crucial that we adopt a more conscious and sustainable approach to dealing with this issue, promoting open dialogue with the community and listening to their concerns and needs. Education plays a fundamental role in this process, and a change in the way we approach this problem is necessary to find effective solutions (Alvaro-Prado, 2020, p. 1).

Furthermore, it is important to organize health services to avoid a significant increase in cases and deaths. Other measures that can be adopted include the use of repellents, wearing clothing that covers most of the body, installing screens on doors and windows, and eliminating containers that can accumulate standing water (CDC, 2017).

EPIDEMIOLOGICAL DATA

According to Brazil's 2023 epidemiological bulletin, the Central-West Region had the highest dengue incidence rate, with 236.6 cases/100,000 inhabitants, followed by the North Regions (75.2 cases/100,000 inhabitants.), Southeast (24.9 cases/100 thousand inhabitants), South (15.7 cases/100 thousand inhabitants) and Northeast (16.4 cases/100 thousand inhabitants). The states that have the highest incidence rates in the country are Tocantins, Goiás, Mato Grosso and Distrito Federal (DATASUS, 2023).

In epidemiological terms, there was a 30% increase in probable cases of dengue throughout Brazil by April 2023 compared to the previous year. This totaled 899.5 thousand cases with 333 confirmed deaths, with Espírito Santo, Mato Grosso do Sul, Minas Gerais, Paraná, Santa Catarina, Acre and Rondônia being the most affected states (DATASUS, 2023). Climate variation, increased rainfall, population susceptibility and changes in virus circulation are contributing factors to this growth (MASULLO, 2015, p. 122).

Faced with this increase in arboviruses, the Ministry of Health launched a national campaign to combat diseases, with the motto “Brazil united against dengue, Zika and chikungunya”. The campaign aims to raise awareness about disease symptoms, prevention measures and control of the *Aedes Aegypti* mosquito, being broadcast in various media and widely circulated locations across the country (BRAZILIAN AGENCY, 2023).

The Ministry of Health also took additional measures, including the creation of the Emergency Operations Center (COE Arboviruses) in March 2023 to monitor the epidemiological situation in different states. COE teams have already visited eight states to assist with local strategies, distributed larvicides and sent kits to diagnose the disease. The ministry invested more than R\$84 million

in the purchase of inputs to control *Aedes aegypti* in 2023 (BRAZIL, 2023).

In the case of the Municipality of Uberlândia, on April 13, 2023, the city hall met in the auditorium of the Municipal Department of Water and Sewage (Dmae), community health agents (ACS) from the network and the coordination of the Disease Control Program Caused by *Aedes aegypti*. This meeting aimed to reinforce this professional's awareness of their relevance in this scenario. The Zoonosis Control Center held a moment of awareness, presenting epidemiological data and forms of prevention. At that moment, some CHWs were surprised by the information that 84% of breeding sites are in homes (UBERLÂNDIA, 2023).

The *Aedes* Building Infestation Index (IIP) is an indicator that shows the percentage of properties that have containers with *Aedes* larvae in relation to the total number of properties inspected by endemic control agents. These results are important for planning and implementing actions to control and prevent arboviruses in Minas Gerais (Coelho, 2008).

According to the study by RIBEIRO (2021), the data collected from 817 municipalities, 46.5% of them (380 municipalities) presented an IIP equal to or less than 0.9. This means that these municipalities are in a satisfactory situation and have a low risk of transmitting these diseases. However, 45.7% of municipalities (373) were in an alert situation, and 7.8% (64 municipalities) remained in a high-risk situation, with an IIP greater than 4.0, which indicates a significant risk of transmission of diseases during the period evaluated.

This article aimed to carry out an epidemiological survey carried out to investigate the occurrence of dengue in the region of Minas Gerais during the year 2023. The main intention of this study was to

evaluate the incidence, associated risk factors and geographic distribution of dengue in the state. Understanding these aspects is crucial to inform disease prevention and control strategies.

METHODOLOGY

The article was conducted as a population-based observational study, using secondary data from official public health sources, using the TABNET tool from the Unified Health System Information Department (DATASUS). The study population consisted of all residents of Minas Gerais during the year 2023.

The following were analyzed:

- **Dengue Notification Data:** Dengue case notification data was obtained from all municipalities in Minas Gerais, provided by the Notifiable Diseases Information System (SINAN) and the Epidemiological Information System (SIEPI).
- **Demographic and Geospatial Data:** Demographic data, such as geospatial information on the municipalities of Minas Gerais, were collected from the Brazilian Institute of Geography and Statistics (IBGE).

The variables present in the studies were:

- **Dependent Variable:** The number of reported cases of dengue in each municipality during the year 2023.
- **Independent Variables:** Geographic variables were considered (geospatial location of the municipalities).

The analyzes obtained were:

- **Descriptive Analysis:** A descriptive analysis was carried out to characterize the distribution of dengue cases in Minas Gerais, including incidence, mortality and geographic distribution of cases.
- **Spatial Analysis:** Using geoprocessing techniques, a spatial analysis was carried out to identify geographic patterns of

distribution of dengue cases.

This study was carried out in accordance with ethical and legal guidelines. Data collection and analysis were carried out in strict accordance with personal data protection regulations, as the data source is a public authority.

The limitations observed are, limitations of notification data, such as underreporting of cases; unmeasured variables that may influence the incidence of dengue and limitations inherent to observational studies.

RESULTS

The data collected is about disease classification criteria, its evolution, hospitalization of patients and death. Fourteen macro-regions of the state of Minas Gerais were evaluated: South, Central-South, Center, Jequitinhonha, East, West, Southeast, North, Northwest, East of the South, Northeast, South triangle, North Triangle and Steel valley.

Next, the state's municipalities were surveyed, with emphasis on the city of Uberlândia, and notifications were evaluated throughout the months of 2023, cases involving hospitalization and deaths.

REPORTED CASES X CLASSIFICATION CRITERIA IN MACRORERIGÃO

The criteria for confirming dengue fever were recorded in relation to macro-regions. Ign/White cases were found among them, confirmed by laboratory tests, clinical-epidemiological tests and cases under investigation.

In the South region it comprises 46,884 cases in total, including Ign/white (11,134), laboratory (14,294), clinical-epidemiological (21,234) and investigation (222).

In the Central South region, it comprises 7,422 cases in total, including Ign/white (3,163), laboratory (2,163), clinical-

epidemiological (2,066) and investigation (30).

The Central region comprises 91,720 cases in total, including Ign/white (42,186), laboratory (15,064), clinical-epidemiological (23,438) and investigation (11,032).

The Jequitinhonha region comprises 2,371 cases in total, including Ign/white (857), laboratory (417), clinical-epidemiological (968) and investigation (129).

In the West region it comprises 35,974 cases in total, including Ign/white (14,441), laboratory (6,901), clinical-epidemiological (13,982) and investigation (650).

In the East region it comprises 8,233 cases in total, including Ign/white (2,048), laboratory (1,499), clinical-epidemiological (1,348) and investigation (3,338).

The Southeast region comprises 19,571 cases in total, encompassing

Ign/white (8,395), laboratory (5,406), clinical-epidemiological (5,536) and research (234).

The North region comprises 29,787 cases in total, including Ign/white (13,017), laboratory (1,903), clinical-epidemiological (14,317) and research (550).

The Northwest region comprises 26,958 cases in total, including Ign/white (4,971), laboratory (10,946), clinical-epidemiological (10,986) and investigation (55).

In the East of the South region it comprises 19,648 cases in total, including Ign/white (2,370), laboratory (5,810), clinical-epidemiological (11,113) and investigation (355).

In the Northeast region it comprises 10,323 cases in total, including Ign/white (7,350), laboratory (1,403), clinical-epidemiological (1,342) and investigation (228).

The South triangle region comprises 25,777 cases in total, including Ign/white (14,785), laboratory (6,210), clinical-epidemiological (4,736) and investigation (46).

The Northern Triangle region comprises 48,742 cases in total, including Ign/white (2,828), laboratory (10,509), clinical-epidemiological (32,816) and investigation (2,589).

The Steel valley region comprises 19,473 cases in total, including Ign/white (2,571), laboratory (2,171), clinical-epidemiological (14,605) and investigation (126).

Thus, the total number of notifications in the macro-regions, involving Ign/whites (130,116), confirmed by laboratory (84,696), by clinical-epidemiological (158,487) and under investigation (19,584), was 392,883 in total.

REPORTED CASES X FINAL CLASSIFICATION IN THE MACROREGION

Regarding the final classification of probable cases of dengue in the region, the

Notifications were stratified into Ign/White, inconclusive, dengue, dengue with warning signs and severe dengue.

In the South region there were 46,479 cases in total, with 2,189 cases ignored/blank (Ign/blank), 9137 inconclusive cases, 35,352 confirmed dengue, 50 cases of dengue with alarm signs and 21 cases of severe dengue.

In the Central South region there were 7,406 cases in total, 1,752 Ign/white, 1,428 inconclusive cases, 4,148 confirmed dengue, 68 cases of dengue with alarm signs and 3 cases of severe dengue.

In the Central region, there were 91,990 cases in total, 12,636 of which were Ign/white,

A total of 38,301 inconclusive cases, 40,746 confirmed dengue, 278 cases of dengue with warning signs and 29 cases of severe dengue.

In Jequitinhonha, there were 2,358 cases in total, including Ign/white (2,358), inconclusive cases (338), confirmed dengue (1,384) and dengue cases with alarm signs (5).

In the West, there were 35,953 cases in total,

including Ign/white (4,002), inconclusive cases (10,756), confirmed dengue (20,830), cases of dengue with warning signs (340) and cases of severe dengue (25).

In the East, there were 8,200 cases in total, including Ign/white (270), inconclusive cases (1,866), confirmed dengue (6,000), dengue cases with warning signs (53) and cases of severe dengue (11).

In the Southeast region, there were 19,505 cases in total, including Ign/white (1,278), inconclusive cases (7,187), confirmed dengue (10,926), dengue cases with warning signs (101) and cases of severe dengue (13).

In the North region, there were 26,693 cases in total, including Ign/white (1,122), inconclusive cases (12,485), confirmed dengue (16,065), cases of dengue with warning signs (13) and cases of severe dengue (8).

In the Northwest, there were 26,972 cases in total, including Ign/white (1,462), inconclusive cases (3,508), confirmed dengue (21,739), cases of dengue with warning signs (148) and cases of severe dengue (15).

In East of the South, 19,622 cases were recorded, with results of Ign/white (636), inconclusive cases (1,828), confirmation of dengue (17,109), cases of dengue with warning signs (38) and cases of severe dengue (12).

In the Northeast, there were a total of 10,198 cases, including Ign/white (705), inconclusive cases (6,817), confirmed dengue (2,261), dengue cases with warning signs (14) and cases of severe dengue (1).

In the Southern Triangle, there were 26,626 cases in total, including Ign/white (4,309), inconclusive cases (10,378), confirmed dengue (10,846), dengue cases with warning signs (62) and cases of severe dengue (31).

In the Northern Triangle, there were 48,620 cases in total, including Ign/white (1,343), inconclusive cases (3,936), confirmed dengue (42,795), cases of dengue with warning signs (469) and cases of severe dengue (77).

In Steel valley, there were 19,473 cases in total, including Ign/white (616), inconclusive cases (1,998), confirmed dengue (16,782), cases of dengue with warning signs (70) and cases of severe dengue (7).

Therefore, the total number of notifications in the macro-regions, involving Ign/whites (32,664), inconclusive (110,256), dengue (247,383), dengue with warning signs (1,709) and severe dengue (253), was 392,265 in total.

REPORTED CASES X HOSPITALIZATIONS IN THE MACROREGION

In relation to hospitalizations for dengue in the macro-regions, a total of 46,884 notifications were reported in the South region, being stratified into

Ign/Whites (11,740), hospitalized (799) and non-hospitalized (34,345).

In the Central South region, a total of 7,422 notifications, being stratified into Ign/Whites (3,268), hospitalized (119) and non-hospitalized (4,035).

In the Central region, a total of 91,720 notifications, being stratified into Ign/Whites (53,660), hospitalized (1,286) and non-hospitalized (36,774).

In the Jequitinhonha region, a total of 2,371 notifications, being stratified into Ign/Whites (782), hospitalized (44) and non-hospitalized (1,545).

In the West region, a total of 35,974 notifications, being stratified into Ign/Whites (13,198), hospitalized (697) and non-hospitalized (22,079).

In the East region, a total of 8,233 notifications, being stratified into Ign/Whites (1,704), hospitalized (289) and non-hospitalized (6,240).

In the Southeast region, a total of 19,571 notifications, being stratified into Ign/Whites (10,181), hospitalized (408) and non-hospitalized (8,982).

In the North region, a total of 29,787 notifications, being stratified into

Ign/Whites (19,204), hospitalized (227) and non-hospitalized (10,356).

In the Northwest region, a total of 26,958 notifications, being stratified into Ign/Whites (5,234), hospitalized (961) and non-hospitalized (20,763).

In the East of the South region, a total of 19,648 notifications, being stratified into Ign/Whites (3,256), hospitalized (288) and non-hospitalized (16,104).

In the Northeast region, a total of 10,323 notifications, being stratified into Ign/Whites (6,375), hospitalized (275) and non-hospitalized (3,673).

In the South triangle region, a total of 25,777 notifications, being stratified into Ign/Whites (14,465), hospitalized (519) and non-hospitalized (10,793).

In the North Triangle region, a total of 48,742 notifications, being stratified into Ign/Whites (3,975), hospitalized (1,767) and non-hospitalized (43,000).

In the Steel valley region, a total of 19,473 notifications, being stratified into Ign/Whites (4,304), hospitalized (563) and non-hospitalized (14,606).

Thus, the total number of notifications in the macro-regions regarding hospitalizations, involving Ign/whites (151,346), hospitalizations (8,242) and non-hospitalizations (233,295).

REPORTED CASES OF DEATH IN THE MACROREGIONS

It was observed that in the South region there were 12,197 ignored/blank cases (Ign/blank) and 34,497 patients progressed to cure, 40 to death due to the reported condition; 4 deaths from other causes, 11 deaths under investigation, totaling 46,749 reported cases.

In the Central South region there were 3,303 Ign/white, 4,102 cured, 1 death per

reported case, totaling 7,406 patients.

In the central region, 58,944 Ign/white cases, 33,003 cured, 16 deaths from the reported case, 8 deaths from other causes and 1 death under investigation, totaling 91,990 cases.

In Jequitinhonha, 980 Ign/white and 1378 were cured, totaling 2,358 individuals.

In the West, 16,501 Ign/blank people, 19,426 cured, 5 deaths from the notified condition, 3 deaths from other causes and 18 deaths under investigation, resulting in 35,953.

In East, 5398 Ign/white patients, 2,798 cured, 1 death due to the reported condition, 2 deaths from other causes and 2 deaths under investigation, totaling 8,200 cases.

In the southeast region, there were 9,282 Ign/White cases, 10,212 cases of cure, 2 deaths due to the reported condition and 9 deaths under investigation, a total of 19,505 cases.

In the North region, 14,441 Ign/White cases were attributed, and 15,273 individuals managed to recover successfully, but there were also reports of 6 deaths related to dengue, 2 deaths were attributed to other causes, and 1 death is under investigation. The sum of all these numbers resulted in 29,693 cases related to dengue in this region.

In the Northwest, 26,872 cases were reported, including Ign/whites (5,219), those cured (21,617), 24 deaths from the notified condition, 3 deaths from other causes and 9 deaths under investigation.

In East of the South, 19,622 cases were registered, resulting in 3,110 Ign/Whites, 16,500 cured, 7 deaths due to the notified condition, 2 deaths from other causes and 3 deaths under investigation.

In the Northeast, there were a total of 10,198 cases, consisting of Ign/whites (7,662), cured (2,531), deaths due to the notified condition (3), deaths from other causes (1) and deaths under investigation (1).

In the Southern Triangle, there were a total of 25,626 cases, consisting of Ign/whites (17,521), cured cases (8,070), reported deaths from the disease (20) and deaths under investigation (15).

In the Northern Triangle, there were a total of 48,620 cases, consisting of Ign/whites (5,756), cured (42,817), reported deaths due to the condition (30), deaths from other causes (7) and deaths under investigation (9).

In Steel valley, there were a total of 19,473 cases, including Ign/whites (2,946), cured cases (16,521), reported deaths due to the condition (2) and deaths under investigation (4).

Therefore, the total number of notifications in the macro-regions, involving Ign/whites (163,231), cured (228,745), reported deaths due to the disease (157), deaths from other causes (32) and deaths under investigation (100), was 392,265 in the total.

PANORAMA IN UBERLÂNDIA

As it was seen in the previous tables, there were 29,688 cases reported from January to August in Uberlândia, with the distribution of 1,010 cases in January, 2,671 in February, 8,038 in March, 8,427 in April, 7,002 in June, 2,278 in July and 262 cases in August. An exponential increase can be noted between the months of February and April, which, as it is known to be the water season, therefore benefits the vector for its reproduction.

Of the reported cases, 25,536 were confirmed, and of these 949 required hospitalizations, 16 died due to worsening of the disease and 4 are still under investigation.

It is important to highlight that these data refer to a specific period and that the evolution of the disease may vary over time and in different regions, as seen in the graphs.

According to epidemiological surveillance/sinan-online, the prevalent serum type that circulated in the municipality of Uberlândia

in 2023 as well as in 2020 was type 1 serum, different from 2019 in which type 2 prevailed and 2021 and 2022 in which type 4 serum prevailed.

CONCLUSION

Analysis of the data collected will allow a better understanding of the epidemiology of dengue in the region, helping to develop more effective prevention and control strategies. The results of this study will contribute to improving public health and the well-being of the population of Minas Gerais.

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