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OVERVIEW OF DENGUE IN THE BRAZILIAN AMAZON FROM 2015 TO 2024

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ABSTRACT

This study aimed to analyze the epidemiological profile of dengue in the legal Amazon from 2015 to 2024. This is an observational, cross-sectional, retrospective, and descriptive study based on data from the Notifiable Diseases Information System (SINAN). 542,860 cases were reported in the period, with a prevalence in the state of Mato Grosso (38.69%). The most affected profile was in women (53.43%), brown women (66.21%) and aged between 20 and 39 years (39.65%). The highest incidence and mortality rate was during 2022, while in 2023 it had the highest lethality. Regarding the evolution of confirmed cases, most evolve to cure (93.39%). The study highlights the persistence of dengue as a public health problem in the legal Amazon for health authorities and emphasizes the importance of more effective control and prevention strategies and improvement in information system records to ensure the collection of accurate and complete data regarding the distribution, evolution, and severity of cases.

Keywords: Dengue; Amazon; Epidemiological profile.

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INTRODUCTION

The dengue virus is an arbovirus belonging to the Flaviviridae family. It has an RNA genome and is characterized by the occurrence of four serotypes with specific antigenic properties: DENV-1, DENV-2, DENV-3, and DENV-4 (FILHA; SOUZA, 2019). Transmission occurs through the bite of the female Aedes aegypti or Aedes albopictus mosquito. Dengue is the most significant arboviral disease in Brazil and may present in either symptomatic or asymptomatic clinical forms. The symptomatic form can progress to systemic complications with a broad clinical spectrum, potentially leading to death (ANDRADE, 2022).

The symptomatic form initially presents with high fever, body aches, retro-orbital pain, skin redness, and fatigue. At this stage, the disease is classified as classic dengue or dengue without warning signs, which can be managed with intensive hydration and specific medications. However, it may manifest in a more severe stage, known as severe dengue, characterized by a heightened systemic inflammatory response, altered blood coagulation, and fluid loss. This can result in intense hemorrhage and a sudden drop in blood pressure, leading to dengue-associated shock, the primary cause of death (INSTITUTO BUTANTAN, 2024).

The American continent, particularly Central and South America, has stood out globally due to the increasing number of reported cases, especially since the late 1990s, accounting for more than half of the global cases. During the 1950s and 1960s, a broad campaign was conducted to eliminate dengue vectors, which yielded positive results in controlling the disease. However, from the 1980s onward, the vectors were reintroduced, and by 1998, the distribution area of Aedes sp. was significantly larger than that recorded in 1930, prior to the campaign (FILHA; SOUZA, 2019).

According to the Pan American Health Organization (PAHO), in the first five months of 2020, over 1.6 million cases of dengue were reported in the Americas, with Brazil (1,040,481 cases) accounting for approximately 65% of this total (PAHO, 2020).

Since the 2000s, Brazil has faced a significant increase in dengue epidemics, particularly in rapidly expanding urban areas. Accelerated urbanization without adequate infrastructure has created ideal environments for the proliferation of the dengue vector, Aedes aegypti, due to the accumulation of discarded containers, waste, and lack of basic sanitation, especially in peripheral areas. Climatic conditions, such as high temperatures and heavy rainfall, have exacerbated the problem, favoring mosquito development. The seasonal pattern of dengue increases the risk between October and May, leading to disease expansion during this period. In recent years, Brazil has recorded unprecedented case numbers, such as in the first quarter of 2024, with over 2.5 million infections and more than a thousand deaths (MEDEIROS et al., 2024).

Brazil has reported alarming numbers of the disease, especially since 2001. Between 2001 and 2016, approximately 11 million cases were reported, with notable outbreaks in 2015 and 2016, which recorded 1.6 and 1.5 million cases, respectively (ANDRADE, 2022). These outbreaks highlight the need for preventive and control measures to mitigate the impact of this condition on Brazilian public health.

The Amazon region stands out for having one of the greatest diversities of arboviruses and arthropod vectors in the Americas (NUNES et al., 2021). Thus, it serves as a significant area for the spread of dengue and other arboviral diseases. For this reason, the Amazon region has already recorded outbreaks of all four dengue serotypes: DENV-1, DENV-2, DENV-3, and DENV-4 (LOPES, NOZAWA, and LINHARES, 2014).

In this context, in 2024, the Ministry of Health incorporated the dengue vaccine into the National Immunization Program for children and adolescents aged 10 to 14 years, with private clinics authorized to offer the vaccine to individuals aged 4 to 60 years (DINIZ et al., 2024). This measure represents a significant advancement in disease control, complementing preventive actions aimed at vector elimination. Therefore, periodic studies are necessary to assess the disease's distribution profile and scenario, especially the impact of new technologies on incidence, as well as potential changes in risk factors associated with the disease cycle.

In 2022, the Amazon region recorded major dengue outbreak centers in Brazil, particularly in states within the Legal Amazon such as Tocantins (22,598 cases), Rondônia (13,557), Pará (6,719), and Amazonas (5,440).

The primary aim of this study is to investigate confirmed dengue cases in the Notifiable Diseases Information System – SINAN. SINAN is the health information system responsible for organizing data on reported conditions, including dengue cases. Once reported, these data are organized and made available on the DATASUS online portal for observation, use, and analysis by the scientific community and the general public.

Given the severity of dengue in the Brazilian context, especially in the Legal Amazon region, this study aims to describe the epidemiological panorama of dengue in the Brazilian Amazon from 2015 to October 2024 (epidemiological week 42), outlining the demographic profile (race, sex, age group), and describing the incidence, mortality, lethality, and progression of dengue cases in the region.

METHODOLOGY

This is an observational, cross-sectional, descriptive, and retrospective study that analyzed a specific region and its population over a defined period to describe the epidemiological course without researcher intervention in the health process (PEREIRA, 1995). It is descriptive in nature, as it aims to

collect and analyze data quantitatively, using graphical representations and absolute and relative frequencies (RODRIGUES; OLIVEIRA; SANTOS, 2021).

According to the Brazilian Institute of Geography and Statistics (IBGE), the Legal Amazon covers an area of 5,015,146.008 km², corresponding to approximately 59% of Brazilian territory. The Legal Amazon comprises nine states: Acre, Amapá, Amazonas, Mato Grosso, Pará, Rondônia, Roraima, Tocantins, and part of Maranhão. The region has a low population density of 5.6 inhabitants per km², and the average monthly income used to calculate the Human Development Index (HDI) for individuals over 14 years old residing in the region in 2020 (BRL 2,059.75) was below the national average of BRL 2,782.50 (IBGE, 2022).

The choice of this region was based on important factors such as its hot and humid climate, which favors the reproduction of the dengue vector mosquito, combined with the unplanned urban growth of many cities in the Amazon region (COSTA et al., 2011).

For this study, publicly available data previously collected by government agencies were used. Data were extracted from SINAN (Notifiable Diseases Information System), made available by the Unified Health System (SUS) through the Department of Informatics (DATASUS).

To calculate incidence, mortality, and lethality rates, population data provided by the IBGE were used, both from the 2022 Census (accessed via the SIDRA online platform on the IBGE website) and from the annual population estimates issued by the agency for the Federal Court of Accounts.

Due to the 2022 Census and in accordance with Technical Note/Semag – Secretariat for Governmental Macro-Evaluation, dated December 30, 2022, the population considered for the year 2023 was the same as that recorded in the 2022 Census.

This research included data on confirmed dengue cases (classic dengue, dengue with complications, dengue hemorrhagic fever, dengue shock syndrome, dengue with warning signs, and severe dengue), regardless of the confirmation criteria, covering the following states: Acre, Amapá, Amazonas, Maranhão, Mato Grosso, Pará, Rondônia, Roraima, and Tocantins, from 2015 to epidemiological week 42 of 2024 (October 13 to 19, 2024). Data on discarded (negative) cases, periods outside the specified range, and cases from other Brazilian states and the Federal District were excluded from this study.

The data obtained from the variables in the compulsory notification form, available through DATASUS, were tabulated using TABNET, a public domain application provided by the Ministry of Health that allows for simple and quick organization of data according to the desired query. After this process, the data were consolidated in Microsoft Excel 2019 for the creation of graphs and tables using absolute and relative frequencies.

To calculate the incidence, mortality, and lethality rates of the condition, the following equations were used:

1. Incidence: the ratio between the number of confirmed cases and the population of the area in question, multiplied by a factor of 100,000. The result is expressed as the number of people affected by the disease per 100,000 inhabitants in that area.
2. Mortality: the ratio between the number of deaths due to the condition and the population of the area in question, multiplied by a factor of 100,000. The result is expressed as the number of people who died from the condition per 100,000 inhabitants in that area.
3. Lethality: the ratio between the number of deaths due to the condition and the number of confirmed cases, multiplied by 100%, with the result expressed as a percentage.

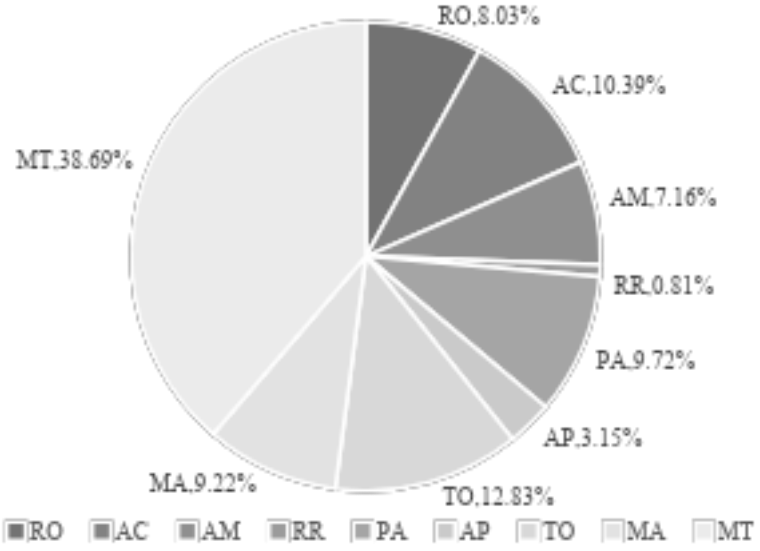
According to Resolution 510/2016, since this study uses public data accessible to the general population, the scientific community, and national and international health entities, submission to a Research Ethics Committee for data analysis and study was not required.

RESULTS

In Brazil, 13,532,760 confirmed cases of dengue were reported on the TABNET-DATASUS platform from January 2015 to October 2024. The year 2015 recorded the highest number of probable cases nationwide (1,387,326), while 2024 saw a significant increase to 5,581,645 cases—an approximate rise of 302.24%, and a 330.09% increase compared to the previous year (1,297,798). Conversely, 2017 had the lowest number of probable cases (167,659).

Within the Legal Amazon during the study period, 542,860 cases were identified, with the highest concentration in the state of Mato Grosso (38.69%), followed by Tocantins (12.83%), Acre (10.39%), Pará (9.72%), Maranhão (9.22%), Rondônia (8.03%), Amazonas (7.16%), Amapá (3.15%), and Roraima with the lowest proportion (0.81%).

Graph 1 – Distribution of confirmed dengue cases in the Legal Amazon, by Federation Unit, from 2015 to October 2024.



Source: Authors, 2024

Regarding race, individuals identified as brown accounted for the majority of cases (66.21%), followed by white (18.18%), unknown/blank (10.05%), black (3.72%), yellow (1.19%), and indigenous (0.64%).

In terms of sex, most cases occurred in females (53.43%), with males accounting for 46.51%, and 0.06% of cases were either blank or ignored.

The most affected age group was 20 to 39 years (36.95%), followed by 40 to 59 years (22.09%), 15 to 19 (9.97%), 10 to 14 (8.97%), 5 to 9 (7.59%), 1 to 4 (4.42%), 60 to 64 (2.92%), 70 to 79 (2.24%), 65 to 69 (2.03%), under 1 year (1.95%), over 80 (0.86%), and blank (0.02%).

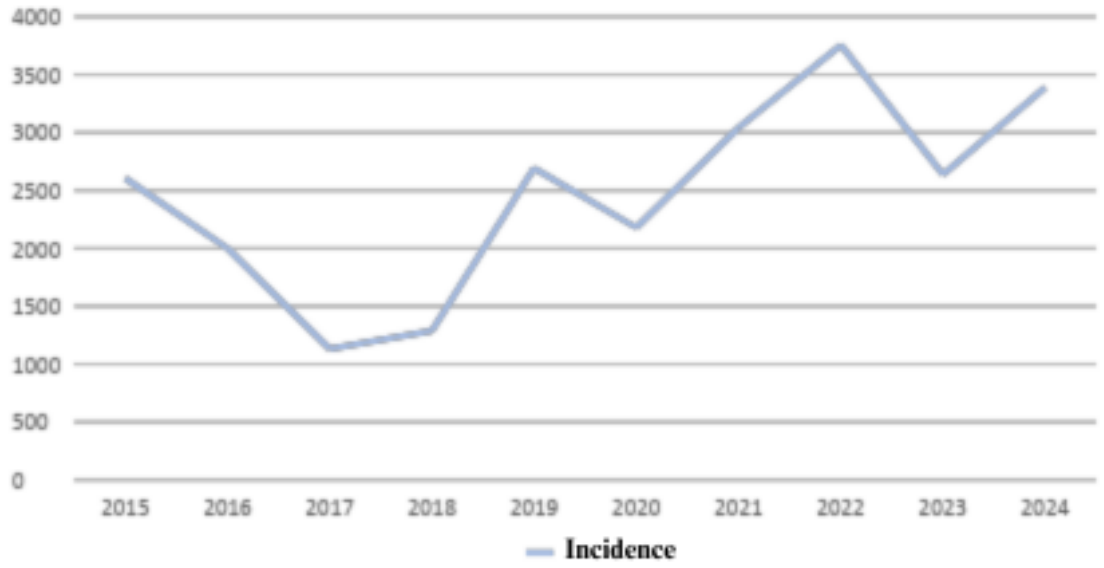
Table 1 – Demographic profile of confirmed dengue cases in the Legal Amazon between 2015 and 2024

Variables	n	%
Sociodemographic profile		
Race		
Ignored/Blank	54581	10,05%
White	98718	18,18%
Black	20187	3,72%
Yellow	6450	1,19%
Brown	359429	66,21%
Indigenous	3495	0,64%
Sex		
Ignored/Blank	303	0,06%
Male	252482	46,51%
Female	290075	53,43%
Age		
Ignored/Blank	121	0,02%
<1year	10575	1,95%
1 a 4	24003	4,42%
5 a 9	41209	7,59%
10 a 14	48717	8,97%
15 a 19	54097	9,97%
20 a 39	200562	36,95%
40 a 59	119924	22,09%
60 a 64	15828	2,92%
65 a 69	11005	2,03%
70 a 79	12152	2,24%
80 <	4657	0,86%

Source: Authors, 2024

Regarding incidence, 2017 had the lowest rate at 1,132.53 cases per 100,000 inhabitants. In contrast, 2022 had the highest incidence at 3,755.20 cases per 100,000 inhabitants—an increase of 231.58% compared to 2017. Other years ranked in descending order of incidence as follows: 2024 (3,390.67), 2021 (3,042.16), 2019 (2,692.81), 2023 (2,638.16), 2015 (2,605.13), 2020 (2,179.56), 2016 (1,999.09), and 2018 (1,286.29).

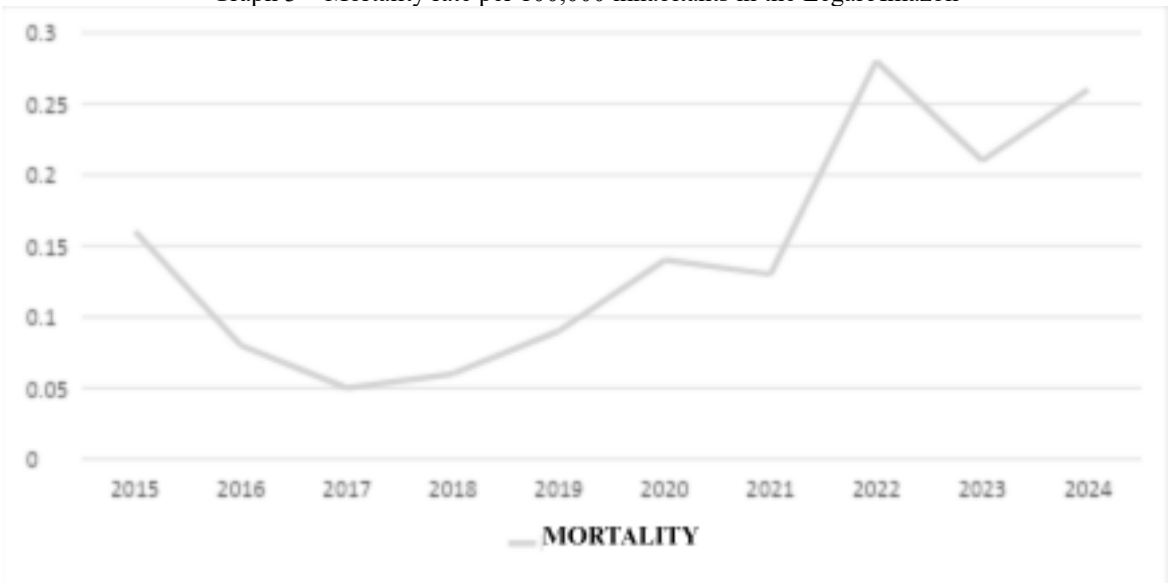
Graph 2 – Incidence of dengue cases in the Legal Amazon, per 100,000 inhabitants, from 2015 to 2024



Source: Authors, 2024

In terms of mortality (defined as the probability of death due to the condition in a given area), 2022 had the highest rate at 0.28 deaths per 100,000 inhabitants, followed by 2024 (0.26) and 2023 (0.21). It is important to note that 2024 data only includes cases up to October, and the rate may increase. Other years ranked as follows: 2015 (0.16), 2020 (0.14), 2021 (0.13), 2019 (0.09), 2016 (0.08), 2018 (0.06), and 2017 (0.05). Between 2017 and 2022, mortality increased by 460%.

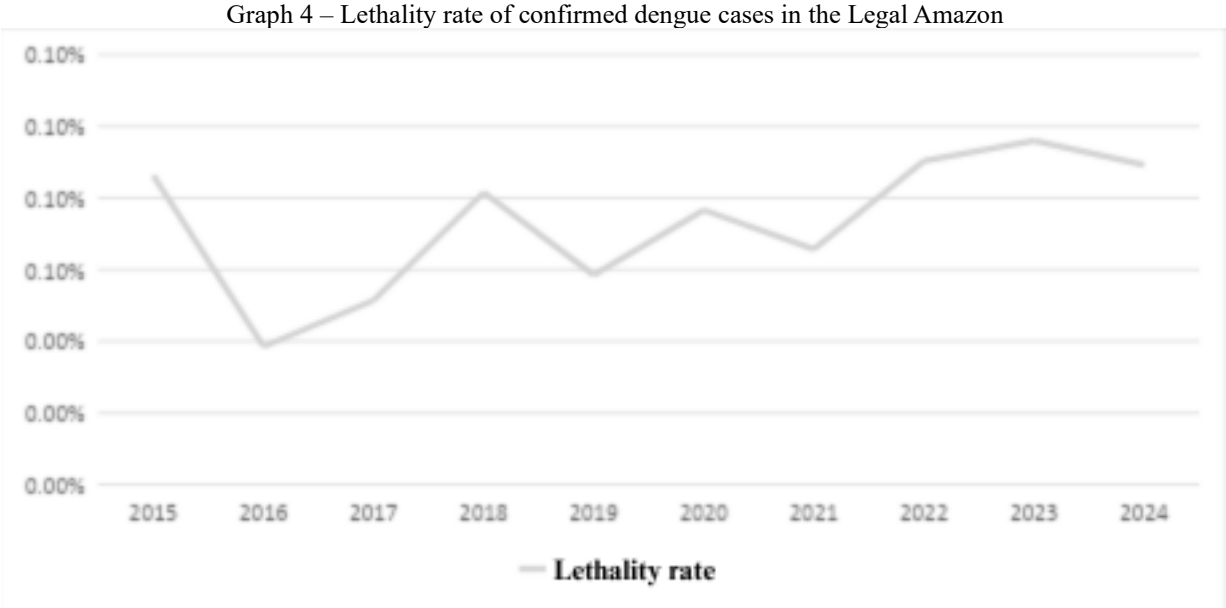
Graph 3 – Mortality rate per 100,000 inhabitants in the Legal Amazon



Source: Authors, 2024

Lethality (defined as the proportion of individuals who die after contracting the disease) was highest in 2023 at 0.10%, followed by 2015, 2022, and 2024 (each at 0.09%), 2018 and 2020 (each at 0.08%), 2021 (0.07%), and 2019 (0.06%). The lowest lethality rates were recorded in 2016 (0.04%) and 2017 (0.05%).

Graph 4 – Lethality rate of confirmed dengue cases in the Legal Amazon

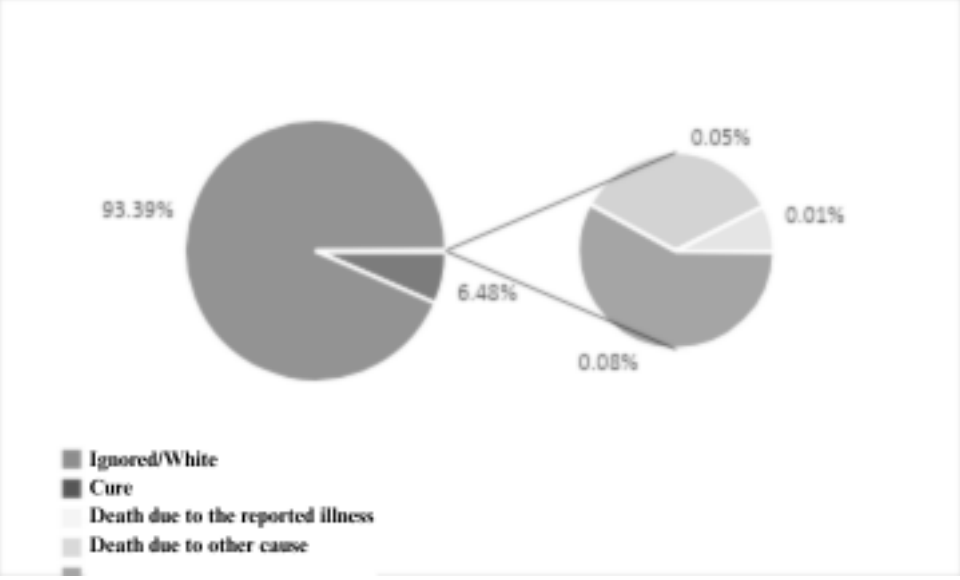


Source: Authors, 2024

Regarding the progression of confirmed dengue cases, 93.39% evolved to cure, while 0.13% resulted in death. Among the deaths, 0.08% were due to dengue, 0.05% were attributed to other causes, and

0.01% remained under investigation. Additionally, 6.48% of notifications lacked valid information in the progression field (either blank or ignored).

Graph 5 – Progression of dengue cases in the Legal Amazon



Source: Authors, 2024

DISCUSSION

Regarding the distribution of confirmed dengue cases across the states comprising the Legal Amazon, this study revealed a predominance in the state of Mato Grosso. This can be attributed to its high population estimates (IBGE, 2024). Additionally, the state presents an environment characterized by high rainfall and elevated temperatures, which contribute to the proliferation of the disease's vector. Other contributing factors include population habits such as improper disposal of solid waste and accumulation of stagnant water (RIBEIRO et al., 2020). Therefore, given that Mato Grosso is one of the most populous states in the Legal Amazon, it is expected to exhibit greater "social disorder."

In analyzing the epidemiological profile of individuals affected by dengue in the Legal Amazon, a predominance of brown-skinned women was observed. This aligns with data from the 2022 IBGE census, which identified women and individuals of brown race as the majority in Brazil, representing 51.5% and 45.3% of the population, respectively. Furthermore, the social marginalization experienced by Black and brown populations is evident, as they recorded the highest rates of unemployment, poverty, and homelessness in 2021 (IBGE, 2022). These precarious living conditions and limited access to healthcare and basic sanitation contribute to increased exposure of this racial profile to the mosquito, particularly in urban and peripheral areas.

The higher number of dengue cases among women may be explained by behavioral factors, such as time spent on domestic tasks, which often occur in environments conducive to the accumulation of

stagnant water (UFMG, 2019). Moreover, the most affected age group—20 to 39 years—includes the economically active population, a group typically characterized by greater urban mobility, which may explain their increased exposure to the mosquito.

During the analyzed period, a downward trend in incidence was observed between 2015 and 2017, followed by an increase from 2017 to 2019, and a sharp decline in 2020. This interruption in growth has been strongly attributed to the impact of the COVID-19 pandemic, which exacerbated underreporting of dengue cases due to reduced home inspections by Endemic Disease Control Agents, diminished zoonosis surveillance and control activities, and public reluctance to seek medical assistance during the pandemic (PAULA et al., 2023).

Additionally, Magalhães et al. (2024) noted that the similarity in symptoms between dengue and COVID-19, combined with low dengue surveillance, may have intensified underreporting in 2020 and 2021. Nevertheless, this study found that in 2021, the Legal Amazon region recorded the highest incidence rate compared to previous years, suggesting a progressive overcoming of the challenges observed in 2020, relative to other regions of Brazil. This growth trend continued, leading to the highest dengue incidence in 2022 within the Legal Amazon during the study period.

Another relevant finding of this research concerns the mortality and lethality coefficients for dengue. In 2018, the lethality rate (0.08%) exceeded the mortality rate (0.06%), a phenomenon attributed to the low incidence that year. Fernandes et al. (2024) argue that during periods of low incidence, the positive predictive value may decrease, resulting in delayed diagnoses—especially of severe cases—which can worsen the clinical condition and increase the likelihood of death. Moreover, the authors affirm that various factors influence these rates, including population density, climate variation, unplanned urbanization, poor sanitation, circulation of serotypes, and local infestation levels of the dengue vector.

It is also noteworthy that the lethality rates during the analyzed period remained below the threshold established by the Pan American Health Organization (PAHO) in 2019, which set the acceptable limit for dengue lethality at below 1%.

Regarding mortality, it was found to be directly associated with incidence, varying proportionally. This observation aligns with findings by Santos et al. (2023) and Coronato (2021), who analyzed dengue-related deaths in southeastern Brazil.

Data on the progression of dengue cases in the Amazon reveal distinct patterns compared to national data presented by Santos et al. (2022). In the Amazon, the progression of confirmed dengue cases shows a relatively positive scenario, with 93.39% evolving to cure—higher than the national average of 76.4%. Deaths from the arbovirus in the region accounted for 0.08%, slightly above the national rate of 0.05%. Additionally, the Amazon stands out for having a lower proportion of notifications with missing or ignored progression data (6.48%), significantly lower than the 23.4% observed nationwide, indicating

greater completeness of notifications in the region. The cure rate is also higher in the Legal Amazon compared to the state of São Paulo, which has an average cure rate of 80.88% (Zuim et al., 2024).

Furthermore, the study observed incomplete information about the disease in official data published by the Ministry of Health. It is emphasized that proper completion of notification forms is crucial in the context of dengue, as it ensures the collection of accurate and comprehensive data on the distribution, progression, and severity of cases. Incomplete or inconsistent information compromises epidemiological analysis, hindering the identification of vulnerable groups, seasonal patterns, and priority regions for intervention. Moreover, the absence of data can lead to underreporting, masking the true magnitude of the disease and resulting in underestimation of control and prevention efforts. Without a reliable database, it becomes more difficult to develop effective public policies, allocate resources efficiently, and plan appropriate strategies to address the disease's impact in the Legal Amazon.

CONCLUSION

Dengue in the Legal Amazon constitutes a significant public health concern for health authorities, particularly due to the climatic and geographic conditions that favor the proliferation of the Aedes aegypti mosquito. High humidity, intense rainfall, and elevated temperatures create an environment conducive to the development of mosquito breeding sites. Additionally, the region's environmental diversity and the presence of urban areas with inadequate infrastructure—such as insufficient sanitation and waste accumulation—further complicate disease control efforts. This vast region, with limited access to healthcare services, also faces challenges in conducting effective epidemiological surveillance and timely diagnosis. Therefore, it is essential that specific public policies and regional strategies be implemented to mitigate the disease's impact, prioritizing preventive, educational, and health system strengthening actions.

In this context, conducting an epidemiological characterization of dengue in the Legal Amazon is crucial for identifying the most susceptible populations and guiding more effective control and prevention strategies. A detailed analysis of the epidemiological profile enables the identification of high-risk groups—such as children, the elderly, pregnant women, and vulnerable populations in rural or peripheral areas—as well as monitoring incidence, mortality, and lethality rates, and the proportion of cured cases. This study identified the most vulnerable group as brown-skinned women aged 20 to 39 years. It also observed a trend of increasing incidence and mortality rates, particularly from 2017 onward, and linked rising lethality rates to periods of low incidence. These findings are essential for informing targeted public policies, optimizing resource allocation, and promoting interventions that reduce disease incidence and its impact on public health in the region.

The lack of preparedness among healthcare teams to detect dengue cases early—especially during periods of low incidence—is another factor that may increase the disease's lethality. Inadequate training and reduced attention to initial symptoms, which are often mistaken for other illnesses, delay diagnosis and treatment, potentially leading to progression to severe forms. This scenario highlights the need for regular training of healthcare professionals, addressing both the clinical signs of dengue and appropriate case management. Implementing a continuous health education program, with periodic training and digital tools to update professionals on care protocols and enhance their response capacity—even during periods of low disease occurrence—is a necessary measure that can reduce dengue lethality and that of other conditions.

Finally, it is essential to expand studies to complete the epidemiological profile of dengue in the Amazon, incorporating information beyond incidence, lethality, and mortality. The region's vast territorial extent, climatic and ecological diversity, and socioeconomic disparities among states present unique characteristics that influence the dynamics of disease transmission. Factors such as sanitation conditions, population mobility, variations in vector density, and unequal access to healthcare services must be considered in more detailed analyses. Conducting in-depth studies that include environmental, cultural, and social aspects is vital to understanding regional particularities and developing more effective and locally adapted control and prevention strategies.

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