

ORIGINAL ARTICLE

Epidemiological Profile of the Main Compulsory Notifiable Diseases in Tremedal, Bahia, from 2011 to 2020

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Highlights:

- (1) The majority of reported cases have low or no education.
- (2) Patients affected by Dengue and Zika are women and come from rural areas.
- (3) Many of the fillable fields are ignored, requiring investigation of the case.

ABSTRACT

Brazil has high biological heterogeneity, favoring the risk of emergence and reemergence of infectious diseases, especially those transmitted by venomous animals and vectors. Regarding these conditions, accidents caused by venomous animals, Dengue, and Zika are highlighted. Thus, the study aims to investigate the occurrence of these conditions from 2011 to 2020, analyzing the sociodemographic characteristics and the clinical-epidemiological outcomes of the notifications. This was an epidemiological, observational, cross-sectional, quantitative, retrospective study. The study area was the municipality of Tremedal, Bahia. Data were collected from SINAN on the SESAB website. They were organized into spreadsheets and analyzed using Epi-Info version 7.2. The incidence rate of the respective conditions (per thousand inhabitants) was calculated. Pearson's chi-square and Fisher's exact tests were used for sociodemographic variables, and Odds Ratio and 95% CI were used for clinical-epidemiological variables. Regarding the results, venomous animal injuries stand out, followed by Dengue and Zika. The study shows the prevalence of women ($p < 0.01$) and rural residents for Dengue and Zika. The notified cases have incomplete schooling and a young age group. However, a considerable number of older adults are highlighted in cases of venomous animals. Finally, cases of venomous animal accidents had recovery as an outcome; however, Dengue and Zika are mostly marked as unknown, illustrating a lack of epidemiological investigation. Therefore, intensifying epidemiological surveillance services, training health professionals, and promoting health education actions are necessary.

Keywords: venomous animals; neglected diseases; descriptive epidemiology; arbovirus infections; public health surveillance.

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INTRODUCTION

The health surveillance complex is part of the essential function of the Unified Health System (SUS) as a national public policy; it has universal and horizontal characteristics and guides the care model of each region. It is responsible for continuously and systematically collecting, analyzing, and disseminating information on health-related events to plan and implement public health measures and to determine health based on the supervision, intervention, and action of the conditions and determinants of the disease¹. In addition, epidemiological surveillance gathers the necessary information for health development, handling the data reliably.

Consequently, Notifiable Diseases (NDs) are included in the list of reportable conditions at all levels of healthcare. They are considered diseases that require effective prevention and control measures, as the infectious agents can cause outbreaks and epidemics².

Health information systems are designed to meet the interactive needs of teams, facilitating decision-making in health surveillance. Moreover, they should help improve the quality and productivity of healthcare and promote research and teaching activities³. In this sense, the Notifiable Diseases Information System (SINAN) is available in all municipalities and states, allowing for the continuous integration of data, assessment, and monitoring of actions related to disease control in the country⁴.

On the other hand, Brazil has high biological heterogeneity, encompassing biomes that include forests, savannas, caatingas, mangroves, and wetlands⁵. As a result, favorable biotic and abiotic conditions, size, and diversity of species and biomes favor the risk of emergence and reemergence of infectious diseases, especially those transmitted by venomous animals and vectors^{6,7}.

Among the health conditions reported in SINAN in Tremedal, Bahia, venomous animal accidents, dengue, and acute Zika virus disease are listed. These infectious diseases present several particularities that differentiate them from other diseases in humans, such as their unpredictable and worldwide triggering characteristics, transmissibility, the intimate relationship between human behavior and the ecosystem, and mainly the attribute of prevention and eradication⁸.

Consequently, venomous animal accidents are classified as a significant public health issue, especially in regions with tropical and subtropical climates. Moreover, they are highly severe, with high morbidity and mortality rates, mainly affecting the population residing in rural areas due to the existence of risk areas and difficulties in accessing health services⁹.

In addition, arboviruses are viral diseases transmitted by arthropods, such as Dengue, Chikungunya, and Zika, which have become emerging and reemerging diseases, considering they are classified as a significant challenge for public health¹⁰.

Dengue is one of the most recurring arbovirus-caused pathologies in the country, presenting various symptoms such as high fever, muscle and joint pains, skin rashes, and even hemorrhages¹¹. Moreover, acute diseases caused by the Zika virus are also characterized as arbovirus, as *Aedes aegypti* transmits them. The presence of the virus is associated with Guillain-Barré Syndrome and microcephaly in babies during the gestational period¹².

In this sense, this study aims to investigate and detail the occurrence from 2011 to 2020, analyzing the sociodemographic characteristics and the clinical-epidemiological outcomes of the notifications.

METHODOLOGY

This was an epidemiological, observational, cross-sectional, quantitative, retrospective study. The study area was the municipality of Tremedal, 14° 58' 33" S 41° 24' 39" W, located southwest of Bahia, approximately 590 km from Salvador (the state's capital). It has an area of 1,679.464 km² and a population of 16,394 inhabitants¹³.

The data were collected from the local SINAN (Notifiable Diseases Information System) database, available on the website of the Bahia State Health Secretariat (SESAB) (<http://www.saude.ba.gov.br/suvisa/vigilancia-epidemiologica/agravos-morbidade-epidemiologia/>), by surveying the occurrences of accidents caused by venomous animals (AAP), Dengue (DENV), and acute Zika virus disease (ZIKV). The following variables were used: Age, Age Group, Gender, Occupation, Case Classification, Zone, Type of Accident, Time Elapsed, Work-Related Accident, Case Outcome, and Confirmation Criterion. Furthermore, the data were collected and analyzed from January 2011 to December 2020.

The guiding instrument used was the Notification Forms provided by SINAN. Not all fillable fields in the forms were used and unavailable in the TabNet program (Health Information).

All notifications from the study period with conclusive diagnoses for the occurrences studied were included. Consequently, all data with a change in the diagnostic outcome were excluded.

The data of interest from the investigation forms of the occurrences were organized into spreadsheets and analyzed using Epi-Info version 7.2. The incidence rate (per thousand inhabitants) of the respective occurrences was calculated. The population estimates provided by the Brazilian Institute of Geography and Statistics (IBGE), available on the SESAB website, were used as denominators.

Pearson's chi-square test and Fisher's exact test were used to compare the proportions of sociodemographic variables. Odds ratios (OR) and their respective 95% confidence intervals (CI) were calculated to compare case characteristics, aiming to investigate factors associated with the individual's gender.

For this research, the use of the Free and Informed Consent Form (FICF) and submission to the National Research Ethics Commission (CEP/CONEP) was not required. However, National Health Council Resolution No. 510's April 7, 2016 recommendations were followed¹⁴.

RESULTS

From 2011 to 2020, 1,831 cases of venomous animal accidents, 680 cases of Dengue, and 39 cases of acute Zika virus disease were reported in the municipality of Tremedal. The highest incidence rate occurred in 2019 (16.53/1,000 inhabitants), 2016 (13.49/1,000 inhabitants), and 2020 (2.10/1,000 inhabitants) for AAP, DENV, and ZIKV cases, respectively (Figure 1).

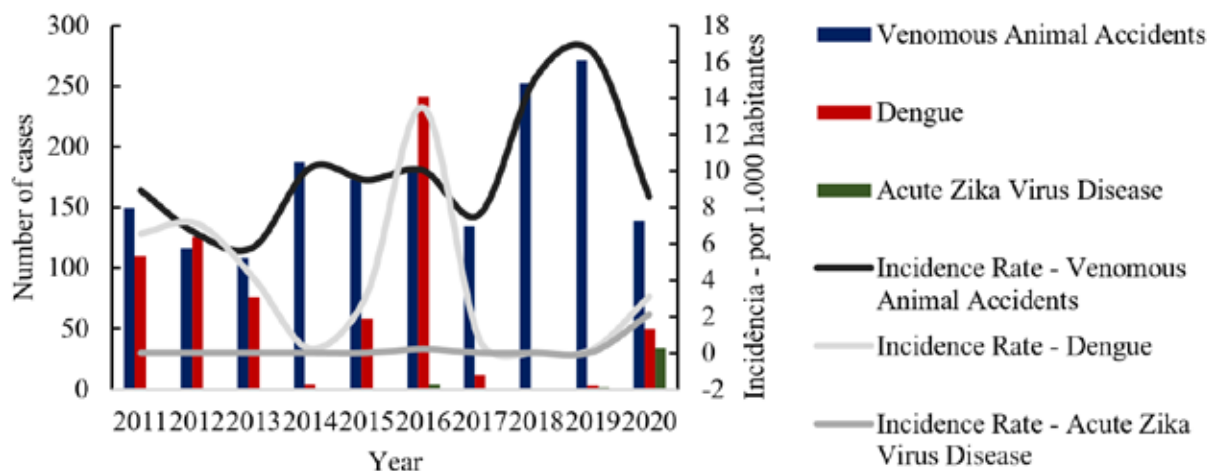


Figure 1. Notifications of venomous animal accidents, Dengue, and acute Zika virus disease by year, and incidence of the conditions per 1,000 inhabitants. Tremedal, Bahia, Brazil, 2011 to 2020.

Source: SESAB/SUVISA/DIVEP/SINAN- Notifiable Diseases Information System. Prepared by the authors, 2021.

It is noteworthy that cases of Venomous Animal Accidents (AAP) stand out as the primary condition in the studied locality. However, Dengue (DENV) cases also have many notifications, especially in 2016 (n=241/680), significantly overshadowing the highlighted condition. Moreover, the Municipality has low notification regarding Zika Virus Disease (ZIKV), except in 2020, with 34 notifications and an incidence rate of 2.10/1,000 inhabitants.

Sociodemographically, the occurrence of Dengue cases prevails in women compared to men ($X^2=19.788$, $p<0.01$), with self-declared white women being proportionally more common (approximately 2:1) compared to white men. Despite this difference, there was no statistical significance between men and women when compared across all self-declared races ($X^2=6.3335$, $p=0.09$ - excluding self-declared indigenous N=1). For Zika, notifications are predominantly of patients aged 35 to 49 and 50 to 64 years ($p=0.15$ – Fisher’s exact test).

Regarding education level, the reported cases of DENV in the municipality mostly have incomplete elementary education. The “education level” field was not fully completed by healthcare professionals in the ZIKV notifications, with only 8.11% (n=03/37) reporting, spanning from elementary to high school (Table 1).

Table 1. Sociodemographic characteristics of Dengue and acute Zika virus disease notifications by gender. Tremedal, Bahia, Brazil, 2011 to 2020.

Variable	Dengue				Acute Zika vírus disease			
	Gender		X^2	p-value	Gender		X^2	p-value
	M	F			M	F		
Race								
White	65	128	6.33	0.09	2	3	4.08	0.13
Indigenous	-	1			-	-		
Brown	126	157			2	11		
Black	15	24			1	0		
Age group								
< 1 year	1	-	17.72	0.03	1	-	-	0,15*
1 to 4 years	8	6			1	-		
5 to 9 years	16	8			1	1		
10 to 14 years	28	40			-	2		
15 to 19 years	31	41			-	3		
20 to 34 years	80	133			4	3		
35 to 49 years	68	99			3	12		
50 to 64 years	28	46			3	3		
65 to 79 years	22	19			-	-		

Education									
Illiterate	3	12			-	-			
1st to 4th incomplete grade of ES	22	36			-	-			
Complete 4th grade of ES	15	25			-	-			
Incomplete 5th to 8th grade of ES	26	44	9.64	0.21	1	-	-	-	-
Complete primary education	13	16			-	-			
Incomplete high school	22	32			1	-			
Complete high school	16	42			-	1			
Complete higher education	-	8			-	-			
Total	282	398	19.79	<0.01	24	13	3.27	0.07	

Caption: M: Male; F: Female; ES: Elementary School; *Fisher's exact test

Source: SESAB/SUVISA/DIVEP/SINAN- Notifiable Diseases Information System. Prepared by the authors, 2021.

DENV and ZIKV cases are classified as inconclusive, especially in 2016, 2011, 2012, and 2020. Moreover, the case confirmation criteria are shown as unknown/blank. Only 15.87% (n=106/685) and 15.38% (n=06/39) of the cases presented a laboratory or clinical-epidemiological diagnosis, both for DENV and ZIKV, respectively (Table 2).

In most cases, the outcome of the reported cases was unknown or left blank on the notification forms, representing 92.07% (n=662/719) of the total cases of the two arboviruses. Thus, the lack of epidemiological investigation is evident, which would allow for more effective and targeted decision-making (Table 2).

Table 2. Clinical-epidemiological characteristics of Dengue and acute Zika virus disease notifications according to the year of notification. Tremedal, Bahia, Brazil, 2011 to 2020.

Variable	Dengue									
	Year									
	2020	2019	2018	2017	2016	2015	2014	2013	2012	2011
Classification										
Discarded	3	-	-	-	-	-	-	-	4	8
Confirmed	7	-	-	-	6	5	-	-	35	12
Inconclusive	41	3	-	12	236	53	4	76	87	95
Confirmation Criteria										
Ignored/Blank	41	3	-	12	236	53	4	76	87	69
Laboratory	9	-	-	-	5	4	-	-	10	45
Clinical-Epidemiological	1	-	-	-	1	1	-	-	29	1
Evolution										
Ignored/Blank	43	3	-	12	240	55	4	76	110	86
Cure	7	-	-	-	1	3	-	-	16	24
Total	51	3	-	12	242	56	4	76	126	115

Acute Zika vírus disease										
Variável	Ano									
	2020	2019	2018	2017	2016	2015	2014	2013	2012	2011
Classification										
Discarded	5	-	-	-	-	-	-	-	-	-
Confirmed	-	-	-	-	1	-	-	-	-	-
Inconclusive	29	1	-	-	3	-	-	-	-	-
Confirmation Criteria										
Ignored/Blank	29	1	-	-	3	-	-	-	-	662
Laboratory	5	-	-	-	1	-	-	-	-	57
Clinical-Epidemiological	-	-	-	-	-	-	-	-	-	-
Evolution										
Ignored/Blank	29	1	-	-	3	-	-	-	-	-
Cure	5	-	-	-	1	-	-	-	-	-
Total	34	1	-	-	4	-	-	-	-	-

Source: SESAB/SUVISA/DIVPEP/SINAN- Notifiable Diseases Information System. Prepared by the authors, 2021.

Regarding AAP cases, there is a predominance of notifications of cases of brown race (n=991/1,507), followed by white, black, and indigenous races (p=0.01). The occurrence of cases according to age group was predominantly female, as, according to associated factors, women aged 65 to 79 were twice as likely to have an accident compared to those reported from the male (OR=2.22; 95%CI 0.85-6.07) (Table 3).

It is also worth highlighting that the age groups of 20 to 34 years old, 35 to 49 years old, and 50 to 64 years old rank with the highest notifications, respectively. Furthermore, it is fateful that children under 19 years of age represent 28.17% (n=461/1,658) of AAP cases. Furthermore, regarding the education level of the notified population, 74.01% (n=800/1,081) have, for the most part, only primary education, with only 25.99% (n=281/1,081) having reached secondary education. or superior. Another variable presented was the area of residence, which highlights the rural population (p=0.01) (Table 3).

Table 3. Sociodemographic characteristics of reports of Accidents caused by Venomous Animals according to sex. Tremedal, Bahia, Brazil, 2011 to 2020.

Venomous Animal Accidents							
Variable	Gender		X ²	df	p-value	Odds Ratio	IC95%
	M	F					
Breed							
White	133	213				1.00	NA
Indigenous	2	5	11.41	3	0.01	1.49	0.30-11.75
Brown	480	511				0.67	0.52-0.85
Black	78	85				0.68	0.47-0.99

		Age group						
< 1 year	11	8				1.00	NA	
1 to 4 years	35	34				1.33	0.47-3.87	
5 to 9 years	54	52				1.32	0.49-3.70	
10 to 14 years	79	63				1.09	0.41-3.02	
15 to 19 years	54	71	20.31	9	0.02	1.79	0.67-4.99	
20 to 34 years	136	197				1.98	0.77-5.30	
35 to 49 years	154	156				1.38	0.54-3.72	
50 to 64 years	133	176				1.81	0.70-4.85	
65 to 79 years	76	124				2.22	0.85-6.07	
80 years +	23	22				1.30	0.44-4.02	
		Education						
Illiterate	52	77				1.00	NA	
1st to 4th incomplete grade of ES	151	176				0.79	0.52-1.19	
Complete 4th grade of ES	63	62				0.67	0.40-1.09	
Incomplete 5th to 8th grade of ES	118	101	15.52	7	0.03	0.58	0.37-0.90	
Complete primary education	29	40				0.93	0.51-1.70	
Incomplete high school	36	57				1.07	0.62-1.85	
Complete high school	39	66				1.14	0.67-1.95	
Complete higher education	4	10				1.65	0.51-6.48	
		Zone						
Rural	555	700	6.04	1	0.01	1.00	NA	
Urban	123	108				0.70	0.52-0.92	
Total	755	903						

Caption: M: Male; F: Female; ES: Elementary School

Source: SESAB/SUVISA/DIVEP/SINAN- Notifiable Diseases Information System. Prepared by the authors, 2021.

Regarding the epistemological axis of the clinical-epidemiological characteristics of AAP injuries, it is clear that the types of accidents intensify, almost exclusively, in scorpion attacks (1,539 notifications). Furthermore, when evaluating the time between the injury and seeking health services, most of the time is 03 hours, both for residents in urban and rural areas ($X^2=101.45$, $p\text{-value}< 0.01$). However, it is worth highlighting that 92.78% ($n=180/194$) of the cases that exceeded the 3-hour deadline came from rural areas (Figure 2).

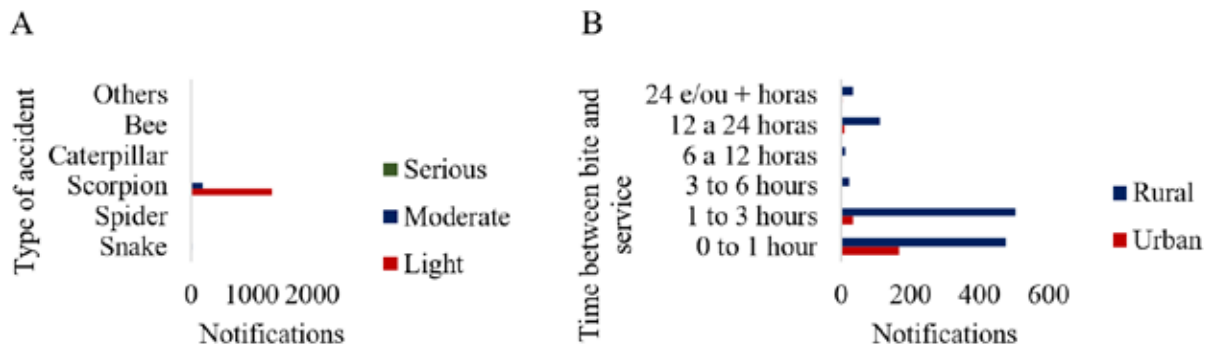


Figure 2. Clinical-epidemiological characteristics of notifications of Accidents caused by Venomous Animals: (A) Notifications according to the type of accident, depending on the classification of the case; (B) Cases according to the bite/service time, depending on the area of residence. Tremedal, Bahia, Brazil, 2011 to 2020.

Source: SESAB/SUVISA/DIVEP/SINAN- Notifiable Diseases Information System. Prepared by the authors, 2021.

Continuing, it is clear that only 6.99% (n=117/1,674) of notifications were related to work accidents. Therefore, it appears that 69.23% (n=1,206/1,742) were cured, with only 1 death (0.06%), which occurred in 2020 (Figure 3).

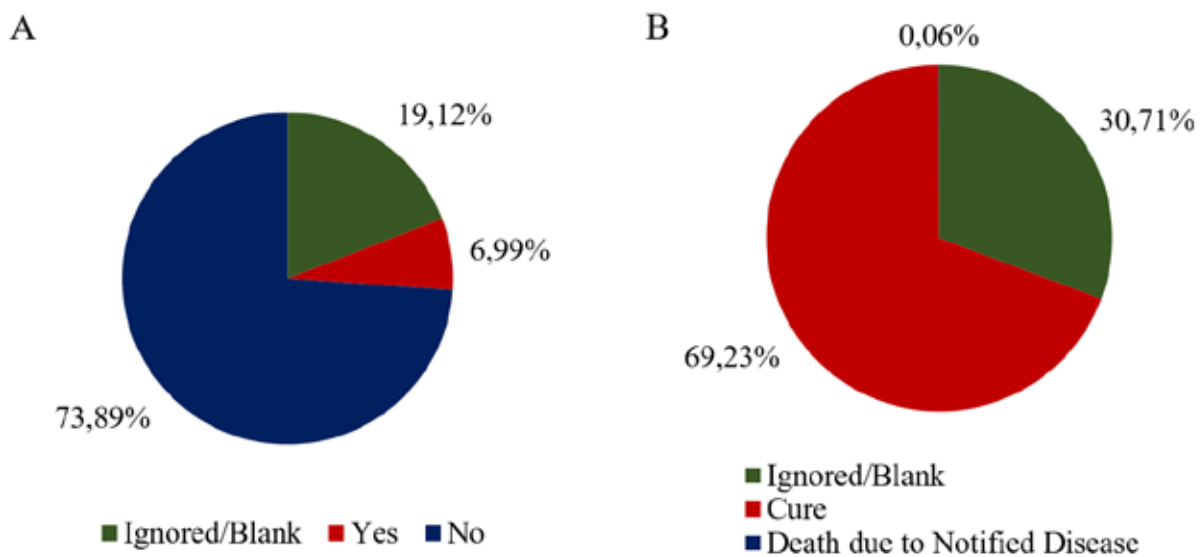


Figure 3. Clinical-epidemiological characteristics of reports of Accidents caused by Venomous Animals: (A) the Percentage of cases related to work; (B) the Percentage of cases according to evolution. Tremedal, Bahia, Brazil, 2011 to 2020.

Source: SESAB/SUVISA/DIVEP/SINAN- Notifiable Diseases Information System. Prepared by the authors, 2021.

DISCUSSION

Brazil has a high rate of notifications of compulsory weekly notification diseases (DNCS), especially concerning diseases caused by venomous animals and arboviruses¹⁵. In this sense, the municipality of Tremedal is connected to this Brazilian statistic, also having similar results to the city of Vitória da Conquista-BA, which had an average of 13.33 annual cases of snakebites and classified Dengue cases as the main predominant arbovirus^{16,17}.

The results demonstrate the prevalence of women in DENV cases. In this sense, the data corroborate the research by Einloft and collaborators¹⁸, which showed that women of childbearing age and pregnant women have a high-risk factor for arboviruses, closely connected to the social determinants of health.

Even with women's active participation in health policies and their relevance in domestic control of the vector, women have become the primary target for arboviruses¹⁹. Mostly, they have spent more time in the residential environment. In addition, according to research by Sousa et al.²⁰, discomfort persists among homemakers and professional sex-endemic community agents—male, affecting the quality of the visit and health education practices.

The abrupt increase in ZIKV in 2020 may have a strong relationship with the COVID-19 pandemic, as they present clinical and laboratory similarities. The high demand for health services in 2020, false positive diagnoses, and laboratory tests with lower sensitivity increased the number of ZIKV notifications²¹.

Therefore, low education is still a reality among the Brazilian population, especially in regions of extreme poverty. The complexity of the problem of arboviruses and their forms of prevention and control is indisputable. Even so, educating the population is still the biggest challenge for public authorities to face this problem. There is also the complexity of the educational process, pointing out that health education should not be understood unilaterally as the transmission-dissemination of knowledge and information between sender and receiver, which is often done and present in health services²².

Furthermore, the study data confirm the possibility of an absence of effective epidemiological investigation in the municipality, being a supplement to the occurrence of underreporting. Therefore, it is necessary to invest in training modalities for health professionals, aiming to review and consolidate the concepts and guidelines of compulsory notification, correct use of information systems, and the complete cycle of epidemiological investigation²³.

Thus, the state of Bahia stands out with the highest number of notifications of accidents caused by venomous animals in the Northeast region in the periods from 2011 to 2020, with a total of 107,769 cases, being the first state with the highest notification of deaths: 270 in total²⁴.

The results brought many notifications regarding the prevalence of diseases caused by venomous animals in the elderly. Beltrame and D'Agostini²⁵ studied notifications of this condition in old age, highlighting several factors within the scope of social determinants. For the authors, the elderly are the fastest growing in the country, and this change in the Brazilian population pyramid directly impacts the health system, as the prevalence of the disease in the elderly population is higher throughout society.

The results show a high incidence of AAP in the rural environment. In this sense, due to the distance from urban centers, the lack of public incentives, and the lack of time caused by activities, which are often exhausting and require long hours of work every day, there is difficulty in obtaining health information²⁶. These imposed barriers provide conditions for illnesses and accidents, and, in addition to hindering rapid medical care and self-care aimed at maintaining health, it is essential to promote care in rural communities through educational practices²⁷.

Bahia is one of the states with the most records of scorpion accidents, and in the Northeast, the problem of scorpions is still little known. This may be related to the lack of scientific communication compatible with their medical importance. The disorderly growth of urban areas, the instability of basic sanitary conditions, and the lack of adequate housing have created a favorable environment for the reproduction of scorpions and people's contact with these arachnids²⁸.

The results are compared to local studies regarding the time elapsed between the accident and medical care, remaining with a maximum time of 03 hours²⁹. However, patients still exceed this time, which must be mitigated, as the longer the time for adequate care, the greater the relationship with local and systemic complications.

However, the main limitation of this study is related to the type of ecological study used, as the data may not refer to the individual conditions of each city citizen but to the population studied (ecological fallacy). In this type of epidemiological study, recognizing a correlation between two variables in an aggregate context does not automatically guarantee that this exact correlation will be maintained when examined at the individual level.

Additionally, the variables used in this research originate from different sources and may exhibit disparities in their quality, finding incompleteness, which many fields ignore. It should also be noted that because the municipality under study is categorized as small, it is not appropriate to generalize the results to the national scope or medium and large municipalities.

Therefore, it is hoped that the information provided will help better understand the risks of the diseases studied. Furthermore, for data from the city of Tremedal to support the risk alert for the population, it is necessary to raise awareness about the risks, the need to use equipment and protective measures, and encourage health education and emergency practices in accident cases.

CONCLUSION

Given the results, injuries caused by accidents caused by venomous animals stand out in the municipality of Tremedal-BA, followed by Dengue fever and acute disease caused by the Zika virus. The study shows the prevalence of women and residents of rural areas. Most of the cases of notified diseases have incomplete education and a young age group. However, a considerable number of older adults are affected by AAP. Finally, the cases of AAP had a cure as the case progressed; however, the cases of DENV and ZIKV, for the most part, are ignored, illustrating a lack of epidemiological investigation.

Linked to this, it is recommended that epidemiological surveillance actions be prioritized and intensified in the municipality of Tremedal, providing the necessary training for professionals, especially regarding the correct completion of notification forms, in addition to adequate diagnosis and treatment.

Relevant to the context, in addition to emphasizing correct prevention management and the search for medical care in case of signs, symptoms, or accidents, the public health service must also use health education strategies to train the population as an immediate preventive measure to avoid infection by arboviruses and accidents caused by venomous animals.

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