Clinical-epidemiological profile and outcome of snakebite accidents in the State of Pará: A portrait of the last two decades

https://doi.org/10.56238/sevened2024.025-028

Eduardo Fernando Pallaro[1], Victor Alexandre Santos Gomes[2], Diego Matos Faria da Rocha[3], Vinícius Silva dos Remédios[4], Jeremias Jonathan de Souza e Souza[5] and Hipócrates de Menezes Chalkidis[6]

ABSTRACT

Objective: The study seeks to address snakebites from venomous snakebites, focusing on the state of Pará, Brazil, over the last two decades (2003-2022). Methods: retrospective research methods were used, using data from the Notification and Notifiable Diseases System (SINAN) and the National Institute of Meteorology (INMET). Results: A total of 98,979 cases were recorded, with a predominance of men (75.5%) in the age group of 20 to 39 years (38.9%). Most cases resulted in cure (82.4%), with the brown ethnicity being most affected (78.8%). Santarém was the city with the most notifications (4,212 cases), and the snake of the genus Bothrops was the most prevalent (87.3%). Conclusion: The results highlight clinical, demographic and environmental aspects of accidents, providing insights for the efficient allocation of resources in coping with these events in Pará and for the education of the population.

Keywords: Snakebite, Brazil, Snake Envenomation, Epidemiological Profile.

[1] Medical Student - UEPA
State University of Pará, Center for Biological and Health Sciences, Santarém, PA, Brazil.
ORCID: orcid.org/0009-0000-6751-6042
[2] Nursing Student – UEPA
State University of Pará, Center for Biological and Health Sciences, Santarém, PA, Brazil.
ORCID: orcid.org/0000-0003-2100-4134
[3] Medical Student – UEPA
State University of Pará, Center for Biological and Health Sciences, Santarém, PA, Brazil.
ORCID: orcid.org/ 0009-0001-9566-9895
[4] Medical Student – UEPA
State University of Pará, Center for Biological and Health Sciences, Santarém, PA, Brazil.
ORCID: orcid.org/0009-0003-2502-1596
[5] Medical Student – UEPA
State University of Pará, Center for Biological and Health Sciences, Santarém, PA, Brazil.
ORCID: orcid.org/0009-0004-0171-7000
[6] Master in Ecology and Evolution - Professor/UEPA
State University of Pará, Center for Biological and Health Sciences, Santarém, PA, Brazil.
ORCID: orcid.org/0000-0002-7466-9669

INTRODUCTION

The problem of snakebites, resulting from venomous snakebites, is a global public health issue, with a significant impact, especially in tropical regions such as Brazil. The World Health Organization (WHO) estimates that millions of people are bitten by snakes each year, with a considerable number resulting in death or permanent disability.[1] In Brazil, venomous snakes, mainly of the genus *Bothrops*, are responsible for the majority of cases.[2]

Despite advances in treating and understanding these accidents, they continue to pose a significant challenge to health systems, especially in remote or under-resourced areas.[1] Correct identification of the snake involved is crucial for proper treatment, but it is not always possible. In addition, symptoms and complications vary depending on the species of snake involved and the composition of its venom.[3]

Thus, existing publications on the subject provide valuable information on the epidemiology, clinical picture, diagnosis, and treatment of snakebites. However, there are gaps in specific knowledge about the clinical-epidemiological profile of these accidents in certain regions, such as the state of Pará.

Therefore, the main objective of this study is to fill this gap, retrospectively analyzing the cases of snakebite accidents that occurred in the state of Pará over the last two decades. This will provide a more comprehensive understanding of the problem in this specific region, allowing for improvements in prevention, diagnosis, and treatment strategies.

METHODOLOGY

This is a retrospective, cross-sectional, descriptive study with a quantitative approach, based on secondary data on the incidence rate of snakebites in the state of Pará, collected in SINAN, from the Department of Informatics of the Unified Health System (DATASUS), at the electronic address (https://datasus.saude.gov.br/).

Access to DATASUS data followed the following search order: health information, epidemiological information and morbidity, diseases and notifiable conditions – 2007 onwards (SINAN), in which the notification of snakebites and the state of Pará were selected. Data from INMET (National Institute of Meteorology) were also used.

The data collection date took place in September 2023, and the established period corresponded to the years 2003 to 2022, considering as variables the number of confirmed cases per year of notification, incidence of cases in each month, evolution of cases, gender, ethnicity, age group, and type of snake.

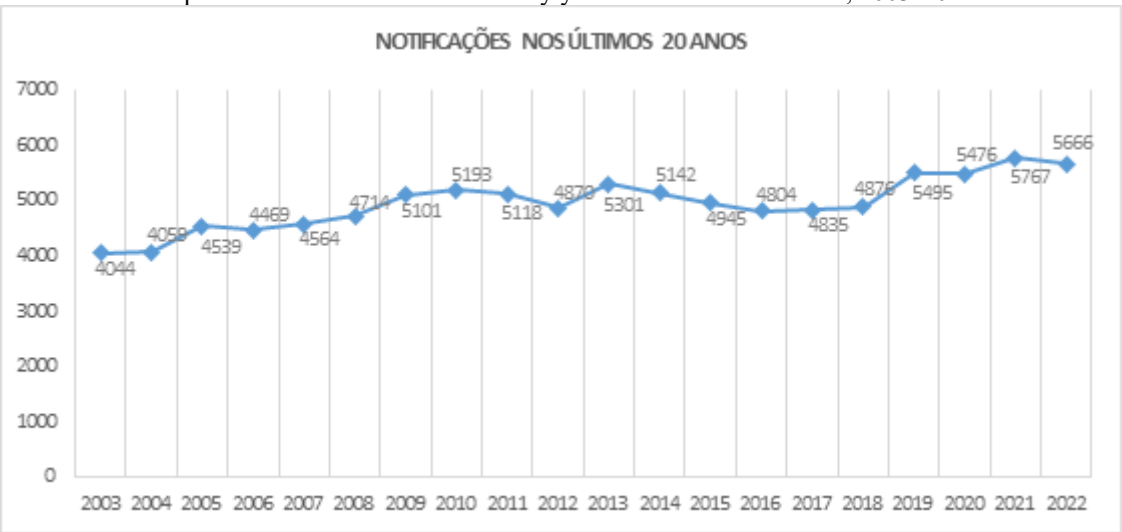
Descriptive statistical analyses of relative and absolute frequency were performed. The incidence (number of new cases/number of people at risk x per 100 thousand inhabitants) of snakebite accidents was calculated according to the annual case notification.

The data were tabulated in Microsoft Office Excel® 2020 spreadsheets and later analyzed. As these data are in the public domain, there was no identification of the people, in compliance with the ethical principles of resolution 466/2012 of the National Health Council, justifying the absence of the opinion of the Research Ethics Committee.

RESULTS

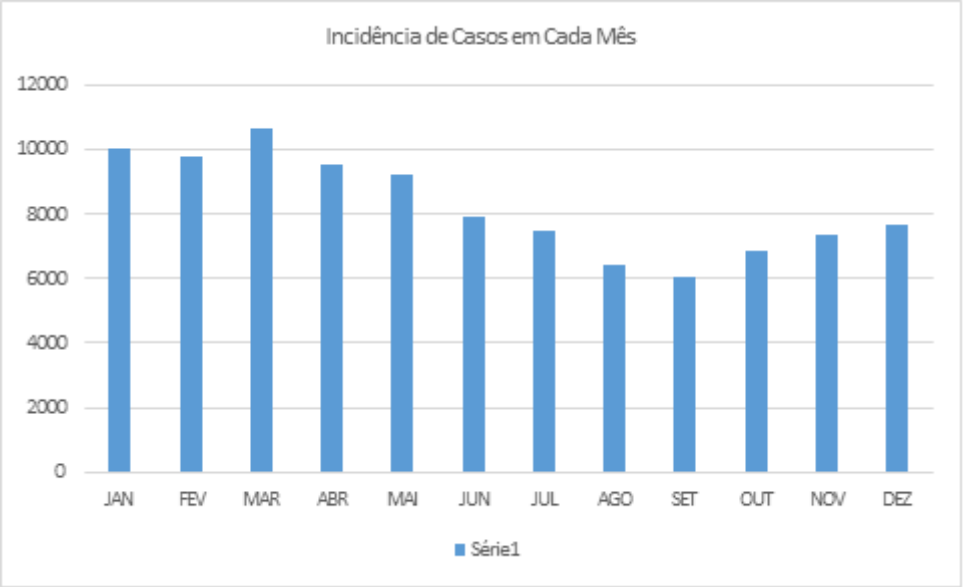
The study analyzed DATASUS data on snakebite accidents in Brazil, showing a 40.1% growth in notifications, from 4,044 cases in 2003 to 5,666 in 2022. This increase is indicative of a higher incidence or better registration of cases over the years. The data show that accidents occur mainly in the period from January to June, but there are specific increases in July 2009 and 2015, in November 2003, 2008, 2017, 2019 and 2020, and in December 2010, 2011, 2014 and from 2018 to 2022, as shown in graphs 1 and 2.

Graph 1 - Total snakebite accidents by year of notification in Pará, 2003-2022.



Source: Prepared by the authors.

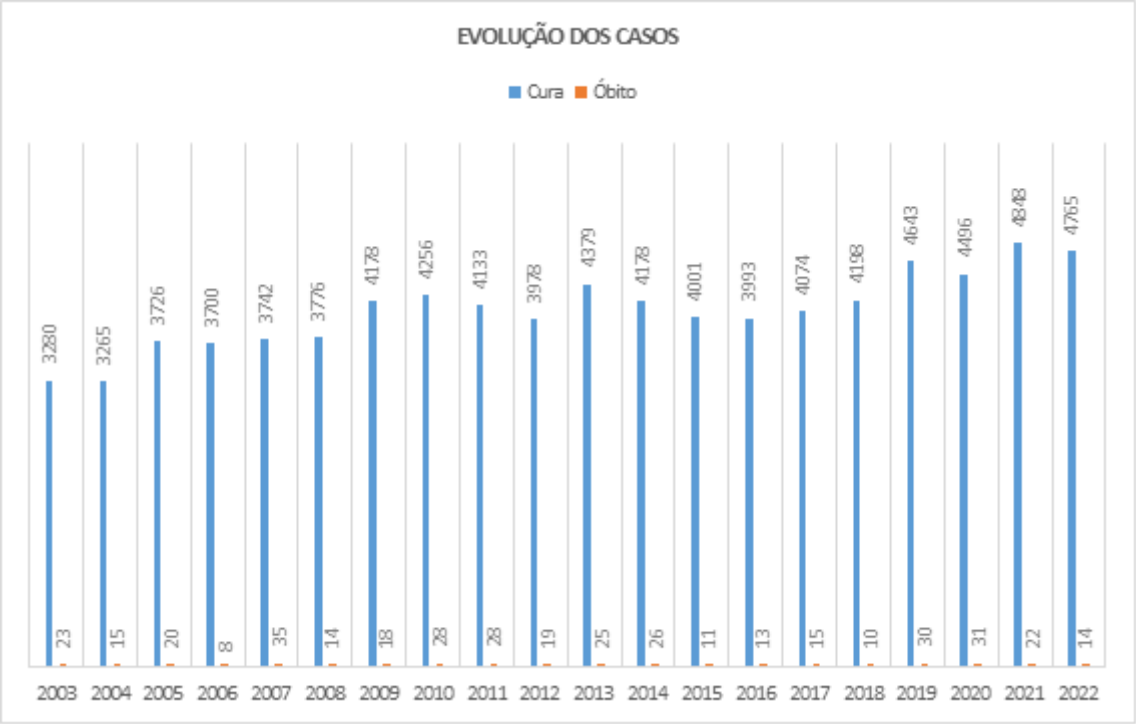
Graph 2 - Incidence of cases by month of notification in Pará, 2003-2022.



Source: Prepared by the authors.

The evolution of the cases revealed that the majority (82.4%) resulted in cure, which demonstrates the great effectiveness of the treatment and the efficiency of health professionals in the management of cases. However, there was a significant number of cases (17.1%) where the "case evolution" field was not filled in, which points to a need for improvement in the documentation of care. Deaths were relatively rare, accounting for only 0.4% of cases. Mortality has not shown a clear pattern over the years, with an average of 20 deaths per year, ranging from a low of 8 in 2006 to a high of 35 in 2007. This fluctuation suggests that, despite the increase in cure cases, the number of deaths did not decrease proportionally, possibly due to the increase in the total number of reported cases, as shown in graph 3.

Graph 3 - Evolution of cases by year of notification in Pará, 2003-2022.



Source: Prepared by the authors.

When analyzing the demographic profile of the victims, it was observed that men were the most affected, representing 75.5% of the cases. The most affected age group was 20 to 39 years, with 38,509 cases (38.9%) in the last 20 years, followed by individuals between 40 and 59 years, with 23,081 cases (23.3%). Children under 1 year of age to 9 years of age accounted for 8,483 cases (8.6%), which is worrisome, since this age group has more fragile health aspects when compared to healthy adults. Adolescents aged 10 to 19 years totaled 21,595 cases (21.8%) and elderly people over 60 years of age suffered 7,298 accidents (7.3%).

Regarding racial distribution, in 2003, most victims were brown, followed by records with "unknown field" and white people. From 2004 onwards, brown people continued to be the majority, followed by black and white people, except in 2012, when the "ignored field" surpassed the number of white victims. At the end of the period, the brown victims totaled 78,056 cases (78.8%), data shown in table 1.

Table 1 - Epidemiological characterization of snakebite accidents in Pará, 2003-2022.

Variables		Absolute Frequency	Relative Frequency (%)
Gender			
	Male	79377	80,19%
	Female	19594	19,79%
Ethnicity			
	white	6357	6,42%
	therefore	8103	8,18%
	brown	78056	78,86%
	indigenous	1099	1,11%
	yellow	835	0,84%
	Ign/Branco	4529	4,57%
Age group			
	<1 year	1164	1,17%
	1 a 4	1664	1,68%
	5 a 9	5655	5,00%
	10 a 14	9921	5,71%
	15 a 19	11674	11,79%
	20 a 39	38509	38,90%
	40 a 59	23081	23,31%
	60 a 64	3129	3,16%
	65 a 69	1992	2,01%
	70 a 79	1776	1,79%
	80+	401	0,40%

Source: Prepared by the authors.

Regarding the time needed to seek help, most of the injured people needed 0 to 6 hours to obtain care, with a predominance of the interval of 1-3 hours. Mortality increased proportionally to the waiting time for help; People who took between 1-3 hours to get assistance had a 0.31% chance of dying, while those who waited 12 or more hours had a probability of 1.09%.

In the state of Pará, all 144 municipalities have reported cases of snakebite accidents in the last 20 years. The municipality of Santarém, except for the years 2007, 2008 and from 2016 to 2018, led in the number of reported cases, with an average of 210 cases per year, totaling 4,212 cases. Belém, the capital, had just over half the cases of Santarém, totaling 2,964. The ten municipalities with the most cases were, in ascending order: Castanhal (1,953), Tomé-Açu (1,972), Thailand (2,078), Capanema (2,462), Portel (2,484), Marabá (2,825), Belém (2,964), Cametá (3,061), Breves (3,202) and Santarém (4,212), together representing 27,213 cases (28% of the records).

In relation to the municipality where the accident occurred, except for the years 2016 to 2018, the municipality of Santarém, again, ranked first in relation to the number of occurrences, totaling 3,998 (4%) cases. The 10 municipalities with the highest number of occurrences, in ascending order are: Barcarena (1,874), Moju (1,931), Tomé-açu (2,052), Acará (2,054), Afuá (2,188), Marabá

(2,434), Portel (2,567), Cametá (3,016), Breves (3,118) and Santarém (3,998). Together, they represent 25,232 cases, 25.49%.

Finally, in relation to the municipality where the accident was notified, Santarém was again in first place, except for the years between 2003 to 2008 and 2016 to 2018, with 4,239 cases in the period surveyed, representing 4.38% of the cases. The complete list of the 10 municipalities that reported the most cases is: Tomé-Açu (1,975), Thailand (2,058), Castanhal (2,348), Portel (2,479), Capanema (2,705), Marabá (2,902), Cametá (3,105), Breves (3,244), Belém (4,158) and Santarém (4,239). Together, they represent 29,213 cases, 30.19% of notifications.

Accidents were more frequent in the period between January and June, with March standing out as the month with the most occurrences in 8 of the 20 years analyzed, totaling 10,636 cases (10.74%). September had the lowest number of accidents, with 6,047 cases (6.1%).

The *Bothrops* species was the most involved in accidents, with 86,392 cases (87.28%), of which 71,569 resulted in cure (82.84%). *Lachesis* was responsible for 4,475 cases (4.52%), with a cure rate of 79.70%. The species *Crotalus* was the most lethal, with a lethality rate of 1.42%, data presented in table 2.

Table 2 – Types of species evidenced in snakebite accidents in Pará, 2003-2022.

Variables		**Absolute Frequency**	**Relative Frequency (%)**
Type of serpentine			
	Bothrops	86392	87,28%
	Crotalus	1067	1,07%
	Micrurus	135	0,13%
	Lβachesis	4475	4,52%
	ign/branco	5924	5,98%

Source: Prepared by the authors.

DISCUSSION

For a state of large proportions such as Pará, the trend of cases reveals an increase in the number of cases at the end of the period, with several oscillations, but always remaining above 4 thousand cases per year. This may corroborate the hypothesis that accidents occur due to the advance of urbanization over the natural habitat of snakes, which increases the number of annual cases. Also from this perspective, it is highlighted in other studies that there was an increase in the number of cases of snakebite accidents in the period of 10 years, but that this increase did not follow the population increase recorded.[10]

Unlike other surveys, it was noticed that the accidents recorded over the last 20 years were concentrated in the first half of each year.[9,12] There is an explanation for this, which points out that these periods are the rainiest in the Amazon region, also contributing to the change in temperature in the region.[10] Regarding climate data, INMET recorded, in the first half of each year, among the 20

years surveyed, an average rainfall of 394.5 mm and an average temperature of 26.3ºC, demonstrating that the highest accident rates occurred in the months with higher rainfall and a slightly lower temperature than the second half of the years surveyed. This data also corroborates the hypothesis that the cases happened in a way that repeated the patterns each year, making it possible to predict periods of increase in cases.

According to another study, the municipality of Santarém - PA had a predominance of accidents by the genus *Bothrops sp*. in relation to the other species.[3] This scenario was repeated when the state of Pará as a whole was analyzed, since cases of this genus represented, at the end of the period, more than 87% of the reported cases, followed by the genus *Lachesis sp*., as the study pointed out.

In addition, it is important to point out the gap left by the lack of completion of the "snake type" field, since almost 6 thousand cases did not have the species specified. Thus, as presented by another research, it is essential to identify the species precisely to provide the patient with the most appropriate treatment, since some treatments vary depending on the snake.[14] In addition, the author also postulates that the symptoms presented by the patient, together with the description of the snake, can help the professional to determine the appropriate type of treatment.

There is a manual that gathers information on snakebites and their treatment, which points out that the time between the occurrence of the bite and the treatment offered is an important risk factor for a worse outcome of the case, especially when it exceeds six (6) hours.[8] In this sense, most of the individuals affected by these accidents took between 0 and 6 hours to get medical help. This information may explain why there were few deaths during these 20 years, when compared to the number of cases that evolved to cure. However, it should be noted that the "evolution" field was not filled in in more than 17% of the cases, making it difficult to reliably determine whether the treatment provided is as effective as it appears and in which cases it is not.

The timely arrival of medical care also depends on the location where the patient lives, since the city closest to him often does not have medical and hospital resources to treat the case, making it necessary to go to neighboring municipalities. This statement, reported in several [studies,3,5] is proven by the data obtained, since, for example, Breves is the second municipality with the highest number of occurrences, but it is the third with the highest number of notifications. This may be due to the lack of resources to care for the entire affected population, as well as the severity of the patient's case. Another example of this is the municipality of Belém, which appears as the second with the most reported cases, but does not even appear in the list of the 10 municipalities in which these cases occurred the most.

After arrival at medical care, the prescription of antivenom would probably be the most effective measure in cases, except, of course, in accidents caused by non-venomous snakes, but what

was observed in many cases is that the serum was not administered even when venomous snakes were the cause of the accidents. Therefore, as discussed in other [studies,5,9] this fact can be justified by medical malpractice or even by the lack of serum, justifying the need for planning both to increase the transfer of funds in periods of increased occurrences of snakebite accidents, and to better manage the resources received by hospitals.

Finally, in relation to the epidemiological profile itself, as reported by other researchers, the most affected were men, between 20 and 39 years of age, who live in rural areas, predominantly brown.[3] In addition, when we talk about the clinical profile of these patients, the predominant type of snake is of the genus *Bothrops sp*., with the bite located mainly on the feet and legs, with a time between bite and care of 1 to 3 hours, with serum therapy being the treatment of choice in most cases and the main outcome being cure.

CONCLUSION

This study revealed important clinical and epidemiological aspects of snakebite accidents that occurred in Pará, highlighting clinical, environmental and demographic characteristics, in order to build the profile of the injured and the evolution of their condition. It was noticed that male individuals, of economically active age, were the most affected, indicating that, in rainy seasons, the economic aspect of the society in which individuals are inserted can be affected.

In addition, the data that show the predominant species in these accidents are of paramount importance, since hospitals can thus better allocate resources and avoid waste of material. Also with this data, governments can create education campaigns, in order to alert the population identified as the most at risk, about forms of protection and how to proceed in the event of such an event.

Governments can also look at smaller municipalities, but with a high number of cases, and send resources to assist this population, since the time until the care of these victims is paramount for their recovery. This is especially important, because many times, long distances are traveled in search of help in larger cities or in the capital.

In summary, the present study reinforces the need for multidisciplinary care for snakebites, a topic with little importance in current debates, but which needs better epidemiological surveillance, health education, and access to quality medical care. Finally, it is suggested that future studies on the subject seek to study individual cases, in order to understand the determining variables and the effectiveness of the treatment given to these victims. Continuing these investigations will be important to reduce the social impact of snakebites, as well as to assist the administrative sector of regional medical centers.

REFERENCES

1. Ministério da Saúde. (2023). *19/9 Dia Internacional de Atenção aos Acidentes Ofídicos*. Disponível em: https://bvsms.saude.gov.br/19-9-dia-internacional-de-atencao-aos-acidentes-ofidicos-2/. Acesso em 23 de out. de 2023.

2. Ministério da Saúde. (2023). *Acidentes ofídicos*. Disponível em: https://www.gov.br/saude/pt-br/assuntos/saude-de-a-a-z/a/animais-peconhentos/acidentes-ofidicos. Acesso em 22 de out. de 2023.

3. Aguiar, M. S. L. de. (2019). *Aspectos epidemiológicos dos acidentes ofídicos, no período de 2005 a 2017, no município de Santarém, Pará, Brasil* (Dissertação de mestrado). UFPA, Santarém.

4. Bochner, R., & Struchiner, C. J. (2003). Epidemiologia dos acidentes ofídicos nos últimos 100 anos no Brasil: Uma revisão. *Cadernos de Saúde Pública, 19*(1), 07-16. https://doi.org/10.1590/S0102-311X2003000100002

5. Borges, C. C., Sadahiro, M., & Santos, M. C. dos. (1999). Aspectos epidemiológicos e clínicos dos acidentes ofídicos ocorridos nos municípios do Estado do Amazonas. *Revista Da Sociedade Brasileira de Medicina Tropical, 32*(6), 637–646. https://doi.org/10.1590/S0037-86821999000600005

6. Bucaretchi, F., Capitani, E. M. de, & Hyslop, S. Jr. (2016). As cobras-corais do Brasil: Biologia, taxonomia, venenos e envenenamentos. *Aspectos clínicos dos envenenamentos causado por cobras-corais no Brasil*, 346–372. PUC Goiás.

7. Cruz, I., et al. (2022). Tendência temporal e perfil epidemiológico dos acidentes por animais peçonhentos no Brasil, 2007-2019. *Epidemiologia e Serviços de Saúde, 31*(3). https://doi.org/10.1590/S2237-96222022000300009

8. Fundação Nacional de Saúde. (2001). *Manual de diagnóstico e tratamento de acidentes por animais peçonhentos*. Ministério da Saúde, 9-36.

9. Lima, J. S., et al. (2009). Perfil dos acidentes ofídicos no norte do Estado de Minas Gerais, Brasil. *Revista Da Sociedade Brasileira de Medicina Tropical, 42*(5), 561–564. https://doi.org/10.1590/S0037-86822009000500015

10. Matos, R. R., & Ignotti, E. (2020). Incidência de acidentes ofídicos por gêneros de serpentes nos biomas brasileiros. *Ciência & Saúde Coletiva, 25*(7), 2837–2846. https://doi.org/10.1590/1413-81232020257.31462018

11. Ministério da Saúde. (2023). *Boletim Epidemiológico* (Vol. 54, no. 18). Secretaria de Vigilância em Saúde e Ambiente. Disponível em: https://www.gov.br/saude/pt-br/centrais-de-conteudo/publicacoes/boletins/epidemiologicos/edicoes/2023/boletim-epidemiologico-volume-54-no-18. Acesso em 23 de dez. de 2023.

12. Moreno, E., Queiroz-Andrade, M., Lira-Da-Silva, R. M., & Tavares-Neto, J. (2005). Características clínico-epidemiológicas dos acidentes ofídicos em Rio Branco, Acre. *Revista Da Sociedade Brasileira de Medicina Tropical, 38*(1), 15–21. https://doi.org/10.1590/S0037-86822005000100004

13. Sachett, J. A. G., et al. (2020). Cerebrovascular accidents related to snakebites in the Amazon—Two case reports. *Wilderness & Environmental Medicine, 31*(3), 337–343. https://doi.org/10.1016/j.wem.2020.04.009

14. Sinimbú, V. P. (2012). *Acidentes ofídicos ocorridos no município de Santarém (PA) no período de 2000-2009* (Dissertação de mestrado). Universidade Federal do Pará, Núcleo de Medicina Tropical.

15. Tres, G. L., Leite, A. D. P., Lodi, L. O., & Gavioli, I. L. (2023). *Abordagem e manejo do acidente botrópico*. Disponível em: https://www.who.int/news/item/12-01-2024-snakebite-and-climate-change---a-call-for-urgent-action-to-future-proof-a-neglected-tropical-disease. Acesso em 23 de out. de 2023.

16. Veronesi, R., Focaccia, R., & AL, E. (2009). *Tratado de infectologia*. Atheneu.