

ORIGINAL ARTICLE

Snakebites in the Municipality of Tarauacá, Acre, Western Brazilian Amazon

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Abstract

Introduction: Snakebites are a public health problem and are considered a common clinical emergency in several tropical countries, especially in rural and forested regions where these animals are more frequent. It is estimated that approximately 28,800 cases of snakebites per year occur in Brazil, with an average of 119 deaths, in which the north region has the highest rate of incidence. However, the accuracy of these data ends up being brought into question, since there are undoubtedly many cases of under-reporting and even cases that are not reported at all, due to logistical and geographical reasons or due to a lack of preparation as to the precise identification of the problem.

Objective: This study aimed to describe the epidemiological characteristics of the reported cases of snakebites victims in the municipality of Tarauacá (Acre), comparing the morbidity coefficient with other Amazonian regions, and to observe possible factors associated with the appearance of complications in these cases.

Methods: This is a retrospective descriptive study through the analysis of the clinical-epidemiological information found on the notification sheets of the Information System of Notification Diseases of victims of snakebites that occurred during the period between 2012 and 2016 in Tarauacá.

Results: We recorded 96 snakebite cases during the study period, with the majority (95.8%) classified as botropic, followed by laquetics (3.2%) and one by a non-venomous snake (1%). No deaths were recorded. Snakebites were more frequent in rural areas (87.5%), most being an occupational accident, and affected mainly adult male individuals in their lower limbs. Most cases occurred during the rainy season and had a positive correlation with rainfall.

Conclusions: The morbidity coefficient registered in Tarauacá in 2016 (72.5 cases per 100,000 inhabitants) was higher than that recorded in the cities of Cruzeiro do Sul and Rio Branco and in the states of Acre and Amazonas. Although most patients receive antivenom within the first six hours, many victims do not receive appropriate hospital care until more than 24 hours after the envenoming, which is a factor associated with the appearance of complications.

Keywords: ophidism, snakes, envenomations, venomous animals, epidemiology.

What is the purpose of this study?

This research was carried out to give a general idea of the problem of snakebites in Tarauacá, a municipality located in the interior of Acre in the Amazon.

What researchers did and found?

A retrospective study was carried out from SINAN files of the hospital of the municipality and from this the epidemiological variables of the snakebites were described for this region.

What do these findings mean?

The snakebites in Tarauacá present a higher morbidity coefficient than other studies carried out in the state of Rio Branco and Cruzeiro do Sul, and the delay in serum therapy is an important factor for the appearance of complication.

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INTRODUCTION

Snakebites are a public health problem and are considered a common clinical emergency in several tropical countries, especially in rural and forested regions where these animals are more frequent¹. According to Silva *et al.*², it is estimated that there are approximately 28,800 annual cases of snakebites in Brazil, with an average of 119 deaths, in which the north region reports the highest rate of incidence. However, the accuracy of these data ends up being brought into question, since there are undoubtedly many cases of under-notifications and even cases where no report is made at all, due to logistical and geographical reasons or due to lack of preparation as to the precise identification of the grievance^{3,4}.

In Brazil, approximately 17% of the snake species on record belong to the venomous group, which are characterised by the presence of poison inoculant teeth in the anterior portion of the upper jaw². The snakes of medical importance are classified into four groups: botropic (genera *Bothrops* and *Bothrocophias*), laquetic (*Lachesis*), crotalic (*Crotalus*) and elapidic (*Micrurus* and *Leptomicrurus*). Of these, the genera *Bothrops*, *Bothrocophias*, *Lachesis*, *Leptomicrurus* and *Micrurus*⁵ are present in the state of Acre, being absent the crotalic accident.

In the Upper Juruá region, Pierini *et al.*⁶ found a high prevalence of snakebites victims in indigenous and riverine populations, and some had been bitten more than once in their lives. In the same region, Bernarde and Gomes⁷ performed a retrospective study of the snakebite cases treated at the Regional Hospital of Juruá in Cruzeiro do Sul, associating the incidence of the cases with the months of highest rainfall. Moreno *et al.*⁸ studied the epidemiological aspects of snakebites in the Rio Branco region and, similar to Bernarde and Gomes⁷, reported unprepared health professionals in the diagnosis of the causative snake and the quantity of serum ampoules to be administered. These authors have related the occurrence of snakebite accidents with high amounts of rainfall and human labour activities, with the epidemiological profile of the victims consisting mainly of adult male individuals who were most often bitten in the lower limbs^{7,9,10}.

The municipality of Tarauacá, as well as several municipalities in the state of Acre, have extensive forest areas (indigenous lands, extractive reserves) and many communities (riverine, indigenous, farmers) live and work in forested and rural areas^{6,7}. Due to these characteristics, encounters with snakes in nature are relatively frequent and often result in envenomings. The present study aims to describe the epidemiological characteristics of the reported cases of victims of snakebites in the municipality of Tarauacá (Acre), Western Amazonia, comparing the morbidity coefficient with other Amazonian regions, and to observe possible factors associated with the appearance of complications in the cases.

METHODS

This is a retrospective descriptive study that analyses the notification files of the Notification System of Injuries (SINAN) of victims of snakebites who were

treated during the period between 2012 and 2016 at the Hospital Dr. Sansão Gomes, located in the municipality of Tarauacá, Acre (Figure 1).

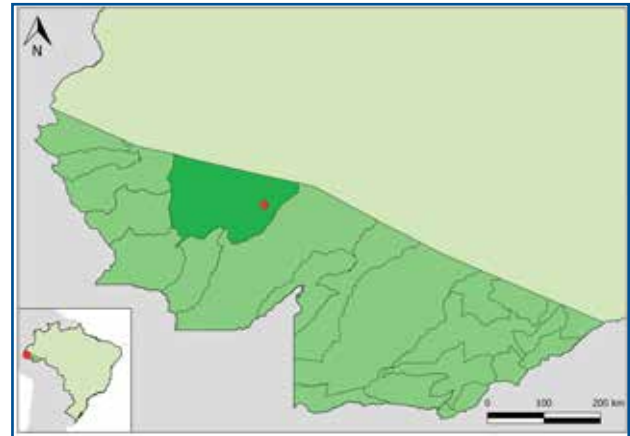


Figure 1: Localização do Município de Tarauacá, Acre, Brasil.

The municipality of Tarauacá is located in the northwestern part of the state of Acre, in the mesoregion of the Juruá Valley, which is approximately 400 kilometres (km) from the state capital, Rio Branco¹¹. It has an approximate population of 40,024 inhabitants, a territorial area of 20,171,053 km², and is the third largest municipality in the state of Acre. The climate of the region is tropical, hot and humid, with an annual average temperature of 24°C¹²; the period between November and April is the rainiest.

Data were collected from snake accidents occurring in the municipality during the period from 2012 to 2016 that were present in the SINAN records and included age, sex, accident circumstances, accident area, month of occurrence, anatomic region affected, type of accident, severity of symptoms and complications, time between the accident and the care and evolution of the cases (cure or death). The morbidity coefficient (number of cases per 100,000 inhabitants) was calculated by dividing the number of people who had snake accidents during the year 2016 by the number of inhabitants of the municipality during the same year¹¹. Rainfall data from the municipality were obtained from the National Institute of Meteorology website¹³. In order to verify a possible relationship between the number of monthly snakebites and amount of rainfall, the Spearman correlation test¹⁴ was performed.

The project was approved by the Research Ethics Committee of the Hospital das Clínicas do Acre - HCA/FUNDHACRE on 10/6/2017 (Opinion no. 2,318,959).

RESULTS

During the period from 2012 to 2016, 96 cases of snakebite accidents were recorded in Tarauacá (Table 1). The majority (95.8%) of the snakes involved were classified as botropic, followed by laquetic ones (3.2%) and one bite (1%) by a non-venomous snake (Figure 2). The year 2016 recorded the highest number of accidents (29 cases), with a morbidity rate of 72.5 cases per 100,000 inhabitants, followed by 2015 (26 cases), 2014 (18 cases),

Table 1: Clinical and epidemiological characteristics of cases of snakebites in Tarauacá (AC) during the period of 2012 and 2016. In parentheses the number of cases in which information is available from a total of 96 (100%).

Characteristics	Number	%
TYPE OF ACCIDENT (n = 96; 100%)		
Botropic	92	95.8%
Laquetic	03	3.2%
Non-venomous	01	1%
TIME OF THE YEAR (n = 96; 100%)		
Rainy (November to April)	58	60.4%
Drought (May to October)	38	39.6%
SEX (n = 96; 100%)		
M	81	84.4%
F	15	15.6%
AREA OF OCCURRENCE (n = 96; 100%)		
Rural	84	87.5%
Urban	12	12.5%
AGE GROUP (n = 96; 100%)		
0 a 10	10	10.4%
11 a 20	23	24%
21 a 30	25	26%
31 a 40	18	18.7%
41 a 50	12	12.5%
51 a 60	07	7.4%
> 60	01	1%
OCCUPATIONAL ACCIDENT (n = 96; 100%)		
Yes	62	64.6%
No	34	35.4%
TIME TO HOSPITAL CARE (n = 94; 98%)		
0 a 1 hour	14	15%
1 a 3 hours	25	26.6%
3 a 6 hours	16	17%
6 a 12 hours	7	7.4%
12 a 24 hours	7	7.4%
> 24 hours	25	26.6%
ANATOMICAL REGION OF THE CHOP (n = 96; 100%)		
Foot	46	47.9%
Leg	24	25%
Thigh	03	3.1%
Hand	15	15.6%
Arm	03	3.1%
Forearm	03	3.1%
Head	02	2.1%
CLASSIFICATION OF ACCIDENT (n = 88; 91.6%)		
Minimal	31	35.2%
Moderate	39	44.3%
Severe	18	20.5%

Continuation - Table 1: Clinical and epidemiological characteristics of cases of snakebites in Tarauacá (AC) during the period of 2012 and 2016. In parentheses the number of cases in which information is available from a total of 96 (100%).

Characteristics	Number	%
LOCAL COMPLICATIONS AND MANIFESTATIONS (n = 94; 97.9%)		
Yes	90	95.7%
No	04	4.3%
Pain	87	92.5%
Edema	86	91.5%
Bruise	14	14.9%
Necrosis	08	8.5%
Secondary infection	20	21.3%
Compartment syndrome	02	2%
MANIFESTATIONS AND SYSTEMIC COMPLICATIONS (N = 90; 95.7%)		
Yes	7	7.8%
No	83	92.2%
Haemorrhagic	15	16.7%
TC changed	50	55.5%
Shock	04	4.4%
IRA	02	2.2%
Septicemia	01	1.1%



Figure 2: Some venomous snakes from the region: A) Jararaca (*Bothrops atrox*); B) Papagaia (*B. bilineatus*); C) Surucucu-pico-de-jaca (*Lachesis muta*). Pictures: P. S. Bernarde (Personal archive).

and 2013 and 2012, both with 11 cases. No deaths were recorded during the study period. Accidents were more frequent in rural area (87.5%) and most cases occurred

during the rainy season (60.4%); there was also a positive correlation with rainfall ($r = 0.3034, p < 0.05, n = 60$; (Table 1, Figure 3).

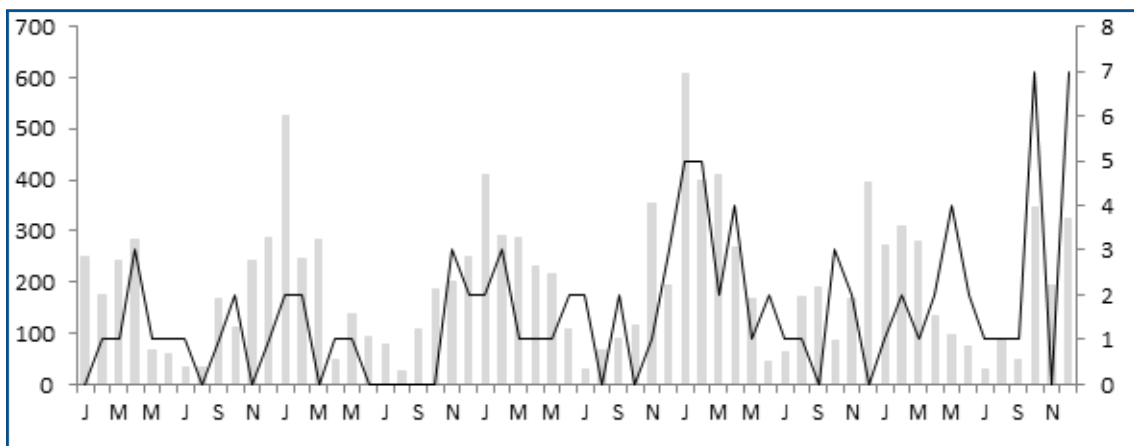


Figure 3: Monthly list of snakebites (Line) with rainfall (Columns) in Tarauacá, Acre, Brazil during January 2012 to December 2016.

The cases of snake envenoming occurred mainly in males (84.4%), in age groups between 11 and 30 years (50%), and the majority of accidents were considered occupational (64.6%) (Table 1). Most of the victims (58.6%) were seen in the hospital within the first six hours after an accident; however, a significant number (26.6%) did not receive care until after 24 hours (Table 1). The majority of cases were classified as moderate (44.3%), followed by mild (35.2%) and severe (20.5%) (Table 1).

The lower limbs, including feet (47.9%) and legs (25%), were the hardest hit during the bites (Table 1). Local manifestations and complications were present in 95.7% of the cases (Table 1), mainly consisting of pain (92.5%) and oedema (91.5%), followed by secondary infection (21.3%), ecchymosis (14.9%), necrosis (8.5%) and compartment syndrome (2%). Haemorrhages (16.7%), shock (4.4%), acute kidney injury (2.2%) and septicaemia (1.1%) were associated with systemic manifestations and complications (Table 1). Of the seven cases that presented systemic complications (shock, acute kidney injury and septicaemia), four (57%) took more than 24 hours to receive the serotherapy, and the other three (16%) were attended to in less than 24 hours.

DISCUSSION

During the study period, an annual average of approximately 19 snakebites were recorded in the municipality of Tarauacá, which was lower than that observed in Rio Branco (89 cases) by Moreno *et al.*⁸ and in Cruzeiro do Sul (97.5) by Bernarde and Gomes⁷, which can be explained by the greater number of inhabitants in the two latter municipalities. The coefficient of morbidity due to snakebites in Tarauacá in 2016 (72.5 cases per 100,000 inhabitants) was higher than in the cities of Rio Branco (35.1) and Cruzeiro do Sul (67.0) and also in the states of Acre (61.1)¹⁵ and Amazonas (52.8)¹⁶. Coefficients larger than 150 cases per 100,000 inhabitants were observed in some municipalities of Amazonas¹⁶, which turned out to be one of the regions with the greatest rate of incidence of snakebites of the planet. It should also be noted that the morbidity coefficient observed for Tarauacá may be underestimated, since many victims of snakebites do not resort to hospital care, and some of those that are injured in BR 364 highway near the Rio Liberdade (limits between the municipalities of Tarauacá and Cruzeiro do Sul) go to the Regional Hospital of Juruá in Cruzeiro do Sul, because it is closer.

The types of accidents recorded in Tarauacá, composed of the botropic majority (95.8%), followed by laquetic (3.2%), was close to that expected in the epidemiology of snakebites in the state of Acre⁵, where botropic envenoming is the most frequent, laquetic is infrequent and elapidic is rare. In Rio Branco, Moreno *et al.*⁸ reported the majority of accidents as botropic (75.7% of cases), followed by laquetic (2.1%) and elapidic (0.7%), and in 21.5% of all cases, no signs or symptoms of envenoming were observed. Botropic envenoming in Acre is mainly caused by the *Bothrops atrox* snake^{5,7,8} and second by *B. bilineatus smaragdinus*. The most common venomous snake species in the Amazon, *B. atrox* has the popular name of jararaca and surucucu, and is

present in anthropic areas (capoeiras, crop field, pastures, urban areas) while also being associated with aquatic environments (rivers, streams, igapós)^{17,18}.

On the other hand, although *B. bilineatus smaragdinus* is considered relatively rare in several regions along its geographic distribution, it is a venomous snake that is abundant in some forests in the Acre¹⁸. This species also contributes to botropic accidents. Although less frequent, the laquetic accident is the second most caused, and the responsible species is popularly known as surucucu-pico-de-jaca (*Lachesis muta*)⁵. It is the largest venomous snake in South America, being able to exceed three metres in length, and occurs in low densities in forested areas. It presents a relatively less aggressive behaviour than the *Bothrops* genera, which explains the low frequency of envenomings caused by this species².

The rarity of cases of bites by true corals^{5,8} is probably due to the few encounters of these snakes in nature, the smaller opening size of their mouth and their secretive habits². Elapidic accidents usually occur during handling by the victim, which are often children or people under the influence of alcohol¹⁹.

Snakebites in Tarauacá were associated with months that recorded higher rainfall, as observed in other studies^{7,16}, which is probably related to higher snake activity during the rainy months in the Amazon region^{17,18} and also to the fact that there is greater contact between humans and snakes during floods^{8,10}. The heightened activity of snakes during the rainy season is associated with a greater abundance of their prey (anuran amphibians and lizards), at which time their offspring are born²⁰. Certain human activities during months with higher rainfall and during river floods, such as extractivism, promote a greater number of encounters between snakes and people in the Terra Firme areas^{10,21}.

The victims of snakebites in this study corresponded epidemiologically to the profile observed for the Brazilian Amazon^{7,8,16}, characterised by a predominance of males and adults, more incidence in the rural area and being occupational in nature. In relation to the anatomical region bitten, there was a predominance of the lower limbs (76%), which is within what was typically registered in other studies in the Amazon (68% to 86% of the bites were in the lower limbs)^{5,16,21}. Here it is pointed out that a lack of preventive measures corresponding to the proper use of footwear, in particular, boots and leggings during work in the brush and forests, contributes to the occurrence of snakebites^{8,10}. Approximately one quarter (24%) of the anatomical regions bit corresponded to the upper limbs, trunk and head, which are often associated with the activity of *B. bilineatus smaragdinus* and *B. atrox arborealis juveniles*^{17,18}.

Accidents were mostly considered moderate (44.3%) and mild (35.2%), with 20.5% classified as severe. Pain and oedema were the main local manifestations observed, with the most frequently observed in botropic and laquetic envenomings^{8,16,22-24}. The percentage of ecchymosis observed in this study (14.9%) was close to that observed by Pardal *et al.*²³ (17.5%) in Belém (Pará) and lower than the 31.4% recorded in Pastaza (Ecuador) by

Smalligan *et al.*²⁴ Necrosis evolved in 8.5% of snakebites patients in Tarauacá, a number lower than that recorded in Antioquia and Chocó in Colombia (12.8%) by Otero *et al.*²² and higher than that of cases recorded for Amazonas (2%) by Feitosa *et al.*¹⁶ and for Belém (2.7%) by Pardal *et al.*²³.

The fasciotomy procedure was performed in 2% of the cases, which corresponds to the percentage that is usually performed in patients with botropic envenoming²⁵. Differences in the proportions of envenoming manifestations in different studies can be explained by the possible geographic variations of the venom of *B. atrox*²⁶, as well as differences in the proportion of other *Bothrops* species that cause accidents in these localities^{22,24}. Secondary infection occurred in 21.3% of all patients, often due to the fact that the snake's teeth cause a perforating wound on the victim's skin surface, breaking the mechanical defence barrier and favouring the occurrence of bacterial infections from the oral flora of the snake, and less frequently, flora from the patient's skin²⁵.

A change in blood coagulation time (prolonged or incoagulable time) occurred in 55.5% of the patients in which the test was performed and was within the percentage observed (39% to 72%) in other studies carried out in the Brazilian Amazon, including the 84.6% to 95% in Colombia and Ecuador^{22,24}. This is possibly due to geographical differences in the biochemical composition of the venom of the main causative species (*B. atrox*) and differences in the proportion of other species responsible for the envenomings.

The majority of the victims (58.6%) were treated within the first six hours after the accident, however, a significant number (26.6%) did not receive care until more than 24 hours after the envenoming. The delay in serum therapy is one of the factors responsible for the appearance of complications and death due to snakebites and is still one of the major problems within this field in the Amazon¹⁶. Of the seven cases that presented systemic

complications, over half took more than 24 hours to receive the serotherapy, denoting how the delay of the serotherapy is a prognostic factor that can aggravate the state of the patient.

The Amazon is characterised by the highest incidences of snakebites in Brazil^{2,16}, as well as by a certain lack of preparation for health professionals dealing with ophidism^{7,8}. In this, it is important to highlight the importance of training health professionals in the perspective of health promotion, especially early in the academic phase of practice, and to construct a critical and reflexive view of health²⁷. It is also important to educate the population in actions for prevention and first aid in cases of snake envenoming²⁸.

The morbidity coefficient registered in 2016 (72.5 cases per 100,000 inhabitants) was higher than that registered in Cruzeiro do Sul and Rio Branco and also in the states of Acre and Amazonas. Although most patients receive serum therapy within the first six hours, many receive appropriate hospital care after 24 hours after the envenoming, being a factor associated with the appearance of complications. Most snakebites are botropic, and less frequently the lachetic, occurring during the rainy season and in the rural area, being an occupational accident, affecting mostly adult male individuals in their lower limbs (feet and legs).

Retrospective studies based on access to information in databases have limitations because they cannot interview the patient or healthcare professional who attended the case, especially when there may be some doubt or other more in-depth information is needed. However, this information, when duly collected and annotated, is a valuable source of epidemiological data that allows a better understanding of a particular health problem. Prospective studies that accompany the treated cases of snakebites can provide a greater wealth of details and reliability.

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Resumo

Introdução: Os acidentes ofídicos constituem um problema de saúde pública, sendo considerada uma emergência clínica comum em vários países tropicais, principalmente em regiões de zona rural e florestadas, onde esses animais são mais frequentes. É estimado ocorrerem aproximadamente 28.800 casos anuais de acidentes ofídicos no Brasil, com uma média de 119 óbitos, no qual a região Norte apresenta a maior incidência. Todavia, a precisão desses dados acaba sendo questionada, pois devem ocorrer muitas subnotificações e mesmo não notificações por questões logísticas e geográficas ou decorrentes ao despreparo quanto à identificação precisa do agravo.

Objetivo: Descrever características epidemiológicas dos casos notificados de vítimas de acidentes ofídicos no município de Tarauacá (Acre), comparando o coeficiente de morbidade com outras regiões amazônicas e observar possíveis fatores associados ao surgimento de complicações dos casos.

Método: Trata-se de um estudo descritivo retrospectivo através da análise das informações clínico-epidemiológicas das fichas de notificação do Sistema de Informação de Agravos de Notificação de vítimas de acidentes ofídicos ocorridos durante o período de 2012 a 2016 em Tarauacá.

Resultados: Foram registrados 96 casos durante o período de estudo, sendo a maioria (95,8%) classificada como botrópico, seguido de laquéuticos (3,2%) e um por serpente não peçonhenta (1%). Nenhum óbito foi registrado. Os acidentes foram mais frequentes na área rural (87,5%), sendo um acidente ocupacional, acometendo principalmente indivíduos adultos do sexo masculino em seus membros inferiores. A maioria ocorreu durante a estação chuvosa e teve correlação positiva com a pluviosidade.

Conclusão: O coeficiente de morbidade registrado em 2016 (72,5 casos por 100.000 habitantes) foi maior do que o registrado em Cruzeiro do Sul e Rio Branco e também para os estados do Acre e Amazonas. Apesar da maioria dos pacientes receber a soroterapia dentro das primeiras seis horas, muitos recebem o devido atendimento hospitalar após 24 horas decorrido o envenenamento, sendo um fator associado ao surgimento de complicações.

Palavras-chave: ofidismo, serpentes, envenenamentos, animais peçonhentos, epidemiologia.