

## EPIDEMIOLOGICAL PROFILE OF SNAKEBITE ACCIDENTS IN A METROPOLITAN AREA OF NORTHEAST BRAZIL

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### SUMMARY

The aim of this study was to describe the epidemiological profile of snakebite accidents reported by the toxicological assistance center in Fortaleza, Ceará, Brazil. Database information on snakebite accidents was analyzed regarding the period from January 2003 to December 2011. A total of 1063 cases were found. The accidents occurred during the rainy months (March, April and May), in urban areas (52.3%), affecting individuals younger than 50 years and predominantly among males (70.7%). The lower limbs were the most frequently affected body area (33.7%). Most accidents involved non-venomous snakes (76.1%). The genus *Bothrops* was the main one involved in venomous accidents (83%). It is expected that this study can be used as the substrate to improve healthcare surveillance and implementing better measures for the treatment of this population.

**KEYWORDS:** Snakebite accidents; Epidemiology; *Bothrops*; Fortaleza; Brazil.

### INTRODUCTION

Snakebite accidents represent a Public Health problem in tropical areas of the globe. Envenomation occurs when the snake injects the content of its venomous glands, which means that not all bites lead to envenomation<sup>19</sup>. Nevertheless, accidents caused by non-venomous snakes can result in important local complications, so they also deserve attention<sup>19</sup>. Most studies, however, describe only accidents caused by venomous snakes. There are approximately three thousands snakes' species and approximately 20% are venomous<sup>16</sup>.

In Latin America, there are four genera of venomous snakes that are clinically relevant: *Bothrops*, *Crotalus*, *Lachesis* and *Micrurus*<sup>16</sup>. The snakes of the *Bothrops* genus are responsible for most accidents due to their broad distribution and aggressive behavior, silently attacking its prey<sup>18</sup>.

The state of Ceará, with 148,920,538 square kilometers of area and 8,452,381 inhabitants, is the third more populated state in the Northeast region of Brazil. There have been few studies on this subject in this area. GUIMARÃES *et al.*<sup>7</sup> identified 1079 cases of snakebite accidents due to venomous and non-venomous snakes from 1986 to 1988, with a mortality rate of 1.6%. FEITOSA *et al.*<sup>5</sup> described epidemiological aspects of these accidents in the State of Ceará in the period between 1992 and 1995. Most victims were males (75.6%), aged 10 to 19 years, who frequently worked in rural areas. The lower (67.1%) and upper limbs (12.1%) were

the most commonly affected areas. The *Bothrops* genus was involved in 88.3% of cases, followed by *Crotalus* (10.7%), *Micrurus* (0.9%) and *Lachesis* (0.2%), and there were a great number of accidents in which the snake genus was not informed. Mortality was 0.7%, but many cases had an ignored outcome.

Due to their high frequency and severity, snakebite accidents require cautious attention from health care services and detailed studies on their epidemiology are important to help improve health measures for this population. The aim of this study was to describe the epidemiological profile of snakebite accidents reported by the toxicological assistance center in Fortaleza, Ceará, Brazil.

### MATERIAL AND METHODS

This is a retrospective study on the clinical and epidemiological characteristics of snakebite accidents reported by the Toxicological Assistance Center, Instituto Dr. José Frota, in Fortaleza, Ceará, a metropolitan area in Northeast Brazil, in the period between January 2003 and December 2011. This is the largest toxicological center in the State of Ceará.

Clinical and epidemiological aspects of these accidents were studied through the review of the National Toxic-Pharmacological Information System ("Sistema Nacional de Informações Toxicológicas" - SINITOX) regarding venomous animals' accidents. The studied parameters included:

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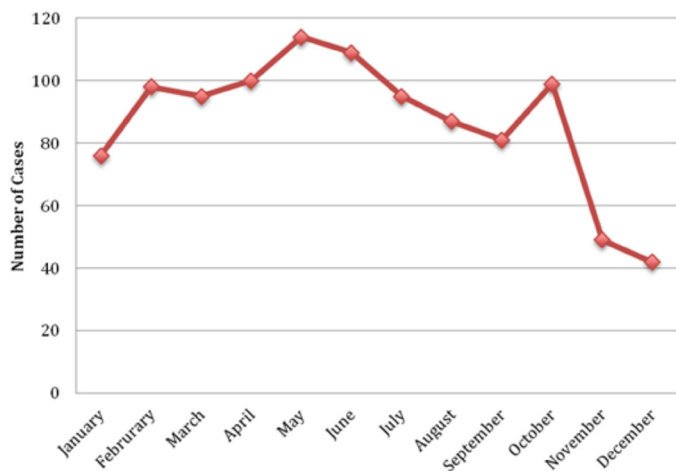
age, gender, accident circumstances, affected body area, time between the accident and the administration of anti-ophidic sera, the month in which the accident occurred, clinical manifestations, classification of the cases, snake's species and patient outcome. The identification of the snake's species was attained based on the victim's description in most cases.

Accident classification was based on the manual for diagnosis and treatment of poisonous snake accidents by the Brazilian Ministry of Health (2001).

Statistical analysis was performed through the SPSS program, version 17.0. The results were stored in a data bank and a descriptive analysis was carried out.

## RESULTS

A total of 1063 cases were reported in the study period. The highest prevalence was observed in the years 2003, 2004 and 2009. The number of cases was, respectively, 153 (14.4%), 149 (14.01%) and 151 (14.2%). The year with the lowest prevalence was 2006, with 79 cases (7.43%). The seasonality of the accidents is shown in Figure 1. The months between January and May were those with the highest number of cases (45.3%). A peak in October was also observed, with 99 cases (9.3%).



**Fig. 1** - Seasonal distribution of reported cases of snakebite accidents in Fortaleza, Ceará, Brazil, in the period between January 2003 and December 2011 (n = 1063).

A total of 557 accidents (52.4%) occurred in urban areas, 462 (43.5%) in rural areas and 44 (4.1%) lacked such information. The city of Fortaleza was the most affected place, with 347 cases (32.6%), as shown in Table 1.

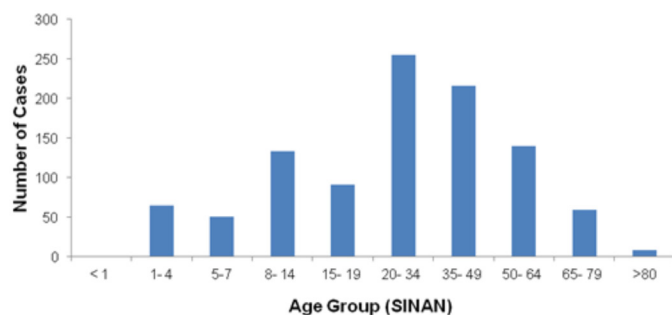
Most victims were aged 20 to 34 years (23.9%) and 70.7% were males (Fig. 2). Regarding the victims' occupation, only 25% of cases reported that information and the majority of individuals were farmers (75.2%).

In 596 reported cases (56%) there was no information about the snake's genus that caused the accident. Among the cases in which this information was reported, 211 (19.8%) were caused by the genus *Bothrops*, 27 (2.5%) by *Crotalus*, 14 (1.3%) by *Micrurus* and two (0.2%) by *Lachesis*. A total of 213 (20.1%) accidents were caused by non-venomous snakes (Table 2). The most frequently affected body

**Table 1**

Demographic data from reported cases of snakebite accidents in Fortaleza, Ceará, Brazil, in the period between January 2003 and December 2011 (n = 1063)

Variables	Number of cases	%
<b>City</b>		
Metropolitan region of Fortaleza	621	58.4
Other regions of Ceará State	378	35.5
Ignored	64	6.1
<b>Gender</b>		
Male	752	70.7
Female	311	29.3
<b>Local of the accident</b>		
Rural area	462	43.5
Urban area	557	52.4
Ignored	44	4.1
<b>Total of cases</b>	<b>1063</b>	<b>100</b>



SINAN: National System of Aggravations and Notification.

**Fig. 2** - Distribution according to age of cases of snakebite accidents reported by the Toxicological Assistance Center in the period between January 2003 and December 2011 (n = 1063).

areas were the lower limbs (71.8%), followed by upper limbs (26.6%), head (1%) and trunk (0.6%). Medical care was provided, in the majority of cases, within less than 12 hours after the accident (n = 148), and in only six cases treatment was provided within less than one hour after the accident (Table 2). In 83 (7.8%) out of 231 patients, the time from snakebite until treatment was greater than 12 hours.

The most frequent clinical manifestations (36.8%) were local complications, including pain and edema, followed by hemorrhagic abnormalities (15.6%). Acute kidney injury (AKI) was observed in 33 cases (3%), as shown in Table 3. Even in the accidents with non-venomous snakes there were important local complications, such as infections and compartment syndrome. One of these cases (non-venomous snake) developed AKI that required dialysis. Among the patients bitten by non-identified snakes, six (1.0%) had central nervous system abnormalities and two (0.3%) had hemorrhagic manifestations and blurred vision.

**Table 2**

Descriptive data regarding the circumstances of the accidents in reported cases of snakebite accidents in Fortaleza, Ceará, Brazil, in the period between January 2003 and December 2011 (n = 1063)

Variables	Number of cases	%
<b>Affected body area</b>		
Ignored	563	52.9
Hand	105	9.9
Foot	288	27.1
Upper limb	28	2.6
Lower limb	71	6.7
Trunk	3	0.3
Head	5	0.5
<b>Type of snake</b>		
Ignored	596	56.1
<i>Bothrops</i>	211	19.8
<i>Crotalus</i>	27	2.5
<i>Micrurus</i>	14	1.3
<i>Lachesis</i>	2	0.2
Non-venomous	213	20.1
<b>Time between the accident and medical care (hours)</b>		
Ignored	832	78.3
0-1	6	0.6
1-3	21	2
3-6	57	5.4
6-12	64	0.5
>12	83	7.8
<b>Outcome</b>		
Ignored	5	0.5
Cured	1028	96.7
Cured with organ dysfunction	28	2.6
Death	2	0.2
<b>Total of cases</b>	<b>1063</b>	<b>100</b>

**Table 3**

Clinical manifestations of reported cases of snakebite accidents in Fortaleza, Ceará, Brazil, in the period between January 2003 and December 2011 (n = 1063)

Manifestations	Number of cases	%
Hemorrhagic abnormalities	75	15.6
Central nervous system abnormalities	120	7.1
Local lesion	391	36.8
Ptosis/Diplopia	25	2.4
Oliguria/Anuria	23	2.2
Myalgia	30	2.8
Acute kidney injury	33	3.0

Regarding the classification of the accident, according to the Brazilian Ministry of Health Guidelines<sup>6</sup>, 72% were classified as moderate or severe and 27.9% as mild (Table 4). Among the patients classified as severe, 19 (20.4%) received the antivenom more than 12 hours after the accident.

**Table 4**

Classification and use of anti-ophidic sera in reported cases of venomous snakebite accidents in Fortaleza, Ceará, Brazil, in the period between January 2003 and December 2011 (n = 254)

Variables	Number of cases	%
<b>Classification</b>		
Mild	71	27.9
Moderate	90	35.4
Severe	93	36.6
<b>Use of antiophidic sera</b>		
Ignored	19	7.5
Yes	227	89.4
No	8	3.1

The anti-ophidic serum was administered to 89.4% of patients in the group of venomous snakes (254) and the serum was not administered in 3.1% of cases (Table 4).

The majority of victims (96.7%) achieved complete cure, 2.6% had some health limitation at the time of hospital discharge and two patients died (Table 2). Of the latter, the first patient was female, 62 years old, from the rural zone. She received 16 ampoules of antivenom and died of anaphylactic reaction after cardiorespiratory arrest unresponsive to resuscitation measures. The second patient was male, 81 years old, from the rural zone. He received 12 ampoules of antivenom and died of hemorrhagic complications.

## DISCUSSION

Snakebite accidents in Brazil had a prevalence increase of 32.7% in the period between 2004 and 2009, according to data from the Ministry of Health<sup>20</sup>. There has been an increase in 32% in the notifications of accidents with venomous animals in the state of Ceará between 2007 and 2010<sup>21</sup>. In 2010, a total of 29,635 snakebite accidents were notified in our country. Eighty-five percent were caused by venomous snakes, 4% by non-venomous and 11% by non-identified snakes. The North region had the highest number of cases, 9191, followed by the Northeast (8238 cases) and Southeast (6343 cases) regions<sup>19</sup>.

The incidence of snakebite accidents in Northeast of Brazil in 2010 was similar to the National incidence (15.5 accidents/100,000 inhabitants) and the state of Ceará showed a prevalence increase in the last years (9.9 accidents/100,000 inhabitants in 2010)<sup>22</sup>.

The underreporting of cases in some regions, including the Northeast, has been reported in several studies<sup>8,18</sup> and the increase in the number of cases in the last years may reflect an improvement in the notification system in our region. The present study is one of the few in our region to describe clinical and epidemiological aspects of this type of accident.

Accidents in urban areas were the most frequent in the present study and if we include the city of Fortaleza and its metropolitan area we will find 62.3% of the reported cases. The metropolitan area of Fortaleza, according to data from the Brazilian Institute of Geography and Statistics (IBGE), is the sixth largest in Brazil, with 3,610,379 inhabitants<sup>8</sup>. The population increase probably had an impact on the occurrence of the snakebite accidents. The increase in domestic garbage volume contributes to the proliferation of rodents, which in turn attract snakes, favoring the occurrence of the accidents. The association between urbanization and snakebite accidents was also described in a previous study in the state of Minas Gerais<sup>10</sup>. The cases reported in urban areas require special attention, demonstrating that large cities need an adequate infrastructure to avoid snake proliferation<sup>11</sup>.

The predominance of the male gender (70.7%) observed in the present study shows a higher exposure of these individuals to risk areas, probably linked to work activities, such as agriculture. However, there were several instances in which the place of accident was not informed. Most victims (43%) were aged 20 to 49 years, which is the most economically active age. FEITOSA *et al.*<sup>5</sup> had already described the predominance of male gender in snakebite accidents (more than 70%), but in a younger population (10-19 years old), in the State of Ceará in the 1990s. BORGES *et al.*<sup>3</sup>, in a study in the Amazon region, also showed the predominance of males (81.3%) and 72.1% of this sample was economically active. The profile of these accidents remained stable during many years and seems to continue to affect mainly young males<sup>2,10-13</sup>.

Regarding seasonality, the occurrence of snakebite accidents is associated to climate factors and an increase in human activity in rural areas. The highest incidence is observed during the months between September and March in the South, Southeast and Midwest regions of Brazil, and between January and May in the Northeast region<sup>6</sup>. Most cases occurred in the warmest and rainy months (February to May). The association between the increase in the number of accidents and rainy season was reported in other studies in Brazil<sup>10-13</sup>. An increase in the number of cases in October in our region may also be due to an increase in the volume of rain during this month, a known phenomenon that favors the cultivation of cashew nuts<sup>19</sup>.

In most studied cases, the clinical and epidemiological history allowed the identification of the type of snake involved in the accident. The genus *Bothrops* is responsible for the majority of accidents involving venomous snakes, varying from 70 to 90% of cases<sup>9,10-13</sup>. The lower limbs were the most affected body area (71.8% of informed cases), similar to the reported in other studies<sup>3,9,11-13</sup>.

The time between the accident and medical care was not informed in 78.3% of cases. Regarding the informed ones (21.7%), we observed a delay in medical care, as 35.9% were admitted to the toxicological center for health care more than 12 hours after the accident. The long time between the accident and medical care may be responsible for the development of a more severe clinical picture (72% of cases were classified as moderate to severe). OLIVEIRA *et al.*<sup>13</sup> showed a higher number of moderate to severe cases in the State of Paraíba, Northeast Brazil, and there was a direct association with the time between the accident and hospital admission. This association has also been found in other studies<sup>9,12,14,15</sup>. LIMA *et al.*<sup>10</sup> showed, in the state of Minas Gerais, that most cases reported in that region (2002 to 2006) were classified as mild. These cases (66.5%) showed rapid

hospital admission (up to three hours after the accident). This fact correlates with the good clinical outcome.

In the present study, anti-ophidic serum was administered to approximately 21.3% of the cases and the lack of serum administration may be related to the type of snake (non-venomous). These data have also been observed in previous studies<sup>10</sup>. We observed that the serum was administered to 89.4% of cases (venomous snake cases). This fact is compatible to the severity of these cases, demonstrating that administration was carried out according to the guidelines by the Brazilian Ministry of Health<sup>6</sup>.

Regarding the clinical manifestations, we observed a predominance of local complications, at the site of the snake bite, followed by hemorrhagic manifestations. It is important to note that even in the accidents caused by non-venomous snakes, there were also important local complications. It is known, for example, that the snake of the genus *Philodryas* (known as "green snake", "cobra-verde" or "cobra-cipô" in Portuguese) and *Clelia* (known as "black snake", "muçurana" or "cobra-preta" in Portuguese), which are classified as non-venomous, can cause important local complications<sup>6</sup>. Experimental studies have shown that the *Philodryas olfersii* venom has hemorrhagic, proteolytic, fibrinolytic and fibrinolytic actions, but no anticoagulant action<sup>6</sup>. CORREIA *et al.*<sup>4</sup> reported a case of *Philodryas olfersii* accident characterized by important local complications and anaphylactic reaction to the use of antithrombotic serum, demonstrating that these accidents cannot be underestimated. Similarly, we observed one case of severe complications due to the bite of this snake, with the development of sepsis and AKI requiring dialysis. Regarding victim outcome, most of them achieved complete cure at the time of hospital discharge, but a significant percentage of cases persisted with some organ dysfunction, with renal impairment being the most frequent finding. The occurrence of kidney dysfunction due to snakebites is well described in literature. It is the main systemic complication of snakebites and occurs more frequently after *Bothrops* and *Crotalus* accidents<sup>17</sup>. There is clinical and experimental evidence showing that these accidents can directly cause kidney injury, which is the main cause of death<sup>2,9</sup>.

In summary, snakebite accidents are frequent in the state of Ceará and the toxicological assistance center has a fundamental role in the management of these victims. The epidemiological profile is characterized by a predominance of young males and the occurrence of local complications. It is important to achieve a correct diagnosis of the type of accident and the early administration of anti-ophidic serum to achieve a favorable outcome. The correct filling out of the notification form is important to provide tools to better plan health policies for the care of this population.

## RESUMO

### Perfil epidemiológico dos acidentes por picada de cobra em região metropolitana do nordeste do Brasil

O objetivo deste estudo é descrever o perfil epidemiológico dos acidentes ofídicos atendidos e notificados ao Centro de Assistência Toxicológica (CEATOX), em Fortaleza, Ceará, Brasil. Foram analisadas informações sobre os acidentes ofídicos relativos ao período compreendido entre janeiro de 2003 a dezembro de 2011, por meio de banco de dados. Os resultados demonstraram 1063 casos notificados

ao CEATOX, Ceará. Os acidentes ocorreram principalmente em meses chuvosos (março, abril e maio), em áreas urbanas (52,3%), em uma faixa etária menor de 50 anos, acometendo predominantemente o sexo masculino (70,7%). Os membros inferiores foram os locais mais afetados (33,7%). A maior parte dos acidentes envolveu serpentes não peçonhentas (76,1%). O gênero *Bothrops* foi o maior responsável pelos acidentes com serpentes peçonhentas (83%). Espera-se que os dados da casuística obtida sirvam de ferramenta para o planejamento de medidas de saúde voltadas para prevenção e atendimento mais adequado da população em estudo.

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