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# **Clinical and Epidemiological Aspects of Accidents by Venomous Animals in Mâncio Lima, a Western Amazonian City**

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### **Authors' contributions**

*This work was carried out in collaboration with all authors. Author MNS chose the theme, designed the research project and the questionnaires, made the submission to the Ethics Council, managed the data collection, review, transcription for the SPSS Program, analysis and review of analysis, did the writing, revision, correction and translation of the text. Authors SASM, ARS, RAA, CBB, BWBA, TMP, ACM, RN and BMD managed the data collection, review, transcription for the SPSS Program, analysis and review of analysis, they also collaborated in the revision and correction of the text (article). Author KASM collaborated in the text writing, the critical and grammar review, formatting of tables and references and adequacy of the article to the Journal's guideline. Author MSN chose the theme, designed the research project and the questionnaires, made the submission to the Ethics Council, managed the data collection, review, transcription for the SPSS Program, analysis and review of analysis, did the writing, revision, correction, translation and publication of the text. All authors read and approved the final manuscript.*

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## ABSTRACT

**Aims:** To characterize the frequency and clinical characteristics of venomous animals' accidents in Mâncio Lima, Acre.

**Study Design:** A cross-sectional study.

**Place and Duration of Study:** The study took place in Mâncio Lima, Acre, Brazil, between 2013 and 2015.

**Methodology:** We included a cohort of 350 households (estimated to be 1,500 people of all ages) in the urban area of Mâncio Lima. The following questionnaires were applied: I. Occurrence of accidents by venomous animals and clinical characterization of accidents; II. The detailed description of households.

**Results:** There were 111 (8%) accidents with snakes, 138 (9.9%) accidents with scorpions, 108 (7.8%) accidents with spiders and 99 (7.1%) accidents with stingrays. *Bothrops jararaca* was the most cited snake, being edema (local and systemic) and muscular pain the main symptoms. In relation to scorpionism and arachnidism, the hands were the body site of the greatest number of injuries, with local pain/tingling and pain/blistering being the main symptoms, respectively. Accidents by stingrays occurred mostly in the shallow part of the river; feet and legs were the main body sites affected and local pain/bleeding were the main symptoms.

**Conclusion:** In Mâncio Lima, there was a severe frequency of envenomation in the population, specifically in low-income brown/black male rural workers with low educational level. A counter action is required with public health measures that protects the inhabitants of the region, offering greater hospital care and wide application of serum for everyone who needs it. It is also important to educate rural workers on venomous animals and preventive measures to avoid accidents.

**Keywords:** *Accidents by Scorpions; accidents by spiders; accidents by stingrays; ophidism; venomous animals; scorpionism; arachnidism.*

## 1. INTRODUCTION

Accidents caused by venomous animals not only constitute an aggravation that requires immediate medical intervention: they also represent a problem of Public Health [1]. Between 2010 and 2014, in Brazil, 601,307 casualties involving venomous animals were registered in the Information System on Diseases of Compulsory Declaration (SINAN). In 2015, 150,004 cases were recorded (24,467 of snakes, 74,598 of scorpions and 26,298 of spiders) and, only in Acre state, there were 985 cases (501 of snakes, 203 of scorpions and 89 of spiders). A year later, in 2016, the total number increased to 173,687, with a higher incidence between March and November, culminating in 305 fatalities [2]. In one of the few studies on stingray accidents, conducted in the Alto Rio Paraná region between 2004 and 2009 (covering southeast, south, and center-west cities), there were, at least, 31 reports of accidents caused only by these animals [3].

In Brazil, poisoning caused by the inoculation of toxins through the inoculating device (prey on snakes, stinger on scorpions and stingrays, and chelicerae on spiders) is frequent and may lead to local or systemic disturbance. Besides

stingrays, the main venomous animals of medical importance in the country are those related to ophidism, arachnidism, and scorpionism. Therefore, are common in the Amazon region:

- Snakes, such as *Bothrops* (jararaca, jararacuçu, urutu, caiçaca), *Crotalus* (rattlesnake), *Lachesis* (surucucu, pico de jaca) and *Micrurus* (true coral).
- Scorpions, such as *Tityus*, possessing several species – *Tityus serrulatus* (yellow scorpion), *Tityus bahiensis* (brown scorpion), *Tityus stigmurus*, *Tityus paraensis* (black scorpion), and *Tityus metuendus*.
- Spiders, such as *Loxosceles* (brown recluse spider), *Phoneutria* (armadeira), and *Latrodectus* (black widow).
- Acantotoxicictism by stingrays, caused by the class Chondrichthyes, subclass Elasmobranchii, subdivision Batoidea, order Myliobatiformes (single order with stingers in the tail), family Potamotrygonidae (where we find freshwater species).

Also, several animals considered non-venomous and of minor medical importance, since they have only a local action — without systemic complications — can be found in Brazil, such as:

- *Phylodrias* (green snake, cobra-cipó), *Oxyrhopus* (false-coral), *Waglerophis* (boipeva), *Helicops* (water snake), *Eunectes* (sucuri), *Boa* (jiboa), *Lycosidae* (grass spider, garden spider) and the caranguejeiras [4].

Accidents by venomous animals are collected in Brazil through notification systems as SINAN, National Poisoning Information System (Sinitox/Fiocruz/MS), Hospital Information System of the National Unified Health System (SIH-SUS) and Brazil Mortality Information System (SIM). And, in spite availability of all these systems, it is verified that the epidemiological data do not show the real situation of the problem, probably due to underreporting cases [5].

The objective of this study is to characterize the frequency and clinical characteristics of venomous animals' accidents in Mâncio Lima, Acre, to reveal the true reality and predict the importance of establishing an emergency care protocol in the region.

## 2. MATERIALS AND METHODS

### 2.1 Area of Study

The study was conducted at the urban center of Mâncio Lima, located in the extreme west of the Amazon region, in Acre state. This municipality, with 550,000 km<sup>2</sup>, is bounded by the municipalities of Cruzeiro do Sul, Rodrigues Alves, and the Republic of Peru. Mâncio Lima has 14,884 inhabitants distributed in urban (57.3%), rural or riverside (37.9%), and indigenous areas (4.8%). The municipality is located 38 km from Cruzeiro do Sul and 650 km from the state capital of Acre, Rio Branco (Fig. 1).

### 2.2 Population, Design and Research of the Study

The study involved, between 2013 and 2015, a cohort of 350 households (estimated to be 1,500 people of all ages) in the urban area of Mâncio Lima. The epidemiological design consists of a cross-sectional study. The following questionnaires were applied: I. Occurrence of accidents by venomous animals and clinical characterization of accidents; II. The detailed description of households.

In the interviews, the study participants were questioned about the occurrence of previous causalities, the symptoms exhibited in each case, the bite location, the clinical consequences (local changes — such as pain, edema, necrosis — and systemic alterations), the necessity of medical care, the place where the accidents occurred (urban, rural or riverside area) and the variables associated with them.



**Fig. 1. Map of Brazil highlighting Acre and the location of Mâncio Lima**

### 2.3 Data Analysis

The data was analyzed in the statistical program SPSS, version 16.0, in which the distributions of the relative and absolute frequencies and standard deviations of the variables were calculated. The Student T-Test was used for independent samples and the Chi-Squared Test was used to compare means and proportions. Only values below  $P = 0.05$  were considered statistically significant.

### 2.4 Ethical Aspects

This study was approved by the Research Ethics Committee of Federal University of Acre (UFAC) – CAE 21457613.6.0000.5010.

## 3. RESULTS

The study obtained a sample of 1,389 people, with 111 (8%) reporting accidents with snakes,

138 (9.9%) with scorpions, 108 (7.8%) with spiders, and 99 (7.1%) with stingrays. The encounter of more than one episode per person was frequent.

The epidemiological data showed us that most of the events with venomous animals occurred in people with the following characteristics: males; people who did not live in rural areas; low educational level; ethnic black or brown; with up to 2 minimum wages. The minimum Brazilian wage in 2013 was approximately R\$ 622 (US\$ 334) (Table 1).

Regarding ophidism, *Bothrops jararaca* was the snake responsible for the largest number of cases (n = 60) (Fig. 2). It was verified that the geographical area (Fig. 3) where the greatest number of accidents occurred was the rural/riverside area (n = 140), with feet and legs being the most affected body site (n = 92 and n = 37, respectively) (Fig. 4). About clinical aspects bite site edema, body edema (anasarca) and muscle pain (n = 143, n = 105 and n = 74, respectively) were the main symptoms reported (Fig. 5). of the total number of snake injuries (n = 111), only 19.5% (n = 30)

**Table 1. Epidemiological characteristics of accidents with venomous animals (Snakes, Scorpions, Spiders, and Stingrays) in Mâncio Lima**

	Snakes			Scorpions		
	N	(%)	P	N	(%)	P
<b>Gender</b>			<.001			<.001
Male	77	69,4		102	73,9	
Female	34	30,6		36	26,1	
<b>Ethnicity</b>			.009			.019
White	21	19,6		20	14,7	
Brown/Black	73	68,2		102	75	
Indigenous/Mestizo	13	12,1		14	10,3	
<b>Educational Background</b>			< .001			<.001
Illiterate	36	34,3		38	28,4	
1-4 Years	43	41		55	41	
>4 Years	26	24,7		41	30,6	
<b>Lived in Rural Area</b>			<.001			<.001
Yes	35	31,5		57	41,3	
No	76	68,5		81	58,3	
<b>Family Income</b>			.71			.66
Up to Two Minimum wages	69	71,9		83	66,4	
More Than Two Minimum wages	27	28,1		42	33,4	
	Spiders			Stingrays		
	N	(%)	P	N	(%)	P
<b>Gender</b>			<.001			.001
Male	81	75		66	66,7	
Female	27	25		33	33,3	
<b>Ethnicity</b>			.015			.6
White	15	13,9		19	19,2	
Brown/Black	79	73,1		72	72,7	
Indigenous/Mestizo	12	11,3		8	8,1	
<b>Educational Background</b>			< .001			.003
Illiterate	25	24		17	17,7	
1-4 Years	46	44,2		32	33,3	
>4 Years	33	31,7		47	48,9	
<b>Lived in Rural Area</b>			<.001			<.001
Yes	46	42,6		35	35,4	
No	62	57,4		64	64,6	
<b>Family Income</b>			.58			.64
Up to Two Minimum wages	59	63,4		56	65,1	
More Than Two Minimum wages	34	36,6		30	34,9	

had hospital care, and 30.1% of the patients (n=46) reported having received antiofidic serum. Regarding the use of tourniquet and the presence of after-effects, a considerable prevalence was observed (n=29 and n=30, respectively).

About scorpionism and arachnidism, the geographical area (Fig. 3) where the greatest number of episodes took place was the rural/riverside area (n = 190 and n = 110, respectively), being hands the region of the body most affected (n = 108 and n = 68, respectively) (Fig. 4).

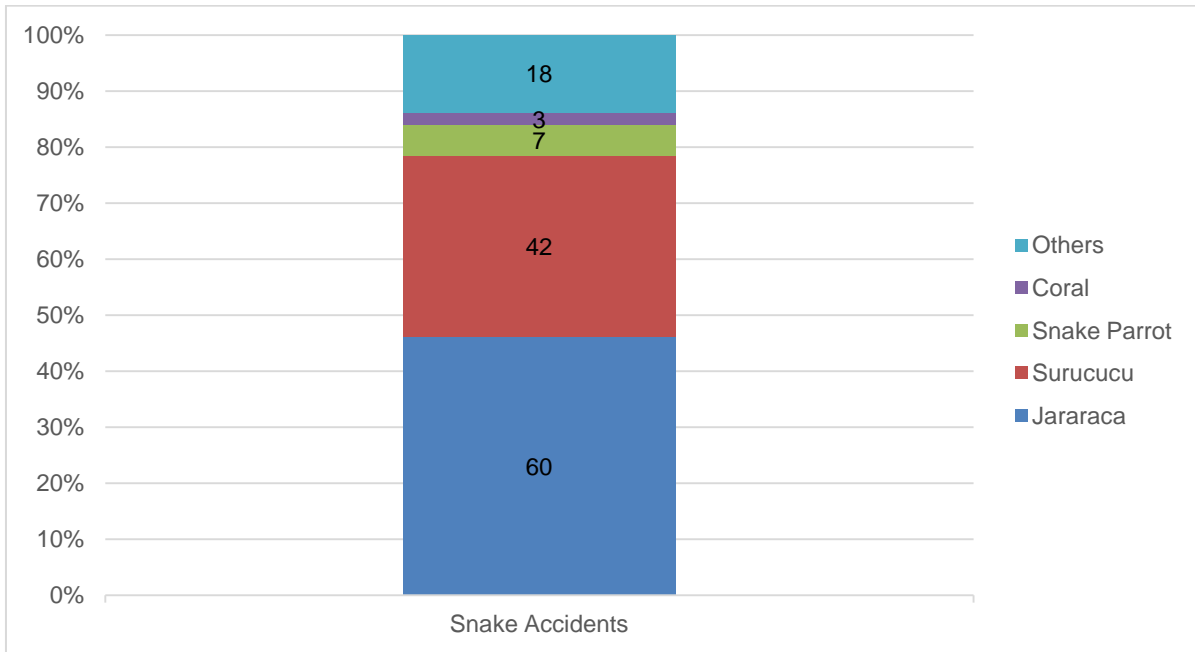


Fig. 2. Snake types Bar Chart

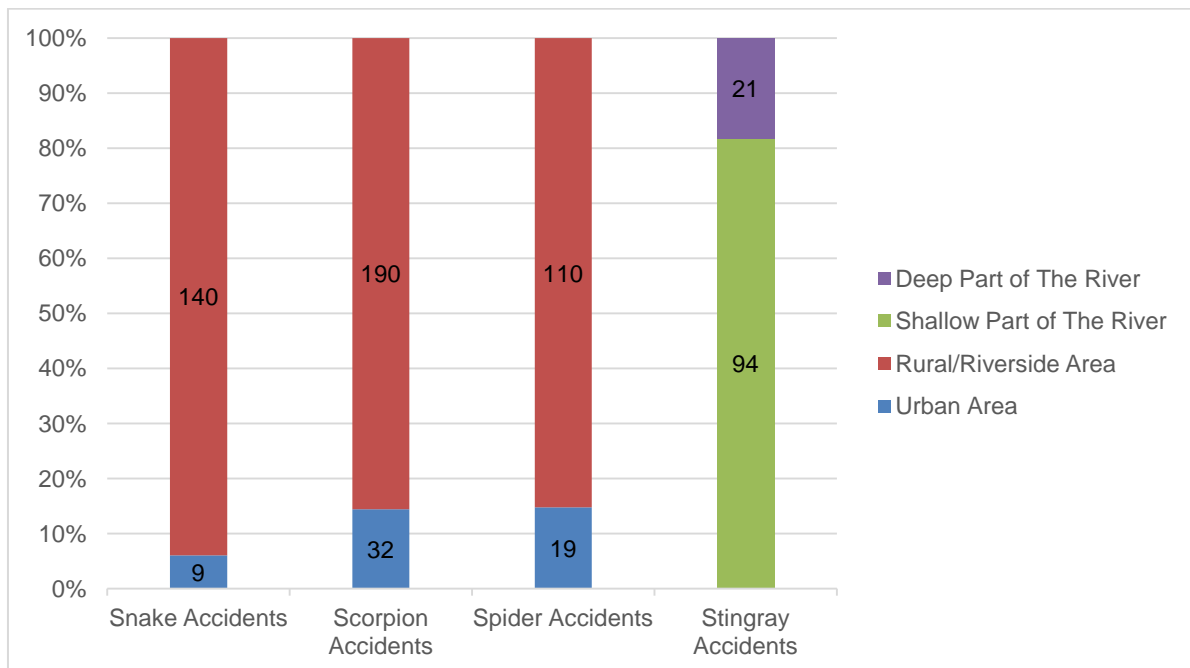
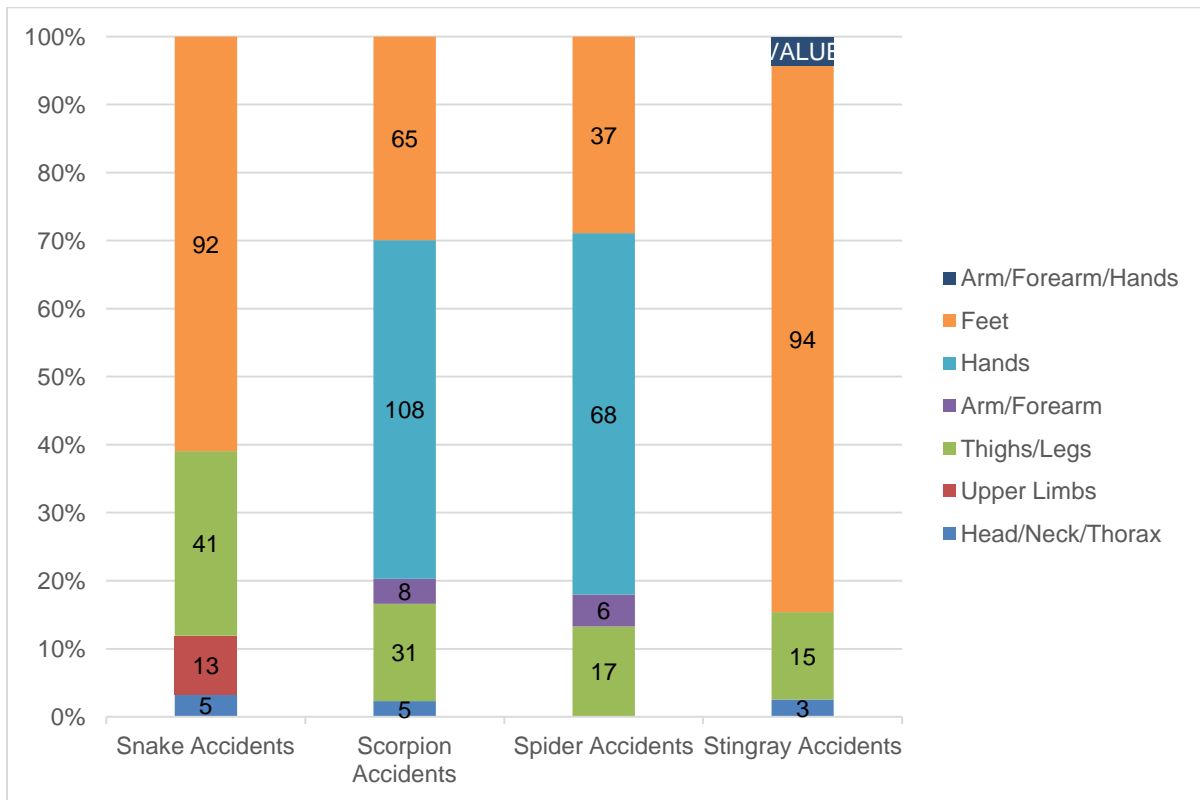
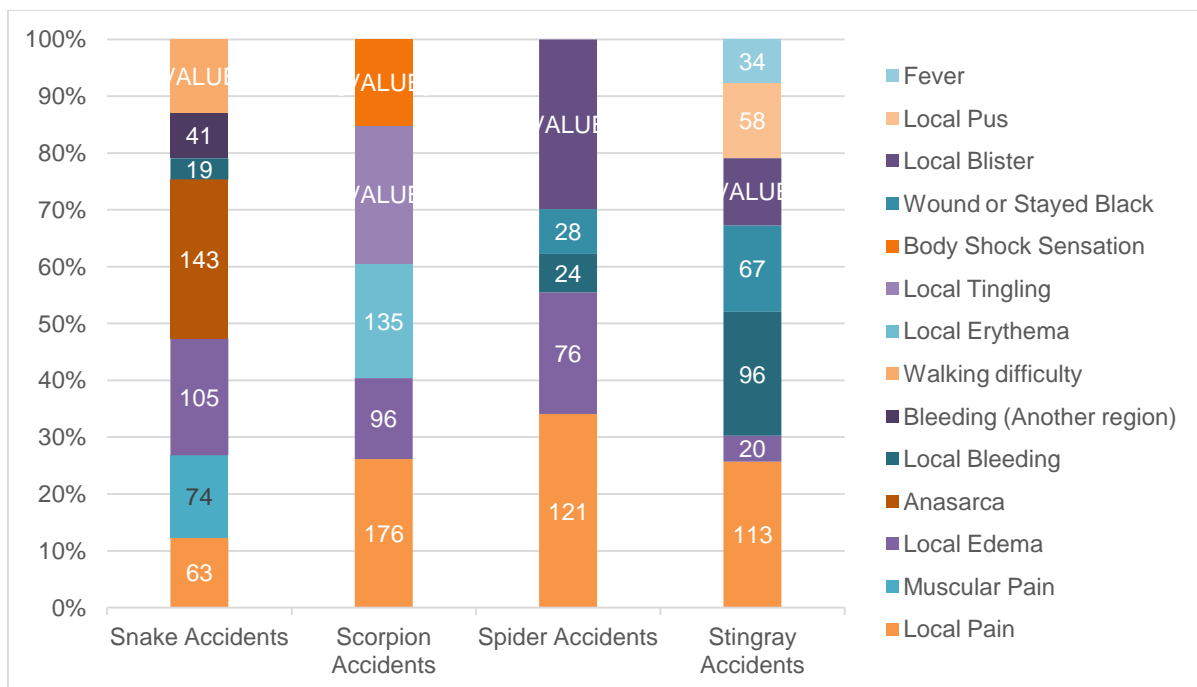


Fig. 3. Geographical area of accidents bar chart



**Fig. 4. Body Site Affected on Accidents Bar Chart**



**Fig. 5. Signs/Symptoms Bar Chart**

As for the symptoms reported by the victims of scorpion and spider causalities, the pain was predominant (n = 176) and tingling at the sting

site (n = 164) involving scorpions, while in spider accidents were found a predominance of pain (n = 121) and blister formation (n = 106). Few

people sought hospital care in cases of scorpionism (n = 21) and arachnidism (n = 13) and few had aftereffects (Figs. 6 and 7).

It was verified most of the injuries caused by stingrays occurred in the shallow part of the river (n = 94) and only a minority reported the trauma occurred in the deep part (n = 21) (Fig. 3). Of the total victims, only 46.2% (n = 54) stated they saw

the animal after the accident, being the feet and legs the body sites where the traumas most occurred (n = 94 and n = 14, respectively) (Fig. 4). Regarding clinical aspects, pain and bleeding at the accident site were reported as the main symptoms (n = 113 and n = 96, respectively) (Fig. 5). Only 18.8% (n = 22) of the victims sought hospital care (Fig. 6) and only 10.1% (n = 12) reported some type of aftereffects (Fig. 7).

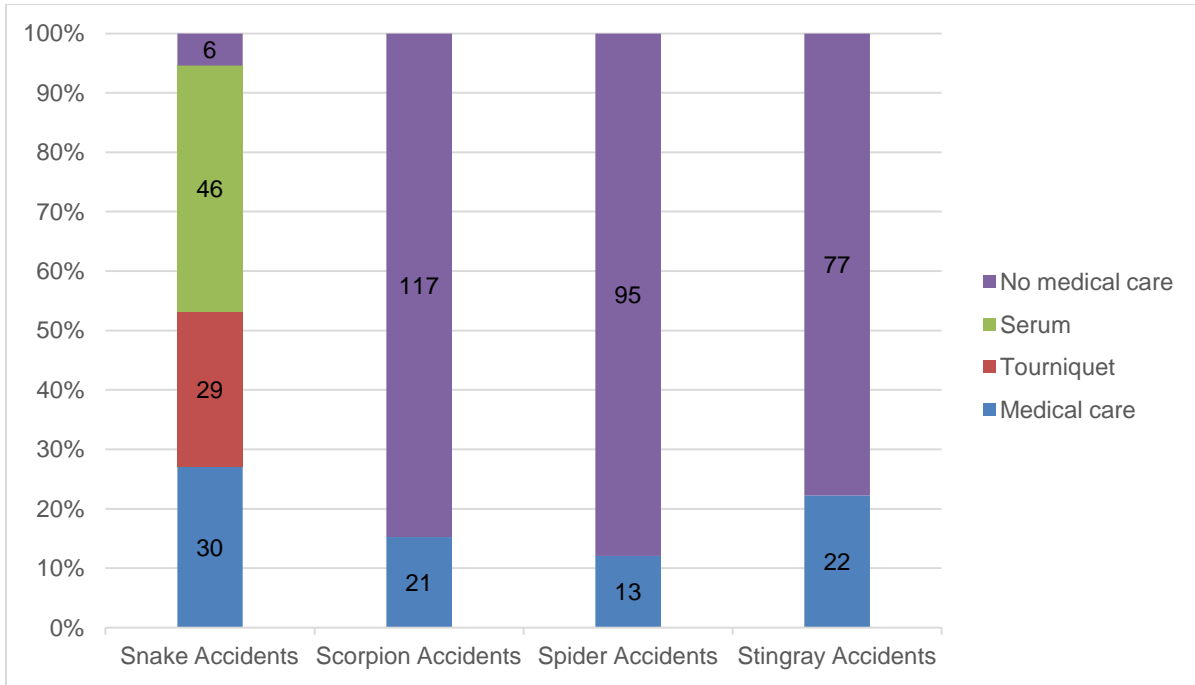


Fig. 6. Medical care bar chart

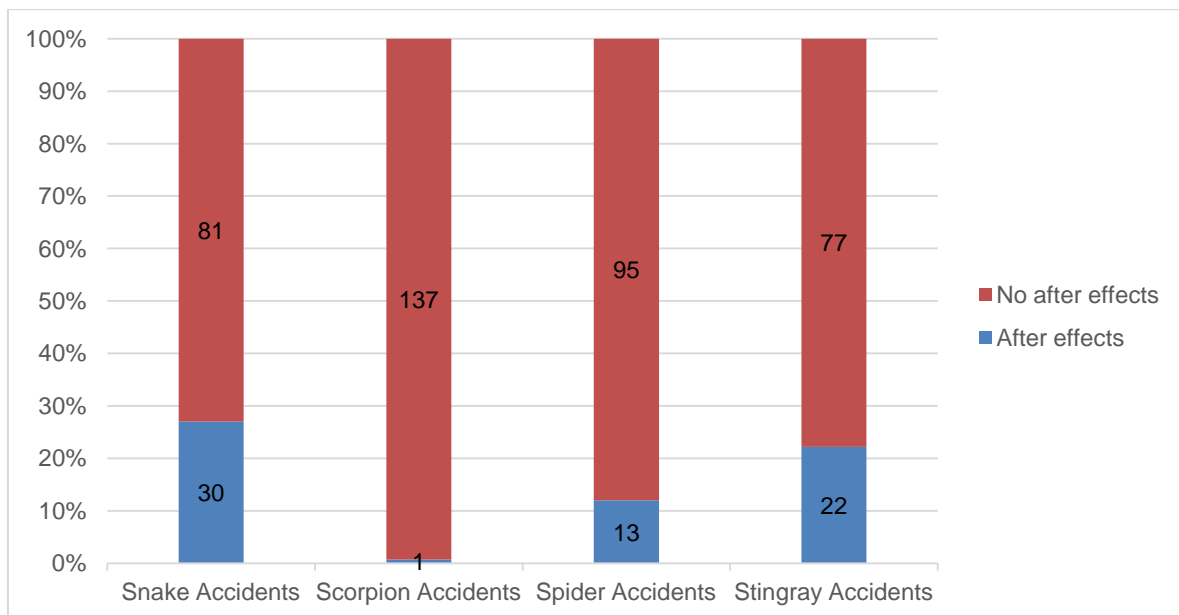


Fig. 7. After effects bar chart

#### 4. DISCUSSION

Among the traumas caused by venomous animals in Mâncio Lima, it was verified predominance of episodes in males who had a low educational level, who were ethnic brown or black, and with up to 2 minimum wages. Therefore, the less advantageous social strata.

Regarding the geographical matter, most of the interviewed reported they never lived in the rural area, however, most of the accidents occurred either in the rural or riverside regions — especially the snake ones — in which only 6% (n = 9) happened in the urban environment.

This leads us to infer that the most affected people were not rural/riverside inhabitants, but rather urban residents that frequented these locations occasionally for work.

This reality may be due to the early insertion of this group in agricultural work and rubber extraction, most likely to contribute to the increase in family income.

Taking into account the characteristics of such activities, this labor segment is more exposed to venomous animals, mainly snakes, and consequently to possible injuries. This data corroborates other studies done in Brazil northeast region and in Acre state itself [5,6] and ratifies that agricultural activity presents itself as a risk factor for the occurrence of snakebites across the globe [7].

The solution for this situation involves better education on these animals and preventive measures before urban people decide to venture into the rural area. Improving on basic Occupational Safety Health Administration (OSHA) by their employers is also an important action.

Concerning snake victims, they were stung more frequently on the lower limbs, highlighting the feet (n = 92). The rural/riverside area was the place of most accidents.

In São Paulo [8] and Campina Grande [5], they also reported that the anatomical region most frequently affected was the foot, followed by legs and hands.

Therefore, the use of specific protective equipment, such as leggings, high boots, gloves or instruments to remove debris and remove the

bush, such as hoes and shovels, could prevent about 50 to 75% of cases [5].

*Bothrops jararaca* was the most cited snake, while the main symptoms referred to were edema in the bite site, edema in the body (anasarca), and muscular pain.

Although this data contradicts a study carried out in Alto Juruá Extractive Reserve (located in the same mesoregion of Mâncio Lima) in which the predominance of accidents was found to be caused by the genus *Lachesis* [9], another study from Acre state [6] also pointed out *Bothrops jararaca* as the most involved snake.

As well, data from the Health Surveillance Secretariat (SVS) and a national level study obtained the same result [1,10].

About the areas of greatest occurrence, the same studies carried out in Acre [6,9] found that the rural area was where most of the episodes occurred.

Regarding the main symptoms, the study accomplished in Alto Juruá [9] found that pain, bleeding and edema were the most frequently mentioned, while a national bibliographic review [11] indicated only pain and edema.

In the present study, however, the causalities involving snakes were not the main responsible for poisoning. The outcome, in this case, pointed out that scorpion accidents were the most frequent (n = 227) but, just like all the others, they occurred more in males and there was a higher frequency in the rural/riverside area (n = 190).

According to other studies, in Brazil, there is, in fact, a predominance of scorpionism (60,370.8 cases per year), but higher frequency on males happens only in cases of ophidism [1,10].

On the other hand, despite our findings pointing to more accidents in rural areas and with men — 73,9% for scorpionism and 75% for arachnidism —, a national Brazilian research [10] found that scorpion and spider accidents happen the most in the urban area, inside the residences and, probably because of that, they have a similar frequency of occurrence in both genders.

The disagreement with our study — in which all types of accidents occurred more frequently in men and in rural locations — is probably due to



the male population of Mâncio Lima who, unlike the large urban population of the country, works mostly in rural activities and is more exposed to these animals than most of the local women.

Nevertheless, domestic activities, such as cleaning the house and yards and washing clothes are a big risk when it comes to exposure to spiders and scorpions [1].

Still regarding scorpionism, the hands were the most referenced body site, matching studies performed in Minas Gerais and Pará [12,13].

The same studies showed that local pain and neurological disorders, such as paresthesia and sensation of "electric shock through the body", were the main symptoms reported by the victims, coinciding with our findings of local pain and tingling.

The spider bites in Mâncio Lima, in its turn, were also mostly in the hands and presented a clinical profile, in the majority of victims, of pain and blister formation at the trauma site.

Concerning the site of the body most affected, in Minas Gerais [14] hands remained as the most exposed region but, in Goiás, the feet were a more recurrent target [3].

As for the clinical aspects, both studies [3,14] agreed that local pain and edema were the main symptoms referred to.

To control spiders and scorpions around the home, a combination of sanitation and pesticides should be effective and they can also be removed by hand (wearing gloves or trapping them in a container) or with a vacuum. Most spiders, however, are not aggressive and bite only when trapped against the skin [15].

When it comes to scorpions, they can be frightened if smoke produced by burning different materials is directed towards a scorpion hole, specifically arsenic trisulfide [16].

Finally, although accidents by stingrays were the lowest among those analyzed, the number of cases indicates a relatively high frequency in Mâncio Lima (n = 99).

Most of them occurred in the shallow part of the river with less than half of the victims claiming to have seen the animal. The region of the body most affected were the lower limbs, especially the feet (n = 94), and the most reported

symptoms were pain and bleeding at the trauma site.

Research on the clinical-epidemiological aspects of stingray accidents is still incipient, especially when it comes to freshwater stingrays, however, two studies in São Paulo found that the main symptoms reported were pain, edema, and necrosis [3], as well as bleeding [17]. The lower limbs were the site of the body mostly affected [3].

Usually, the lesions caused by stingrays are very painful and involve edema and necrosis by poison [18,19]. If not given proper first aids they can be compounded because there is a risk of severe secondary infection by microbial population related to stingray's mucus [20,21].

In the case of an eventual stingray injury, a study from Tocantins [22] reported, as the first measure, that immersing the lesion in hot water (about 45°C) by at least 60 min was efficient to denature poison proteins.

Attending the hospital service, however, cannot fail to occur after attacks by stingrays, since it is important to disinfect and clean the wound from mucus, besides taking broad-spectrum antibiotic and anti-inflammatory to control the wound development and reduce the nociceptive pain and edema [22].

Therefore, the low medical care of stingrays' accidents in Mâncio Lima (n = 77/99) is extremely worrying, because the after-effects of their injuries can be as dangerous as that of snakebites. The results of our study are proof of that (28,5% of stingrays' wounds presented after effects, while 27% of snake's had the same outcome).

## 5. CONCLUSION

Accidents by venomous animals (snakes, scorpions, spiders, and stingrays) constitute aggravation of great medical and public health interest, considering the possible number of hospitalizations and the risk of death.

In Mâncio Lima, there was a severe frequency of envenomation in the population, specifically in low-income brown/black male rural workers with low educational level.

Out of all animals' accidents studied, the lower limbs were the anatomical region most affected, being pain and edema in the body site the main symptoms reported by the victims.

To make matters worse, collected data pointed out that the region presents low demand for hospital care and reduced use of antivenom serum.

In the face of this reality, a counteraction is required with public health measures that protect the inhabitants of the region, offering greater hospital care and wide application of serum for everyone who needs it. It is also important to educate rural workers on venomous animals and preventive measures to avoid accidents.

## CONSENT

As per international standards, the patient's written consent has been collected and preserved by the author(s).

## ETHICAL APPROVAL

All authors hereby declare that all experiments have been examined and approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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