

Ethnoherpetology and snakebites in a risk area in Northeast Brazil

Mikaelle Kaline Bezerra da Costa

Universidade Federal do Rio Grande do Norte Centro de Biociencias

Rômulo Romeu da Nóbrega Alves

Universidade Estadual da Paraíba

Julio Alejandro Navoni

Instituto Federal de Educacao Ciencia e Tecnologia do Rio Grande do Norte

Eliza Maria Xavier Freire (✉ elizajuju1000@gmail.com)

Universidade Federal do Rio Grande do Norte <https://orcid.org/0000-0001-9486-6347>

Research

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Abstract

Background

Ethnozoology comprehends human interactions with animals, including their knowledge, meaning, and use by societies. In this sense and from the point of view of the human relationship with snakes, this study had the objectives to describe and analyse the level of Ethnozoological knowledge of snakebite accident victims in the semi-arid region of Northeast Brazil.

Methods

The accident records were accessed through case notifications registered in the SINAN between 2007 and 2016 in the Borborema Potiguar Microregion of Rio Grande do Norte State, specifically in the municipality of Santa Cruz, which was identified as a risk area. An effort was made to locate the snakebite accident victims during this period. Next, a semi-structured questionnaire was applied through an interview to identify the characteristics of the accident, record the victim's perception of the snake and the accident, their daily life, as well as positive and negative attitudes towards snake conservation and knowledge about species. Information about the possible uses of traditional treatment, allopathic care characteristics along with the symptoms and sequelae resulting from the accident were also recorded.

Results

The most relevant characteristics detected in these accidents were the strong influence of myths about traditional treatment and the knowledge about identifying common snake species in the region. No perception was detected about the importance of these animals, but there were negative attitudes when finding a snake, thus constituting facts which may be related to the deficiency in the education level of this population which is interfering in environmental and public health issues.

Conclusion

Work on improving the knowledge and local perception could subsidize actions and policies aimed to prevent accidents, demystify snakes and contribute to the conservation of the species.

Introduction

People and snakes have been interacting for millennia, virtually everywhere they coexist [1, 2, 3, 4], which is reflected in a series of interactions involving utilitarian, symbolic and conflicting aspects between humans and snakes [4, 5, 6, 7, 8, 9, 10, 11, 12]. Conflicts with snakes are mainly motivated by the fact that they eventually attack domestic animals and pose risks to human life [13, 14]. The death of humans associated with snakes is certainly one of the main factors which provokes aversion by most people to these animals, generally resulting in the indiscriminate slaughter of snakes when found [6, 7, 8]. Associated with this, there is a "bad reputation" of snakes which have inspired many myths, tales and sayings which often stimulate negative human attitudes towards these animals [2, 6].

Snakebite accidents are a public health problem which frequently occur all over the world, especially in tropical and subtropical regions [10], and Brazil illustrates this situation well. There is an average of 28,000 snakebites per year in Brazil, with 25% of them occurring in the Northeast region of the country. According to the epidemiological study conducted by Da Costa et al. [15], 3,909 cases of snakebites occurred between 2007 and 2016 in the state of Rio Grande do Norte, mainly involving snakes of the *Bothrops erythromelas* species (Caatinga lancehead - jararaca).

Epidemiological follow-up facilitates understanding a particular problem and the management of related risks. For example, in the distribution of inputs for providing care of victims, adequate availability of specific anti-venom serums, and in the direction of accident prevention activities. In addition, it is necessary to understand the interactions and perception of victims of snake accidents with snakes, highlighting the context in which accidents occur [15, 16, 17]. In this context, ethno-herpetological studies are important because they can contribute with relevant information to support creating accident prevention tools and to develop snake conservation strategies.

Ethno-zoological research has been intensifying around the world [18, 19, 20, 21] and in Brazil [22] in recent years, especially considering its importance for conservation [23]. Ethnozoological research and more specifically ethnoherpetological research [5, 7, 24, 25, 26] has been revealing the utilitarian value of snakes, but mainly showing that they are a target of people's dislike and are therefore frequently slaughtered [6, 8]. In view of this scenario, the present study is the first to investigate snake accidents and people in Brazil from an ethnozoological perspective. Thus, this study aimed to analyze the profile, attitudes and consequences of actions taken in confronting snakebites in areas endemic to this type of accident. More specifically, we aim to: i) identify and analyze the profile of the population of snakebite victims; (ii) analyze the perception of the victims through attitudes and knowledge in relation to the snake species occurring in the region; (iii) assess the impact on public health resulting from the population's behavior in initial moments after the accident; (iv) describe the possible impacts of the perceptions and attitudes of the victims on the conservation of snake species.

Method

Study area

This study was carried out in the municipality of Santa Cruz, the most populous city in the Borborema Potiguar microregion and one of the most affected by snakebites in the state of Rio Grande do Norte (RN), with maximum accident rates and an incidence of 450 cases/100,000 inhabitants in this micro-region, according to a study carried out by the same authors of this work [15] (Fig. 1).

The municipality of Santa Cruz, RN, presents relief marked by residual inselbergs, wide and smooth hills [27], and a predominant semi-arid climate in an area of the Caatinga domain [28]. The total population of this municipality is 35,797 inhabitants [29], 15% distributed in the rural area and 85% in the urban area, with a demographic density of 57.33 inhabitants/km². The economy is based on agricultural activities,

mainly on temporary crops, in addition to raising goats, cattle and sheep. It is noteworthy that 16% of the 624,356 hectares of Santa Cruz territory is natural forest areas, and 55% of natural area is destined for permanent preservation or legal reserve [30], a fact which demonstrates habitat availability for different snake species.

Data collection

The sample universe of this study is composed of snake accident victims notified in the Information System for Notifiable Diseases (SINAN) in the period from 2007 to 2016, and which occurred within the geographical limits of the municipality of Santa Cruz, RN. However, 38 from the 168 registered cases were excluded for this study due to the following facts: being duplicated in the system, individuals under 18 years of age until the day of the interview, and cases notified by the municipality, but which occurred in another municipality. Therefore, the number of cases selected for this study was 130 (48 in the urban area; 82 in the rural area). Registration information and assistance from the municipality's environmental surveillance were used in order to locate the snakebite victims. Once contact was made, people were invited to voluntarily participate in the study by signing the Informed Consent Form (ICF), which was approved by the Research Ethics Committee of the Federal University of Rio Grande do Norte (CEP-UFRN; CAAE-57951516.8.0000.5537), according to Resolution 466/12 of the National Health Council (CNS).

The data collection of the accidents in the field was carried out between March and December 2017. Thus, a semi-structured form was applied during this period through an interview to describe the sociodemographic profile of the interviewed victims, and to seek information about snake accidents, perception and experiences regarding snakes, and also analyzing attitudes (positive and negative) in favor of snake conservation, in addition to knowledge about the popular names of snakes found in the region and their general characteristics. Furthermore, they were asked about the possible techniques adopted as popular treatment in case of snakebites, and the symptoms and sequelae resulting from the accident. Identification of the snakes involved in the accidents was evaluated by presenting images of snakes from the semi-arid region (Caatinga domain), available in the Educational Booklet organized by Kolodiuk et al. [31]. Information on popular name and the type of risks linked to "poisonous" (venomous) or "non-poisonous" (non-venomous) snakes was also requested.

Pearson correlations were performed to analyze the correlation between the use of popular therapy resources and the time to search for a specific treatment (serotherapy), and between the time to search for a specific treatment and the time hospitalized (in days), through the SPSS 20 statistical program.

Results

From the total snakebite accidents which occurred in the municipality of Santa Cruz/RN ($n = 130$) in the period under analysis (2007–2016), 47% ($n = 61$) of the victims were located and constituted the sample universe of this research. The others were unable to be contacted for various reasons, such as death, change of address or incomplete registration information.

Sociodemographic description of the participants

The interviewed victims ($n = 61$) were between 19 and 73 years old, making an average age of 46 years. Among these, 67% ($n = 41$) were male, and 33% ($n = 20$) were female. Regarding education, 44% ($n = 27$) declared they had no educational level, 39% ($n = 24$) had incomplete or complete elementary education, 11% ($n = 7$) incomplete or complete secondary education, 3% ($n = 2$) incomplete or complete higher education, and 2% ($n = 1$) did not report their education level.

Most of the interviewed victims (77%; $n = 47$) lived in rural areas distributed in 23 sites; the rest (23%; $n = 14$) lived in an urban area, distributed in 3 residential neighborhoods (Fig. 1). The average time living in these places was 32 years, and 61% ($n = 37$) had some professional occupation, among which 22% ($n = 8$) reported being subjected to some type of danger. Agricultural work stood out (92%, $n = 34$) among the work activities mentioned, followed by others such as pottery, trader and motorcycle/taxi driver.

The accidents reported by 61 interviewees occurred during work in the fields or in an aviary, in hunting activities in the mountains, in caring for farm animals, while cleaning their residences or surroundings, and in casual activities (watching a soccer game, walking on the side of the road). The morning period (44%, $n = 27$; Fig. 2) during agricultural activities stood out (36%; $n = 18$) for the period of the day when the accident occurred.

Accidents in the morning mainly occurred with people who performed activities which directly or indirectly involved growing plants or caring for domestic animals (63%, $n = 17$). Regarding the weather on the day of the accident, the participants classified it as dry (it was not raining, or no recent rain), or rainy (it was raining, or there was recent rain). According to these characteristics, 67% ($n = 41$) described the climate as dry, and 33% ($n = 20$) as rainy.

Characterization of the accidents

Anatomical region of the snakebite

The region of the body most injured by the snakes was that of the lower limbs, mainly the feet 75% ($n = 46$; Fig. 3).

Symptoms described by the victims linked to the accident

Local pain (22%, $n = 22$) and bleeding (13%, $n = 13$), mainly in the gums (Fig. 4) were among the symptoms described right after the snake bite ($n = 99$).

Attitudes and knowledge about snakes and snakebites

When asked about their attitude towards the snake after the accident, 74% ($n = 45$) of the interviewees claimed to have killed it, 20% ($n = 12$) did not see the snake, and 6% ($n = 4$) let the snake go. Of those who reported having killed the snake, 33 (73%) were men and 12 (27%) were women. Regarding what was

done with the dead snake, 16 (36%) did not answer; 14 (31%) took them to the hospital; 13 (29%) left the snake dead at the accident site; and 2 (4%) burned the snake.

Of the snakes involved in the accidents, 10% ($n = 6$) were not seen by the victim and the clinical laboratory data did not identify them as accidents by venomous species. A total of 10% ($n = 6$) of the cases were attributed to venomous species, with the following being classified as the possible species involved: Caatinga lancehead (jararaca; *Bothrops erythromelas* – 83%, $n = 5$) and one (17%) green snake (corre-campo; *Philodryas nattereri* Steindachner, 1870). The remaining cases (80%; $n = 49$) were viewed by the victims and/or taken to the hospital for possible identification. Among these, 94% ($n = 46$) was caused by the Caatinga lancehead (Jararaca) and 6% ($n = 3$) by the species identified as Salamanta, Coral and Cascavel. Considering the knowledge related to snakes, the victims (80%, $n = 49$) classified them in relation to size as small (30 to 40 cm in length – 71%, $n = 35$); medium (40 to 50 cm – 20%, $n = 10$); and large (over 50 cm – 8%, $n = 4$). Salamanta, Coral and Cascavel were all classified as small. Those observed and classified Caatinga lanceheads ($n = 46$) mostly presented a size classified as small (69%; $n = 32$); the others (22%; $n = 10$) as medium; and 9% ($n = 4$) as large. According to 66% ($n = 40$) of the participants, snakes are animals which are easily found in the researched area; each of these cited at least three popular names referring to snakes, totaling 120 citations. Of these, the most cited by the participants with 33% ($n = 39$) was the Caatinga lancehead (Jararaca; Table 1).

Family	Vernacular name	Scientific name	Total number of citations	%
Boidae	Cobra-de-veado	<i>Boa</i>	1	1
Gray, 1825		<i>constrictor</i>	Linnaeus, 1758	
	Salamanta-boi	<i>Boa</i>	7	6
		<i>constrictor</i>	Linnaeus, 1758	
Colubridae	Cobra-cipó	<i>Oxybelis aeneus</i> (Wagler, 1824)	3	3
Oppel, 1811	Boipeva	<i>Xenodon</i> <i>merremii</i> (Wagler, 1824)	1	1
	Cobra-preta	<i>Pseudoboa</i> <i>nigra</i> (Duméril, Bibron e Duméril, 1854)	3	3
	Surucucu	<i>Pseudoboa</i> <i>nigra</i> (Duméril, Bibron e Duméril, 1854)	2	2
	Corre-campo	<i>Philodryas</i> <i>nattereri</i> Steindachner, 1870	24	20
	Cobra-verde	<i>Philodryas</i> <i>olfersii</i> (Lichtenstein, 1823)	3	3
	Coral		18	15
Elapidae	Boie, 1827	<i>Micrurus</i> sp. (Merrem, 1820)		

Family	Vernacular name	Scientific name	Total number of citations	%
	Cascavel	<i>Crotalus</i>	15	13
Viperidae		<i>durissus</i> (Linnaeus, 1758)		
Laurenti, 1768				
	Jararaca/Jararaca-do-rabofino/Jararaca-malha-de-cascavel	<i>Bothrops erythromelas</i> (Amaral, 1923)	39	33
Amphisbaenidae	Cobra-de-duas-cabeças*	<i>Amphisbaena sp.</i>	4	3
Total			120	100

*Although it is an Amphisbaenidae, the two-headed snake (cobra-de-duas-cabeças), the citations were kept because they express the knowledge of the participants.

Table 1 - Family, scientific name, vernacular name of the snakes cited by the interviewees and number of citations for each species found in the municipality of Santa Cruz/RN [14; 15, 16].

Regarding the feeling and/or reaction expressed by the interviewees when they found a snake ($n = 61$), fear/panic and the killing reaction were mentioned, which added up to 60% ($n = 35$) (Fig. 6); most of these were reported by men ($n = 21$, 60%). One party mentioned a reaction to escape (10%, $n = 6$), a fact considered positive because it prevents the death of the snake and thus contributes to its preservation.

All respondents stated that snakes are threats to domestic animals, 33% ($n = 20$) of these said they had at least one animal, whether this was bred for food or as a pet, and 45% ($n = 9$) of these stated that they already had some of their animals attacked by a snake, and in all these cases they had died (Fig. 7).

Of the nine species of common venomous and non-venomous snakes from the Caatinga presented to the participants through the images contained in the educational booklet, the one they most easily identified was the Caatinga lancehead (Jararaca), totaling 42 citations. The ones they found the most difficult to identify were the liana snake and Boa constrictor (salamanta-boi), with only one citation for each one.

Regarding the total number of correct classifications ($n = 113$), the *Bothrops erythromelas* species, popularly named Caatinga lancehead (Jararaca, Jararaca-Malha-de-Cascavel or Jararaca-do-rabo-fino), obtained the highest percentage of correct answers (33%, $n = 37$); being a common species in the studied region (Table 2).

Table 2

Classification of common snakes in the northeastern semiarid: popular name and potential cause of snakebites (recognition if it is poisonous or not), according to the knowledge of the victims ($n = 61$), followed by the percentage of correct answers in relation to the recognition of the species of snake.

Vernacular name	Scientific name	Is it poisonous?			Correct % (n)
		Yes	No	Did not know	
		n	n	n	
Cascavel	<i>Crotalus durissus</i> (Linnaeus, 1758)	21	1	38	19% (21)
Cobra-de-cipó	<i>Oxybelis aeneus</i> (Wagler, 1824)	0	1	59	1% (1)
Cobra-preta ou surucucu	<i>Pseudoboa nigra</i> (Duméril, Bibron e Duméril, 1854)	0	5	55	4% (5)
Cobra-verde	<i>Philodryas olfersii</i> (Lichtenstein, 1823)	0	2	58	2% (2)
Coral	<i>Micrurus sp.</i> (Merrem, 1820)	18	2	40	16% (18)
Corre-campo	<i>Philodryas nattereri</i> Steindachner, 1870	0	23	37	20% (23)
Jararaca*	<i>Bothrops erythromelas</i> (Amaral, 1923)	37	5	18	33% (37)
Jiboia ou cobra-de-veado	<i>Boa constrictor</i> Linnaeus, 1758	0	1	59	1% (1)
Salamanta	<i>Epicrates assisi</i> Machado, 1945	0	5	55	4% (5)
Total					100% (113)

*Jararaca, Jararaca-malha-de cascavel ou Jararaca-do-rabo-fino

Treatments and sequelae

All respondents sought medical assistance to carry out the specific treatment after the snakebite for which they were victims, but some of them (20%, $n = 12$) sought the hospital only after using or ingesting medicinal or popular/homemade therapeutic resources. Use of analgesics (8%, $n = 1$), water (8%, $n = 1$), pinhão-roxo milk (17%, $n = 2$), partridge feather tea (*Nothura* sp.) (17%, $n = 2$), fumo de rolo tobacco (a product derived from the *nicotiana* genus) (25%, $n = 3$), or milk from domestic animals (25%, $n = 3$). The pinhão-roxo milk (*Jatropha gossypifolia*) was extracted directly from the green branches of the pinhão-roxo, which were broken, and its sap sucked. The tobacco was chewed by the victim and its saliva was

deposited in the injured spot by the snake; then the place was tied with a piece of fabric. Animal milk was taken pure, as it was believed that it served to "cut"/neutralize the effect of the poison.

The length of time the victims claimed to have sought medical assistance was 1 to 48 hours after the accident. It was found that the people who delayed the search for specific treatment were mainly those who used a popular treatment (Pearson = -0.342, p = 0.008). However, there was no significant correlation between the time to seek medical care and the number of days hospitalized (Pearson = 0.011, p = 0.933).

Most of the interviewees (85%, n = 52), stated that they did not know what the serum used in cases of snake accidents is made of. From the 9 (15%) respondents who said they knew what is used for the production of anti-venom serum, 8 (89%) of these reported that snake venom is used, and only 1 (11%) said horse blood.

From the interviewees, 34 (56%) did not know the nearest place where they could find the serum, and 27 (44%) stated that the local hospital (Hospital Regional Aluízio Bezerra) is the place to get serums against snake poison. Among the victims who claimed to still have symptoms related to the snake accident (n = 9, 15%), 3 (33%) said they felt a headache and believe that the pain is due to the snake poisoning, and that not only the headache, but all other symptoms are intensified during the full moon phase.

Discussion

Snakebite accidents in the surveyed area mainly affect people who work in agricultural activities, as evidenced by the professional profile of the interviewed victims. This reality is not surprising, following a trend registered in other places with a high frequency of snakebites [32, 33, 34]. Agricultural activity increases the risk of encounters with snakes, especially in areas where deforestation is intense and there are few remnants of native vegetation, such as in areas of the Brazilian semi-arid region [35], which forces snakes to seek shelter and food in crops agricultural products. Although snake accidents occurred in all periods of the day, they mainly stood out in the morning, which coincides with the period when the population is most active in exercising their agricultural work activities, and also the activity period of most snakes of the Caatinga. The Caatinga lancehead "jararaca" (*Bothrops erythromelas*), which was most involved in snake accidents [15], presents greater activity during the night, however it can easily be found at rest sheltered on substrates, decomposing tree trunks, debris, and dense vegetation, among others [36]. In addition, the lancehead has wide geographic distribution, being observed in several areas in both open formations and those with greater plant density, and even in anthropized areas [37, 38]. All this brings human beings closer to the local snakes, which can increase the probability of occasional encounters with these animals.

Regarding the weather during the accident, the victims stated that it was predominantly dry with no recent rains, which is typical of semi-arid regions, including the surveyed area. The Brazilian semi-arid region, especially the Caatinga, is a region with little rainfall and home to a great diversity of snakes [38, 39, 40]. It is worth mentioning that studies indicate that the increase in temperature favors the movement of snakes to anthropized areas in search of shelter and food [41], which may justify the cases which occurred inside or outside homes during the performance of domestic activities.

Most of the victims interviewed in this study were bitten by small snakes (20 to 30 cm in length), mainly being injured in the foot region, and claimed to experience mainly local pain, and in some cases followed by bleeding. These symptoms and signs are common in cases of accidents involving lanceheads "jararacas" (*Bothrops*). The region most bitten in these accidents is the lower body; adult snakes reach the leg, while the young ones usually bite the foot region [42, 43]. Among the main poison actions of the *Bothrops* species (lanceheads), proteolytic, coagulant or hemorrhagic actions stand out, and the most common symptoms are those which are expressed at the bite site such as pain, inflammatory edema, and there may be changes in blood coagulation if it involves an adult snake [43, 44, 45]. This type of accident can be avoided if the population is aware of the importance of using personal protective equipment such as high boots and gloves, but the victims reported that they only started to wear boots after suffering the accident, and even then there are days that they think they do not need to use them. The use of high boots can prevent about 85% of cases of Bothropic poisoning.

The low level of education of most victims is a worrying fact, as it can negatively impact proper treatment of the accident for their health and animal protection [46]. Deficiency in the knowledge level of snakes in rural areas about snakes is common, and errors in the identification of really poisonous species and consequent snake death may be related to limited knowledge about them [47]. This limitation may be due both to the need to prioritize work in the field, even among young people, and because the school system is unable to address issues related to the needs of this population.

Attitudes and traditional knowledge on snakes

The slaughter of snakes involved in accidents was the attitude adopted by most victims in the surveyed area, whenever possible. This attitude is common even among people who are not snakebite victims in view of the potential risk of accidents and the strong aversion towards these animals in the Brazilian semi-arid region [6] and other regions of Brazil [8, 48]. Most of the victims interviewed in the researched area even take the slaughtered snake to the hospital in order to help identify the animal; a situation which can help in the treatment, but on the other hand it encourages slaughtering the animals. The attitude of burning the dead snake reported by some interviewees can be attributed as an act to eliminate the "evil", to end the "danger" that snakes represent for most people [6, 8]. However, from an ecological perspective it should be noted that the slaughter of snakes contributes to an imbalance in the trophic chains and the return of some pests such as the bubonic plague, for example. In addition, causing the death of wild species, either for food or because they threaten livestock, domestic animals or human life, contributes to species extinction [13, 14]. From an epidemiological point of view, when approaching a snake with the intention to kill it, people put themselves at risk for a new accident in facing a natural reaction of the animal when trying to defend itself from a threat [17]. The attitudes of the interviewees often reflect the victim's lack of knowledge of the main morphological characteristics of local snakes which help to differentiate venomous from non-venomous ones, and the belief in myths which associate the image of the snake with danger [2].

Traditional treatment

All victims interviewed during this study sought a hospital to receive the necessary treatment. However, during the interviews eight of the victims revealed that they had suffered more than one accident, and that these occurred approximately 30 years ago, and only used traditional therapy resources as treatment. The population used only charms, rituals and resources from traditional medicine to cure snake poisoning when anti-venom serum was not available [48].

The most common of the resources used in treating the cases was to consume milk from pinhão-roxo, which is latex from *Jatropha gossypifolia* extracted directly from the plant branches. This belief of the pine nut milk came from the behavior of the tegu (*Salvator merianae*), lizard which seeks to bite the top of the pine nut when confronted with a venomous snake, and manages to consume more without dying from the effect of the snake's poison, as highlighted in an excerpt from an interviewee's testimony: "If a tegu runs to bite the top when bitten by a snake and doesn't die, I won't die either" (Female, 22, 57 years old). This report corroborates what was recorded by Costa-Neto [49] during a survey of traditional knowledge about the *Salvator merianae* species (Tegu, teiú); in this, the participants reported about the fight between a rattlesnake (cascavel) and the tegu in which the lizard bites the root of a plant known to them as potato-of-tegu, and then returns to win the fight.

The therapeutic properties of pinhão-roxo (*Jatropha gossypifolia*) have been studied, as its substrate seems to have bactericidal action among its effects [50, 51]. In addition, it is believed that this substrate may assist in the treatment of poisoning by *Bothrops erytromelas* in the future, considering that this species is not included in the polyvalent anti-venom compound currently used to treat snakebites in Brazil; this includes poisons from five *Bothrops* species in its manipulation (*B. jararaca*, *B. jararacussu*, *B. alternatus*, *B. neuwiedie*, *B. moojeni*) [52]. However, the indiscriminate use in traditional medicine of pinhão-roxo substrates is discouraged, as there is a potential risk added to its benefits [51], as some medicines used in traditional medicine can bring problems to the health of its users [53]. The Ministry of Health in Brazil warns that this and other types of traditional treatment can aggravate the case, emphasizing that specific clinical treatment is the only guarantee of success in the evolution of the case [54].

Conclusion

This assessment of ethno-herpetological knowledge from snakebite accident victims is innovative, and also made it possible to reinforce the fact that agricultural activity increases the risk of encounters with snakes and consequently of accidents during the morning period when people are more active in their agricultural work. In addition, although the majority of accidents occurred with Caatinga lanceheads "jararacas" (*Bothrops erythromelas*, endemic to the Caatinga), a nocturnal species, it is commonly found in terrestrial substrates during the day; a fact which facilitates the occurrence of accidents. The low education level of most victims can have a negative impact on both the proper treatment of the accident to favor public health and the animal's protection, as well as causing errors in the identification of really poisonous species, and the consequent death of non-poisonous snakes. Additionally, killing the snakes involved in accidents was the attitude adopted by most victims, which is common even among people

who are not victims of snakebites due to the potential risk of accidents and the great historical aversion to these animals. This fact, in addition to contributing to the imbalance of the trophic chains and the return of some pests increases the mortality of wild species, contributing to extinctions. Although all victims interviewed sought hospital care for proper treatment, some had suffered more than one accident, and in the first only used popular therapy about 30 years ago, with the most common being the consumption of *Jatropha gossypiifolia* milk; it is possible that this substrate may contribute to treating snakebites by *Bothrops erytromelas* in the future, since this species is not included in the polyvalent anti-venom serum currently used in snakebite treatment in Brazil.

Declarations

Consent for publication

We declare that the Informed Consent Term approved by the referred Ethics Committee of the Federal University of Rio Grande do Norte was applied to all research participants. If necessary, we can make it available.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

MKBC, the first author participated in the preparation of research, data collection, data analysis, interpretation of data, writing of the article and review; RRNA second author participated of the writing and revision of the article; JAN third author participated of the analysis and interpretation of data; EMXF fourth author guided all steps, participle of writing, review and submission.

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Figures

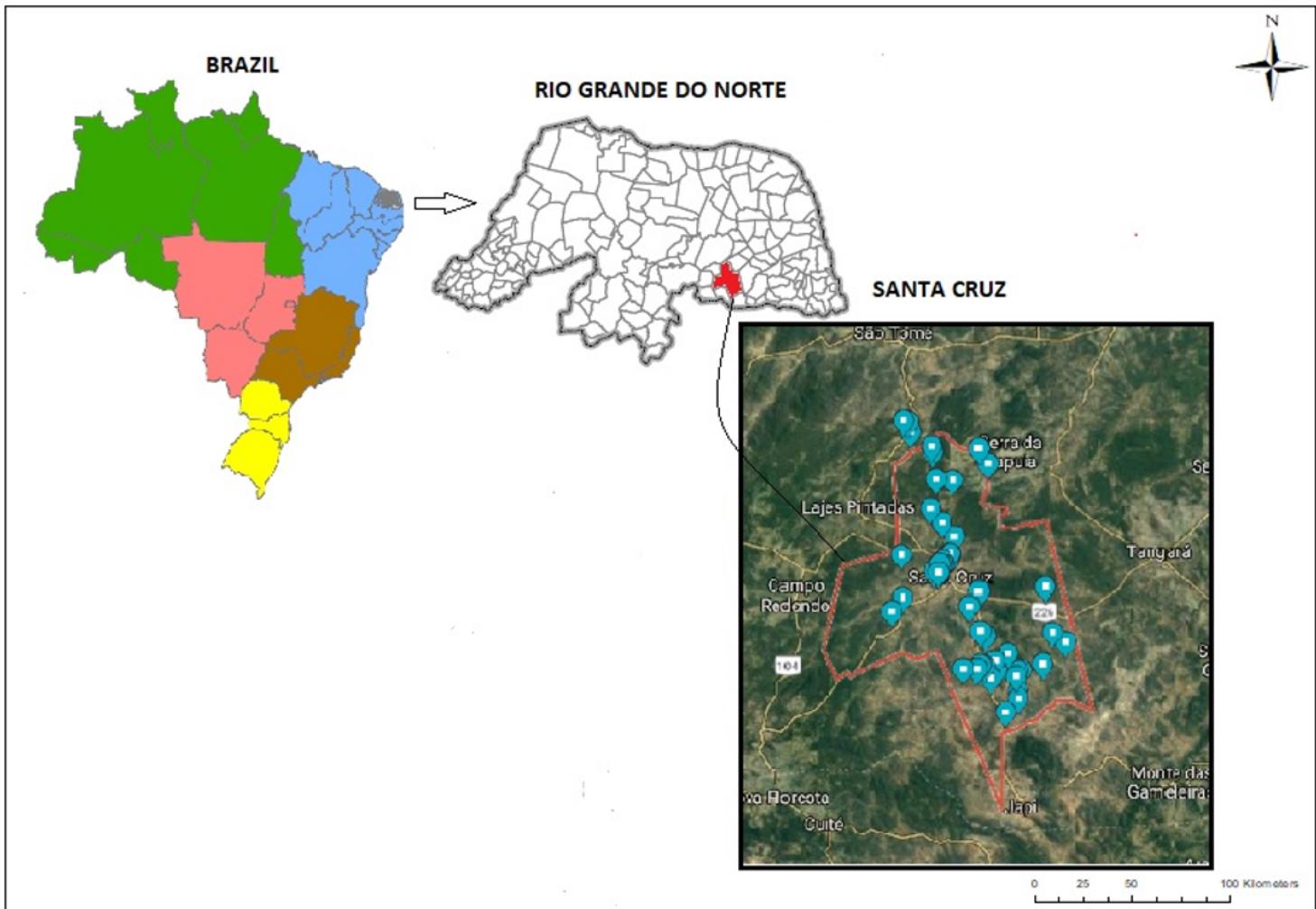


Figure 1

Location of the municipality of Santa Cruz, Rio Grande do Norte, northeast region of Brazil. Highlighted blue dots to the right of the map are the locations where the victims were located and interviews were conducted between March and December 2017.

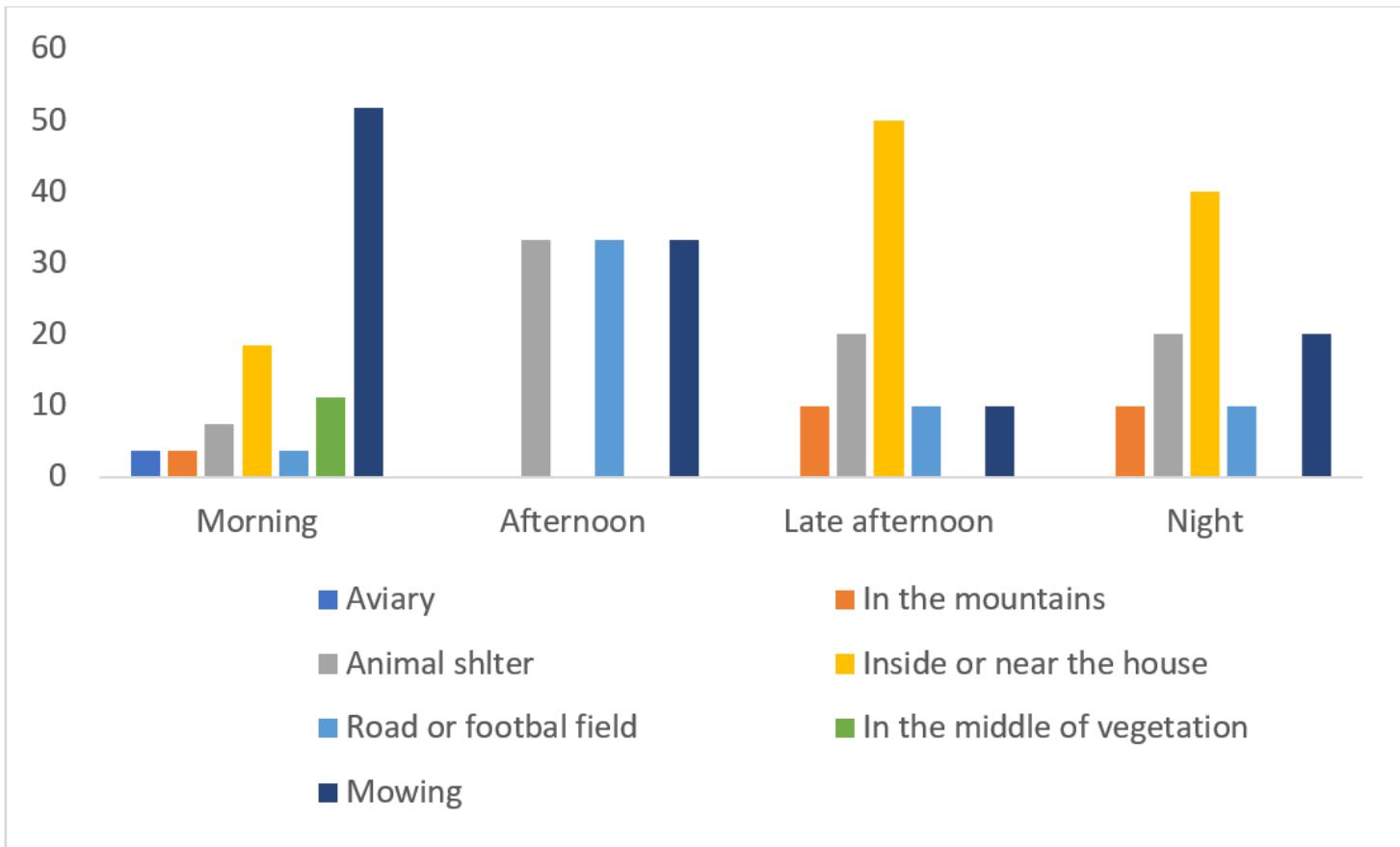


Figure 2

Period of the day (axis x); Distribution (%) of the victims by accident location. Periods of the day in which accidents occurred and distribution of victims by places of occurrence. Data collected between March and December 2017.

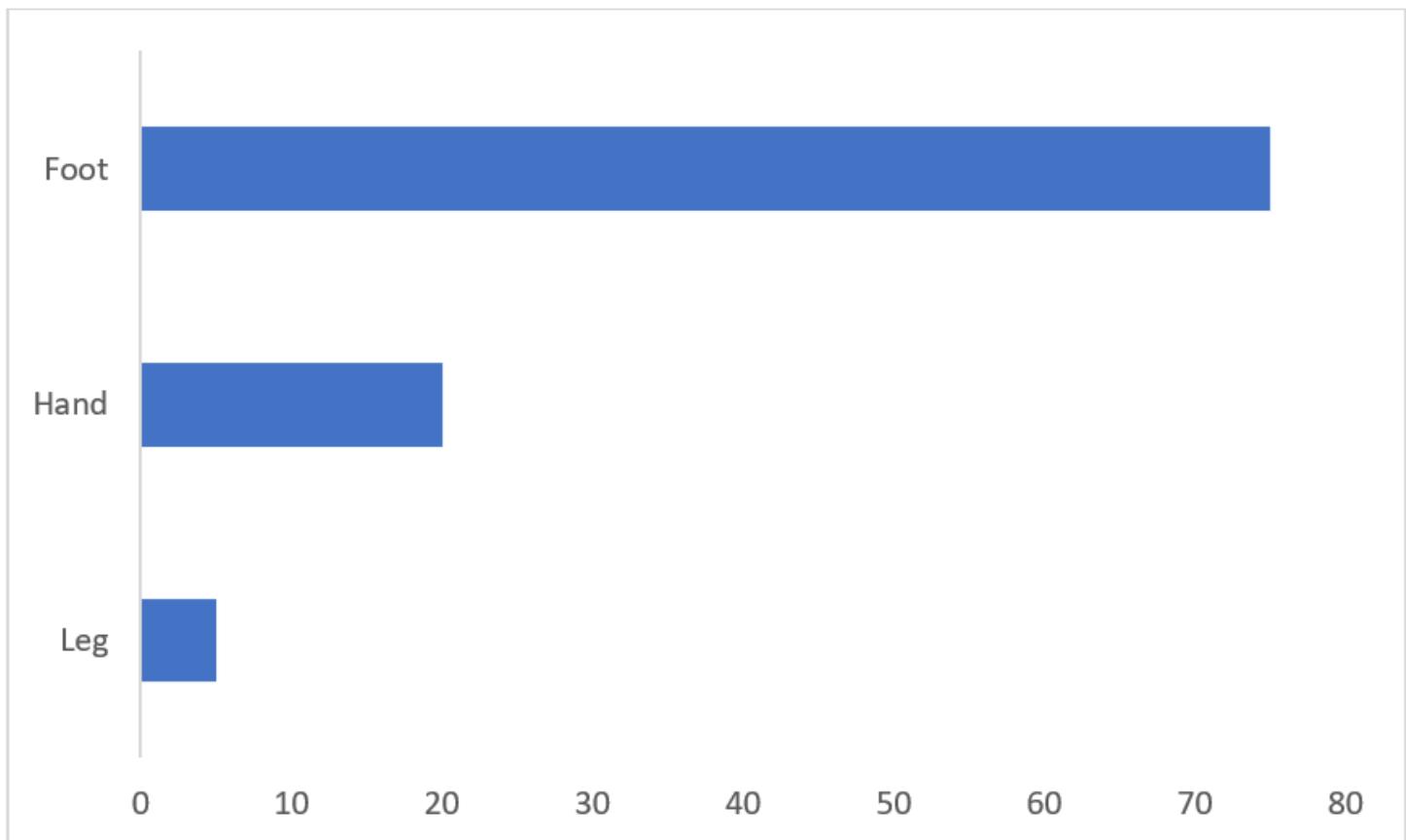


Figure 3

% of snake accidents (axis x); Anatomical region of the snakebite (axis y). Distribution of snakebite accidents ($n = 61$) by anatomical region affected by the bite. Data collected between March and December 2017.

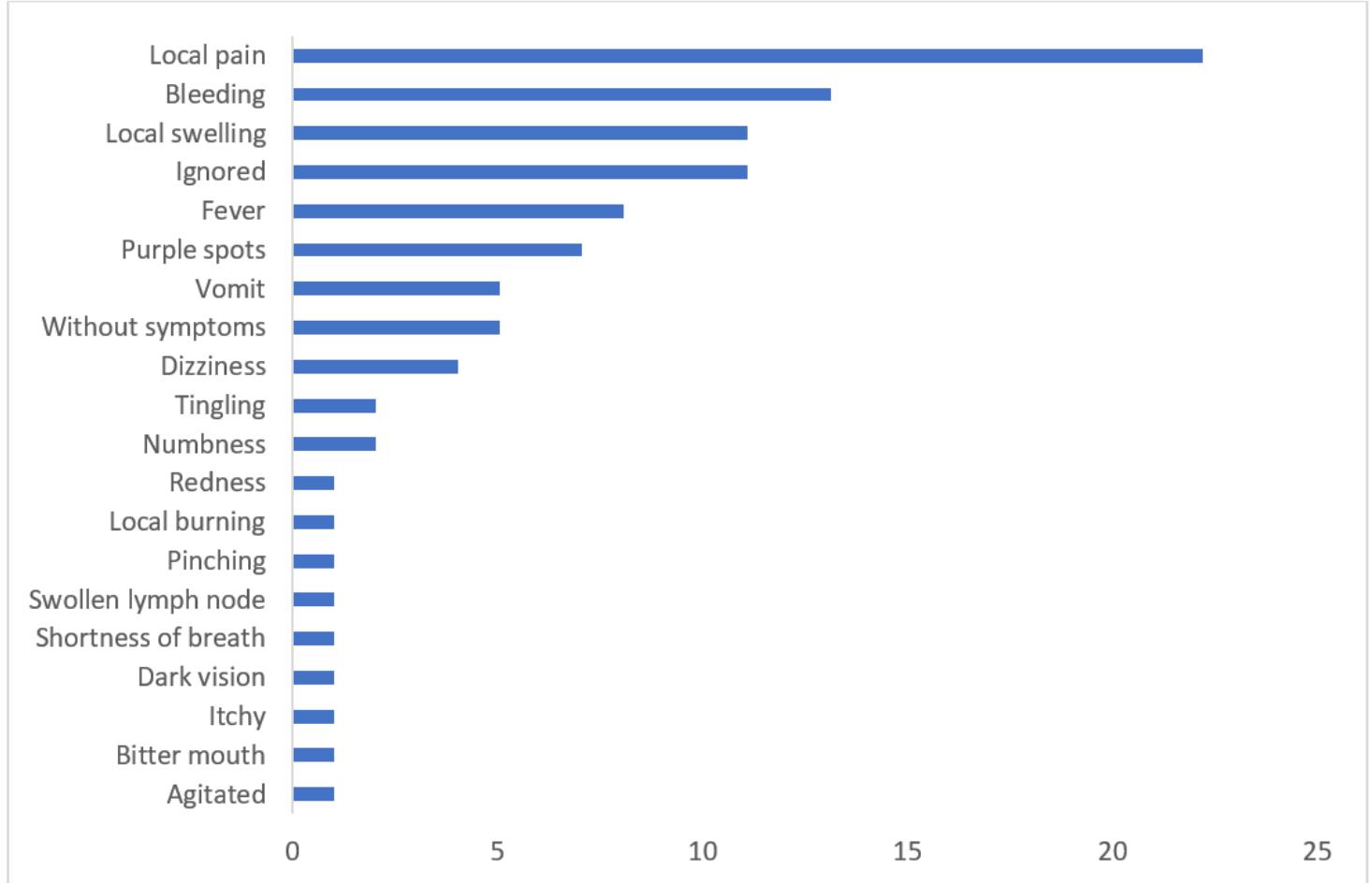


Figure 4

% of symptom manifestations (axis x); Described symptoms (axis y). Description of symptoms and manifestations shortly after the snakebite accident according to the interviewed victims. Data collected between March and December 2017.



Figure 5

Snake species cited by respondents in the study area (Santa Cruz, Rio Grande do Norte), from March to December 2017. *Boa constrictor* (A), *Oxybelis aeneus* (B), *Xenodon merremii* (C), *Pseudoboa nigra* (D), *Philodryas nattereri* (E), *Philodryas olfersii* (F), *Micrurus ibiboboca* (G), *Crotalus durissus* (H), *Bothrops erythromelas* (I), *Amphisbaena almae* (J) - cobra-de-duas cabeças (*Amphisbaenia*), considered by locals to be a snake. Photos: Matheus Meira (C), Raul Sales (E,J), Willianilson Pessoa (A, B,D,F,G,H,I).

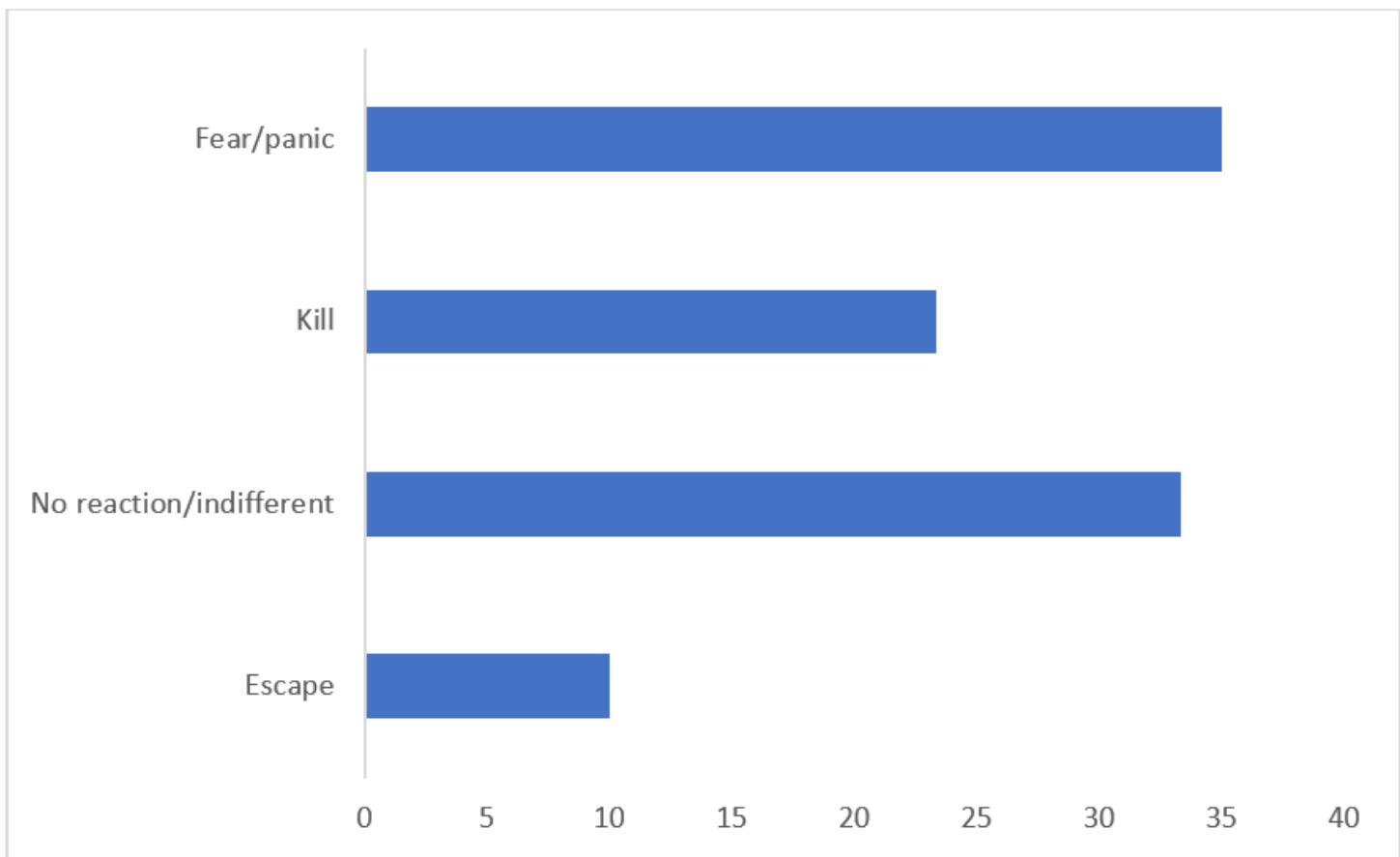


Figure 6

% of the population (axis x); Feelings/reactions (axis y). Description of the attitudes of the victims when encountering a snake. Data collected between March and December 2017.

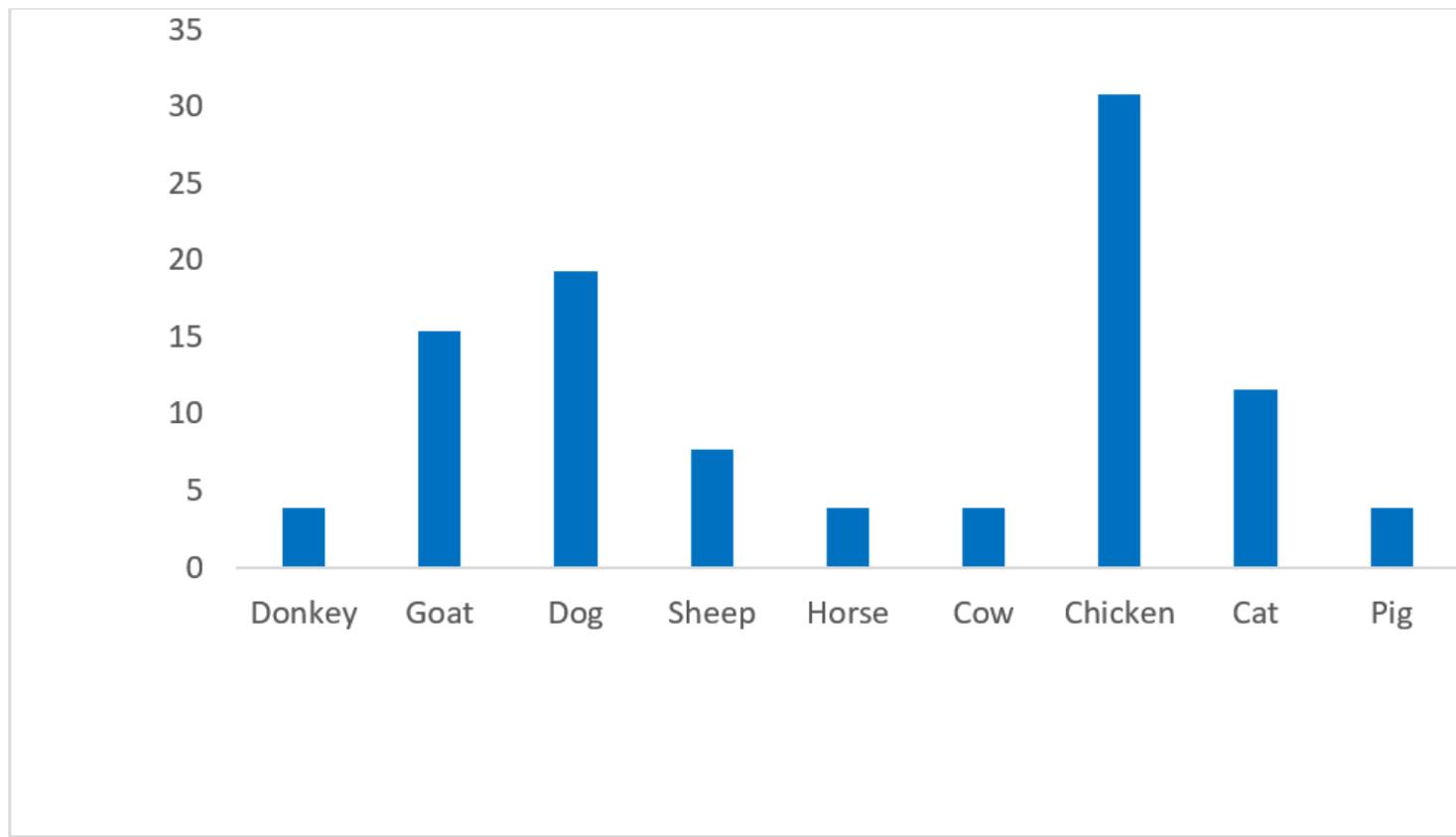


Figure 7

Domestic animals (axis x); % of snakebite accidents (axis y). Description of livestock/pets belonging to the victims who were bitten by snakes and died. Data collected between March and December 2017.