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ORIGINAL ARTICLE

Venomous Animals of State of Piauí: Epidemiology of Accidents and List of Medical Importance Species

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RESUMO

Animais peçonhentos do estado do Piauí: epidemiologia dos acidentes e lista de espécies de importância médica. Os casos de envenenamentos aumentaram consideravelmente no Brasil, no entanto, para o estado do Piauí apenas dois estudos foram realizados até o momento. Aqui, investigamos, através dos formulários de notificação, as características epidemiológicas dos casos de envenenamentos ocorridos durante 11 anos na macrorregião de Picos, estado do Piauí, Nordeste do Brasil. Além disso, também verificamos se as espécies registradas nos formulários de notificação correspondem às espécies que ocorrem na região. Registramos 1.249 casos de envenenamentos, sendo 41% causados por escorpiões, 35% causados por serpentes e 24% causados por aranhas. Na maioria dos casos (aracnídeos = 99%, escorpiões = 93%, serpentes = 52%) não houve a identificação da espécie causadora do acidente. A maioria das vítimas dos acidentes (66%) eram indivíduos do sexo masculino entre 18 e 24 anos de áreas rurais, picadas durante atividades de campo na estação chuvosa (janeiro a março). Os locais de lesão mais comuns foram os membros inferiores (37%) e a maioria (53%) dos acidentes foi do tipo leve. Este é o primeiro estudo que reporta o perfil epidemiológico de uma série de envenenamentos (incluindo aracnídeos e serpentes) durante 11 anos de ocorrência no estado do Piauí. Além disso, também apresentamos a primeira lista de espécies de aracnídeos e serpentes de importância médica para o estado. Nossos resultados demonstram que houve uma alta incidência de acidentes por animais peçonhentos na região centro-sul do estado, a maioria dos registros não foi notificada no SINAN, a maioria dos registros não apresentou a identificação das espécies responsáveis pelo acidente, e há registros cujas espécies foram identificadas incorretamente.

Palavras-chave: Araneísmo, Envenenamento humano, Escorpionismo, Picadas de serpentes, Saúde pública.

ABSTRACT

Cases of poisoning have increased considerably in Brazil, however for state of Piauí only two studies were carried out so far. Here, we investigated, through the notification forms, the epidemiological characteristics of cases of poisoning that occurred during 11 years in a macro-region of Picos, state of Piauí, Northeastern Brazil. Furthermore, we also check whether the species recorded in the notification forms correspond to the species that occur in the region. We recorded 1.249 cases of envenomations, being 41% caused by scorpions, 35% caused by snakes and 24% caused by spiders. Most cases (arachnids = 99%, scorpions = 93%, snakes = 52%) there was no identification of species causing the accident. Most of the victims of the accidents (66%) were male individuals between 18 and 24 years from rural areas, stung during field activities in the rainy season (January-March). The most common injury sites were the lower limbs (37%) and the majority (53%) of the accidents was the mild type. This is the first study that reports the epidemiological profile of a series of envenomations (including arachnids and snakes) during 11 years of records in the state of Piauí. Furthermore, we also present the first list of species of arachnids and snakes of medical importance to the state. Our results demonstrate that there was a high incidence of accidents by venomous animals in the Center-South region of the state, most of the records was not notified in SINAN, most records does not present the identification of the species responsible for the accident, and there are records whose species was incorrectly identified.

Keywords: Araneism, Human envenomation, Scorpionism, Snakebites, Public health.

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INTRODUCTION

There are a series of animals (e.g., snakes, spiders, scorpions, centipedes, caterpillars, moths, fishes, snails, bees, hornets, wasps) that can cause severe poisoning in humans (Cardoso et al., 2003). Among the venomous animal groups, scorpions, spiders and snakes are among the most common epidemiological agents, considered a public health problem in Brazil (Cupo, 2015).

About 39.490 cases of poisoning caused by scorpions annually are reported in Brazil (Ministério da Saúde, 2014a). Among the 18 known scorpion families (Prendini et al., 2011), only four (Bothriuridae, Buthidae, Chactidae and Hormuridae) have been reported in Brazil (Lourenço & Eickstead, 2003). Moreover, there are at least 160 species of scorpions occurring in the country (Pardal et al., 2014), of which 27 may cause accidents, however only four species are recognized as potentially medical important, namely: *Tityus serrulatus* (Lutz & Mello, 1922), *Tityus stigmurus* (Thorell, 1876), *Tityus bahiensis* (Perty, 1833), and *Tityus obscurus* (Gervais, 1843) (Ministério da Saúde, 2009).

Concerning snakes, there are recorded 3.709 species in worldwide (Uetz, 2019). Of the 405 species that occur in Brazil, 19% (n = 76 spp.) of them are of medical importance and belong to two families: Viperidae (genus *Bothrops* Wagler, 1824, *Bothrocophias* Gutberlet & Campbell, 2001, *Crotalus* Linnaeus, 1758 and *Lachesis* Daudin, 1803) and Elapidae (genus *Leptomicrurus* Schmidt, 1937 and *Micrurus* Wagler, 1824) (Costa & Bérnils, 2018). The snakebite is one of the most common problem of public health among the causative agents of epidemiological envenomations. According to the Ministry of Health, annually about 25.750 snakebites occur in Brazil (Ministério da Saúde, 2014b).

Although relatively neglected compared to the scorpionism and the snakebites (Benício, 2018), accidents caused by spiders also are treated as a public health problem, especially in tropical regions (Brazil et al., 2009). Presently, spider species considered to have some medical importance are allocated in four genera. Among the araneomorph spiders, the representatives of the genus *Latrodectus* Walckenaer, 1805 (Theridiidae) and *Loxosceles* Heineken & Lowe, 1832 (Sicariidae) occur worldwide, while the *Phoneutria* Perty, 1833 (Ctenidae) species are exclusively found in the Neotropics (Lucas, 2003). It is estimated to occur every year in Brazil about 19.348 accidents caused by spiders, of which only in the Northeastern region occurred 9.920 accidents (Ministério da Saúde, 2014c).

The number of cases of envenomations is increasing in Brazil. Between 2003-2013, there were recorded 1.235.569 accidents by venomous animals in the country (Ministério da Saúde, 2014d). In the Northeastern region, studies on envenomations have also increased considerably (e.g., Lira-Da-Silva et al., 2000; Mise et al., 2007; Albuquerque et al., 2009; Albuquerque et al., 2013; Araújo et al., 2017).

However, for the state of Piauí only two publications reported envenomations cases, one caused by snakes (Oliveira et al., 2015) and another by scorpions (Carvalho et al., 2007).

Therefore, owing to the scarcity of information on cases of envenomation in the state of Piauí, and the importance of these accidents to public health, here we present the epidemiological profile of these poisonings over 11 years of notification on a macro-region of the state. Furthermore, we check whether the species recorded in the notification forms correspond to the species that occur in the region. Thus, we also present the first list of species of arachnids and snakes of medical importance from the state of Piauí.

MATERIAL AND METHODS

We conducted the study in the municipality of Picos, Center-South region of state of Piauí. The climate is characterized as semi-arid, with average annual rainfall less than 900 mm, irregularly distributed in two to three months, and an average annual temperature of 27.3°C (Lima et al., 2000). It has a territorial area of 534.715 km^2 and a population of 76.042 people (Ibge, 2014).

We gathered the data through the notification forms of the cases of envenomations that occurred from 1999 to 2010 by the Epidemiological Surveillance Center of a public hospital in the municipality of Picos. The hospital cares for the whole macro-region of Picos, which comprises 20 municipalities, including its main city, Picos (Figure 1). We analyzed only the cases of accidents caused by arachnids (scorpions and spiders) and snakes. The epidemiological parameters of the accidents were causative agent of injury, sites of bites/pricks/stings, the accident classification and outcome (Table 1). In addition, in this study, we present a focus not only on accidents but also on which species are responsible for these accidents.

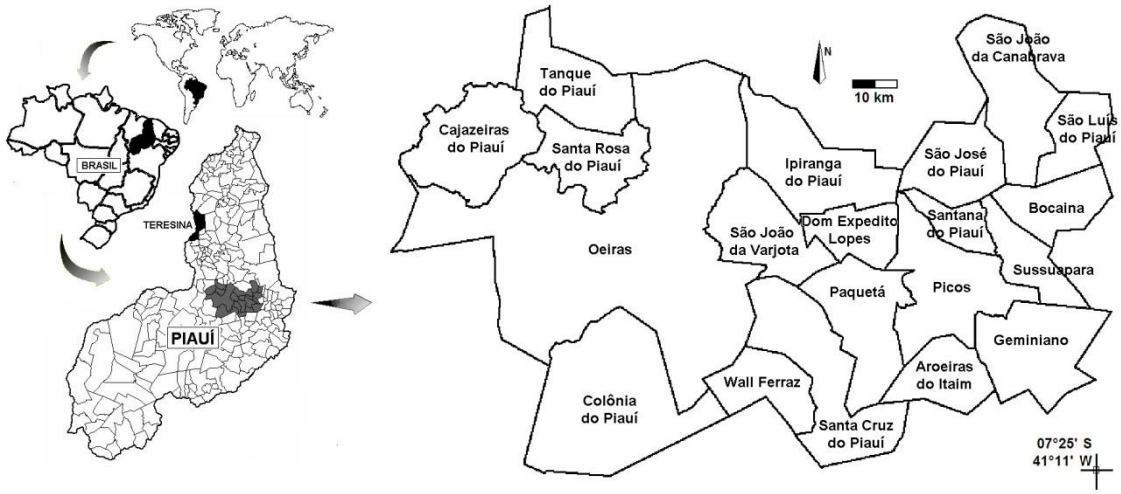

Figure 1. Location of the study area, Picos macroregion, state of Piauí, Brazil.

We present a list of species of arachnids and snakes of medical importance that occur in the state of Piauí from a compilation of species occurrence data (Table 2). For the municipality of Picos, we collected some specimens from October 2008 to September 2009 (arachnids) and August 2007 to June 2011 (snakes), through diurnal and nocturnal active search in different locations (details in Benício et al., 2015).

The species of arachnid and snakes were identified using specialized bibliography. We deposited the specimens in the scientific collection of the Universidade Federal do Piauí, Campus of Picos (MG Fonseca, curator; Picos, PI).

RESULTS

There were recorded 1.249 cases of envenomations in the notification forms, being 41% (n = 512) caused by scorpions, 35% (n = 432) caused by snakes and 24% (n = 305) caused by spiders. Of the accidents caused by scorpions, in most cases (92%, n = 475) there was no identification of species causing the accidents, 4% (n = 19) of the accidents were attributed to *Tityus bahiensis*, 3% (n = 14) to *T. serrulatus*, and only 1% (n = 4) was attributed to *T. stigmurus*. In 52% (n = 223) of the snakebites there was no identification of species causing the accidents, 40% (n = 174) of the cases were caused by snakes of the genus *Bothrops*, 5% (n = 20) were caused by snakes of the genus *Crotalus*, 2% (n = 9) by unpoisonous snakes, and 1% (n = 6) was caused by snakes of the genus *Micrurus*. For spiders, in 99% (n = 303) of the cases there were no identification of species causing accidents. Only two reports have been determined in the genus level the causative agent, one attributed to black widow spiders (*Latrodectus* spp.) and the other attributed to brown recluse spiders (*Loxosceles* spp.) (Table 1).

The majority of the victims (66%, n = 824) was male individuals between 18 and 24 years from rural areas, and got injured during farming activities in the rainy season (January-March). The most common injury sites were the lower limbs (37%, n = 462) and the upper limbs (27%, n = 337). In 21% (n = 262) of the accidents, there was no information of the injured body part. Regarding the classification of accidents, 53% (n = 662) were of mild type, 35% (n = 437) of moderate type, 2% (n = 25) of cases were considered severe, and about 10% of the case reports did not exhibited any envenomation classification (Table 1). The evolution of the cases was not also recorded in the notification forms.

Table 1. Summary of the envenomation cases reported from 1999 to 2010 in the Picos macroregion, in the state of Piauí. N.I. = Not identified.

Reported envenomation agent	N (%)
Scorpions	512 (41%)
Tityus bahiensis	19 (4%)
Tityus serrulatus	14 (3%)
Tityus stigmurus	4 (1%)
N.I.	475 (92%)
Snakes	432 (35%)
Bothrops	174 (40%)
Crotalus	20 (5%)
Micrurus	9 (1%)
Non-poisonous	6 (2%)
N.I.	223 (52%)
Spiders	305 (24%)
Latrodectus	1 (0.5%)
Loxosceles	1 (0.5%)
N.I.	303 (99%)
Envenomation classification	
Mild	662 (53%)
Moderate	437 (35%)
Severe	25 (2%)
N.I.	125 (10%)
Sites of bites/stings	
Foot	462 (37%)
Hand	337 (27%)
Leg	88 (7%)
Trunk	63 (5%)
Arm	25 (2%)
Head	12 (1%)
N.I.	262 (21%)

In the notification forms, there were reported only three species identified so the lowest taxonomic level (species), and two of them (*Tityus serrulatus* and *T. bahiensis*) have no previous record to the state of Piauí. On the other hand, based upon our literature review and field collections, we recorded 11 species of venomous animals (arachnids and snakes) of medical importance to the state of Piauí, being seven species of snakes of three families: Dipsadidae (*Philodryas nattereri* (Steindachner, 1870) and *Philodryas olfersii* (Lichtenstein, 1823)), Viperidae (*Bothrops erythromelas* (Amaral, 1923), *Bothrops lutzi* (Miranda-Ribeiro, 1915), *Bothrops moojeni* Hoge, 1966, *Crotalus durissus* (Linnaeus, 1758)) and Elapidae (*Micrurus* sp.); two spiders, one of family Sicariidae (*Loxosceles amazonica* Gertsch 1967) and one of the family Theridiidae (*Latrodectus* gr. *curacaviensis* (Müller, 1776)); and two scorpions of the families Buthidae (*Jaguajir agamemnon* (C. L. Koch, 1839) and *Tityus stigmurus* (Thorell, 1876)) (Figures 2 - 4, Table 2).

Figure 2. Species of arachnids of medical importance recorded for the state of Piauí: A) *Jaguajir agamemnon*, B) *Tityus stigmurus*, C) *Loxosceles amazonica*, D) *Latrodectus* gr. *curacaviensis*.

Figure 3. Species of snakes of medical importance recorded for the state of Piauí: A) *Philodryas nattereri*, B) *Philodryas olfersii*, C) *Bothrops erythromelas*, D) *Bothrops lutzi*.

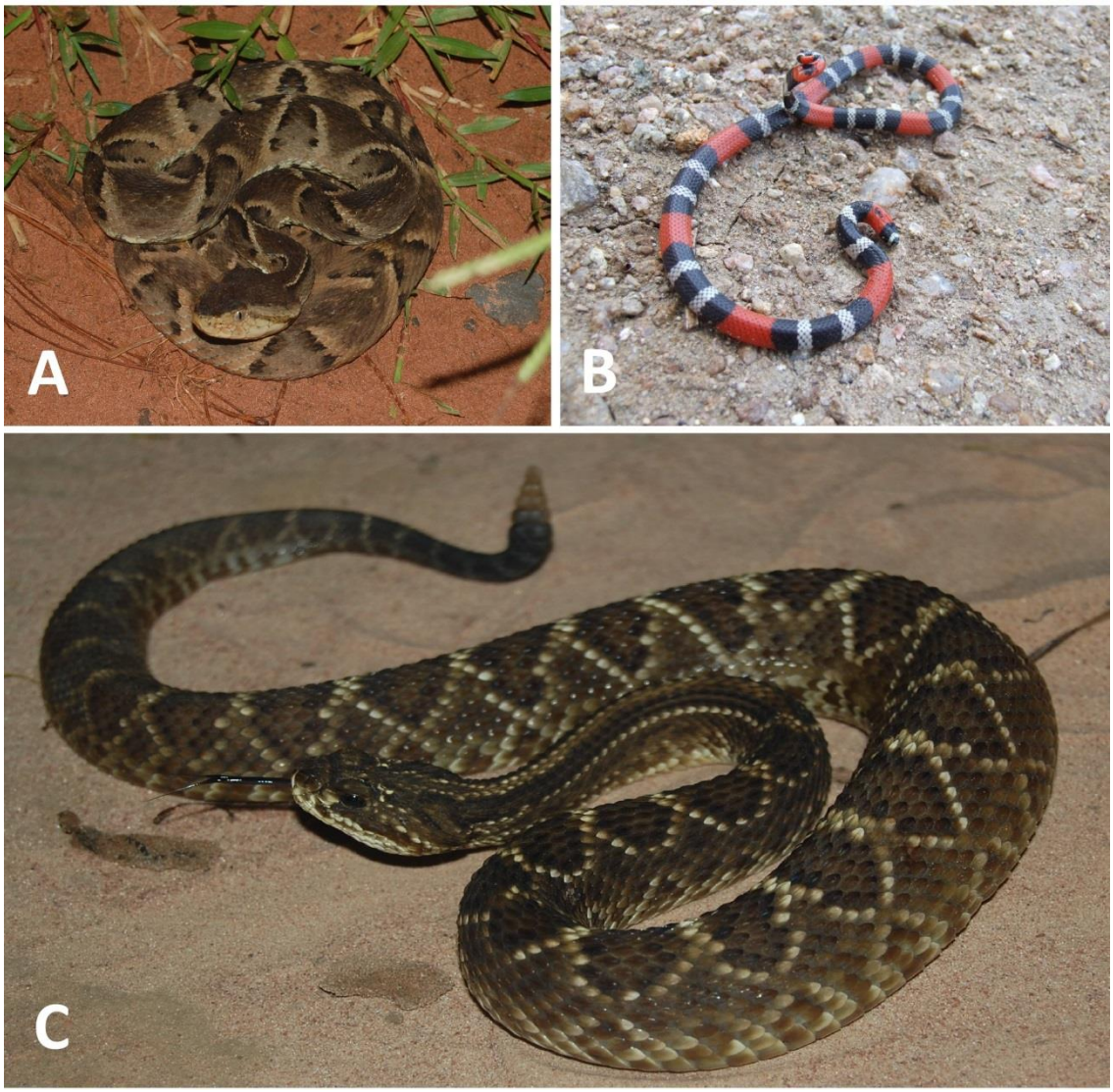

Figure 4. Species of snakes of medical importance recorded for the state of Piauí: A) *Bothrops moojeni*, B) *Micrurus* sp., C) *Crotalus durissus*.

Table 2. Species list of arachnids and snakes of medical importance recorded for the state of Piauí.

Táxon	References
Scorpions	
Jaguajir agamemnon (C.L. Koch, 1839)	Carvalho et al., 2007; Esposito et al., 2017
Tityus stigmurus (Thorell, 1876)	Porto et al., 2014
Snakes	
Philodryas nattereri (Steindachner, 1870)	Benício et al., 2015
Philodryas olfersii (Lichtenstein, 1823)	Benício et al., 2015
Bothrops erythromelas (Amaral, 1923)	Benício et al., 2015
Bothrops lutzi (Miranda-Ribeiro, 1915)	Guedes et al., 2014
Bothrops moojeni (Hoge, 1966)	Dal Vechio et al., 2013
Crotalus durissus (Linnaeus, 1758)	Dal Vechio et al., 2013
Micrurus sp.*	Benício et al., 2015
Spiders	
Loxosceles amazonica (Gertsch, 1967)	Carvalho et al., 2014
Latrodectus gr. *curacaviensis* (Müller, 1776)	Present Study

* Species previously called *Micrurus ibiboboca*.

DISCUSSION

The number of papers regarding envenomation cases (arachnids and snakes) has increased in Northeastern of Brazil (e.g., Lira-Da-Silva et al., 2000; Mise et al., 2007; Albuquerque et al., 2009; Albuquerque et al., 2013; Araújo et al., 2017). However, this number of papers is still low compared to other regions of the country, especially when related to studies of snakebites (Bochner & Struchiner, 2003).

In the Northeastern region the problem of the scorpionism is still poorly known (Brazil et al., 2009). Specifically, for the state of Piauí, one case of scorpion envenomation, with *Jaguajir agamemnon*, was recorded (Carvalho et al., 2007). Therefore, the present paper is the first study that reports the epidemiological profile of a series of accidents involving scorpions during 11 years (1999 - 2010) records.

In this study, we call attention to the fact that some scorpions species (e.g. *Tityus serrulatus* and *T. bahiensis*) reported as responsible for accidents do not match the species with occurrence in the region (Porto et al., 2014), and shall be considered misidentifications. On the other hand, common species in the Caatinga region as the bothriurid *Bothriurus asper* Pocock, 1893 and *B. rochai* Mello-Leitão, 1932, and the buthid *Jaguajir rochae* (Borelli, 1910) did not present any record in the notification forms. In addition, *Tityus stigmurus*, endemic to Northeastern Brazil, was the one presenting the lowest number of accidents, differing from most studies in the Northeastern region where this species is considered the main cause of accidents (e.g., Barbosa et al., 2003; Lira-Da-Silva et al., 2009; Furtado et al., 2016). This could be attributed by a lower abundance of this species in the state of Piauí, reflected by the low number of geographical distribution records in the region (Porto et al., 2014). Another important factor is that *T. stigmurus* venom is potentially fatal to humans (e.g., Albuquerque et al., 2013), but it is not yet in the national of serum production pool (Wen et al., 2015). This is at least concerning, since there is a variation and diversity of toxicity of the venom of some species of scorpions (e.g., *Tityus obscurus*) in distinct regions, and that this variation may result in differences in the clinical manifestations and the severity of the poisoning (Pardal et al., 2014). Thus, to use a specific serum for the treatment of poisonings caused by a particular species can drive greater economy and increased efficiency in treatments.

The identification of the species responsible for the accidents and their distribution in the various municipalities are still precarious, leaving a gap of essential data for the proper assessment of poisoning (Furtado et al., 2016). Besides, the knowledge of the species responsible for accidents is of great relevance, because the diversity of scorpion venom components may be the result of geographical differences and environmental changes in habitat and have been described for many species of scorpions

(e.g., Badhe et al., 2006; Rates et al., 2008; Abdel-Rahman et al., 2009; Ozkan & Ciftci, 2010; Ruiming et al., 2010).

Regarding accidents caused by spiders, there was a high number of cases in the region (n = 305), compared with the number of cases recorded in the System of Notifiable Diseases Information (SINAN, acronym for the Portuguese name 'Sistema de Informação de Agravos de Notificação'). According to the SINAN, in the same period (2000 - 2013), 343 spider accidents occurred throughout the Piauí (Ministério da Saúde, 2014c). The number of accidents recorded only for macroregion of Picos represents about 89% of all accidents to the state. This result demonstrates that the SINAN data may be underestimated due to lack of system power by local authorities. An important aspect that should be taken into consideration is the fact that many notification forms are not filled adequately causing a high number of unreported cases and erroneously identified. The species identification error can be explained by the fact that the notification forms are standardized following a model in which only predetermined species can be considered and includes species that do not occur in the state of Piauí. Besides, the lack of expertise of health professionals in the identification of poisonous species increases the problem.

Despite the cases of snakebites are showing steady growth, in an epidemiological review of snakebites in the last 100 years (1901 - 2000) in Brazil, the Northeastern region was the one presenting the lowest number of publications on snakebites (Bochner & Struchiner, 2003). Nevertheless, this region presents the highest fatality rate of accidents by snakes (Bochner et al., 2014). For the state of Piauí only recently (Oliveira et al., 2015) the first study on epidemiology of snake cases in the region was published. This study indicates that the epidemiological profile of snakebites in the state Piauí is similar to that observed throughout Brazil. Our data demonstrate that most of the records was not notified in SINAN, most records does not present the identification of the species responsible for the accident and there are records whose species was misidentified. This generates spending of public money, delay treatment due to lack of efficacy and worsens the efficiency of treatments.

In this study the genus *Bothrops* was responsible for the majority of snakebites (40%, n = 174), which corroborates other studies conducted in the Northeastern region (e.g., Lemos et al., 2009; Albuquerque et al., 2013; Oliveira et al., 2015). The genus *Bothrops* presently comprises 27 species, with representatives in all regions of Brazil (Costa & Bérnils, 2018). Of these, three species (*B. erythromelas*, *B. lutzi* and *B. moojeni*) occur in the state of Piauí (Dal Vechio et al., 2013; Guedes et al., 2014; Benício et al., 2015). Two species of medical importance of the family Dipsadidae (*Philodryas nattereri* and *P. olfersii*) that occur in the municipality of Picos were not recorded in the notification forms, even considering that *P. nattereri* is one of the most abundant species in the region (Benício et al., 2015). We call attention to the fact that in about 52% (n = 223) of snakebites the species that caused the accidents was

not identified. Thus, it is clear the lack of preparation of health professionals in the identification of the abuser animal as well as the lack of knowledge of the population about the fact that taking the aggressor animal to the hospital or health center can help in the identification and the appropriate treatment.

The number of medically important species for the state is still preliminary, once no survey of this nature was performed in the region. Also, owing to the lack of knowledge about the biological activity venoms of various species (e.g., *Sicarius tropicus* Mello-Leitão, 1936, *Sicarius cariri* Magalhães, Brescovit & Santos 2013, *Loxosceles niedeguidonae* Golçalves-de-Andrade, Bertani, Nagahama & Barbosa, 2012 and *Tityus confluens* Lourenço & Aparecida-da-Silva, 2007) this number may increase considerably, especially for arachnids.

CONCLUSION

The high incidence of envenomations for this region is a case of public health and suggests the need to develop strategies to promote the control and prevention of these accidents. This study providing relevant data on the epidemiological profile of envenomations for the Center-South region and the first list of species of arachnids and snakes of medical importance to the state of Piauí, Northeastern Brazil.

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