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Short Communication

A profile of scorpionism, including the species of scorpions involved, in the State of Amazonas, Brazil

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Abstract

Introduction: This study investigated scorpionism profile in the State of Amazonas, Brazil. **Methods:** Data referring to stinging incidents were obtained from the National Databank of Major Causes of Morbidity. Information on the scorpion species involved was obtained from the Amazonas State health units. **Results:** Amazonas has a scorpionism rate of 8.14 cases/100,000 inhabitants. Some municipalities (e.g., Apuí) presented higher rates (273 cases/100,000 inhabitants). Most species involved in envenomation belonged to the genus *Tityus*. **Conclusions:** Our results reaffirm the notion of scorpionism being a public health hazard and provide data that can guide public policy aimed at scorpionism prevention and treatment.

Keywords: State of Amazonas. Scorpions. Scorpionism.

Scorpions are terrestrial invertebrates with a wide geographical distribution. In some countries, scorpionism, which refers to envenomation by scorpion stings, is considered a public health hazard[1]. Between the years 2008 and 2014, almost half a million people in Brazil were stung by scorpions, of whom 581 died as a result[2].

The State of Amazonas has the widest variety of scorpions in Brazil, harboring 46 of the 140 species documented in the country; these scorpions are sometimes involved in fatal envenomation[3]. However, the lack of knowledge on the distribution of scorpion stings in Amazonas, the species involved, and the profiles of the injured are some of the obstacles that hinder implementation of adequate prophylactic measures and prevent the tackling of this important public health problem. In light of the need for adequate public data that can influence policies on the prevention and control of scorpionism, this study aimed to map the areas with higher incidences of scorpion stings in Amazonas, trace the profiles of those injured, and determine the main species involved in envenomation.

Mapping of the areas with higher incidences of scorpionism was performed according to the geopolitical sectors determined by the *Instituto Brasileiro de Geografia e Estatística* (IBGE), which divides the state into 13 microregions.

Source of information on patients

The profiles of those injured were captured from the National Databank of Major Causes of Morbidity [*Sistema Nacional de Agravos e Notificações* (SINAN)][2], as recorded between January 1st, 2008 and December 31st, 2014. The following variables were considered for analysis: *sex, severity of the sting, serotherapy administered, clinical outcome, anatomical region of the sting, time until medical care was received, age group, and the victims' levels of education*.

Identification of the species involved in envenomation

A survey of the specimens deposited in the health care units that treated individuals stung by scorpions, which are distributed throughout the state, was performed. Posterior identification was performed according to the taxonomical identification keys described by Lourenço[4]. A collecting and transport permit (# 43625-1) was granted by the Chico Mendes Institute for Biodiversity Conservation (*Instituto Chico Mendes de Conservação da Biodiversidade*).

Statistical analyses were performed with the BioEstat[5] software and the Statistical Package for the Social Sciences (SPSS)® 14.0 package for Windows. The non-parametric Friedman and Spearman correlation tests were used for analysis; the significance level was set at 5%.

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There were 1986 incidents of scorpion stings recorded between the years 2008 and 2014, representing an annual average scorpionism rate of 8.14 cases per 100,000 inhabitants. Of the 13 microregions that comprise Amazonas, nine presented average annual scorpion sting rates that were above the state's average rate; these included (scorpion stings per 100,000 inhabitants): Alto Solimões (9.24), Japurá (14.74), Juruá (11.43), Madeira (23.20), Parintins (8.67), Purus (10.60), Rio Negro (11.26), Rio Preto da Eva (32.01), and Tefé (13.20). The microregions with lower-than-average rates were: Boca do Acre (3.20), Coari (4.92), Itacoatiara (5.78), and Manaus (3.11). The differences in rates between the microregions were significant according to the Friedman test (Fr=71.27, p=0.001).

Figure 1 presents the correlation between the distribution of scorpion stings by month and the average annual rainfall in the state[6]. The annual incident rates were separable into two distinct periods: the first included January to June (months with higher rainfall), and the second spanned from July to December (months with lower rainfall). Spearman correlation analyses revealed a significant difference between the two periods (rs=0.62; p=0.030).

Table 1 presents the variables associated with significantly higher rates of scorpionism. There was a significantly higher rate of incidents in rural regions than in urban municipal areas. Furthermore, the frequency of stings was significantly higher in males. Individuals in the 20-34 year age group were more susceptible to scorpionism, and stings most frequently occurred in the upper limbs. While people of all education levels were affected by scorpionism, rates were highest in those who only had elementary school education. A majority of injured individuals (66.3%) received health care in the first three hours

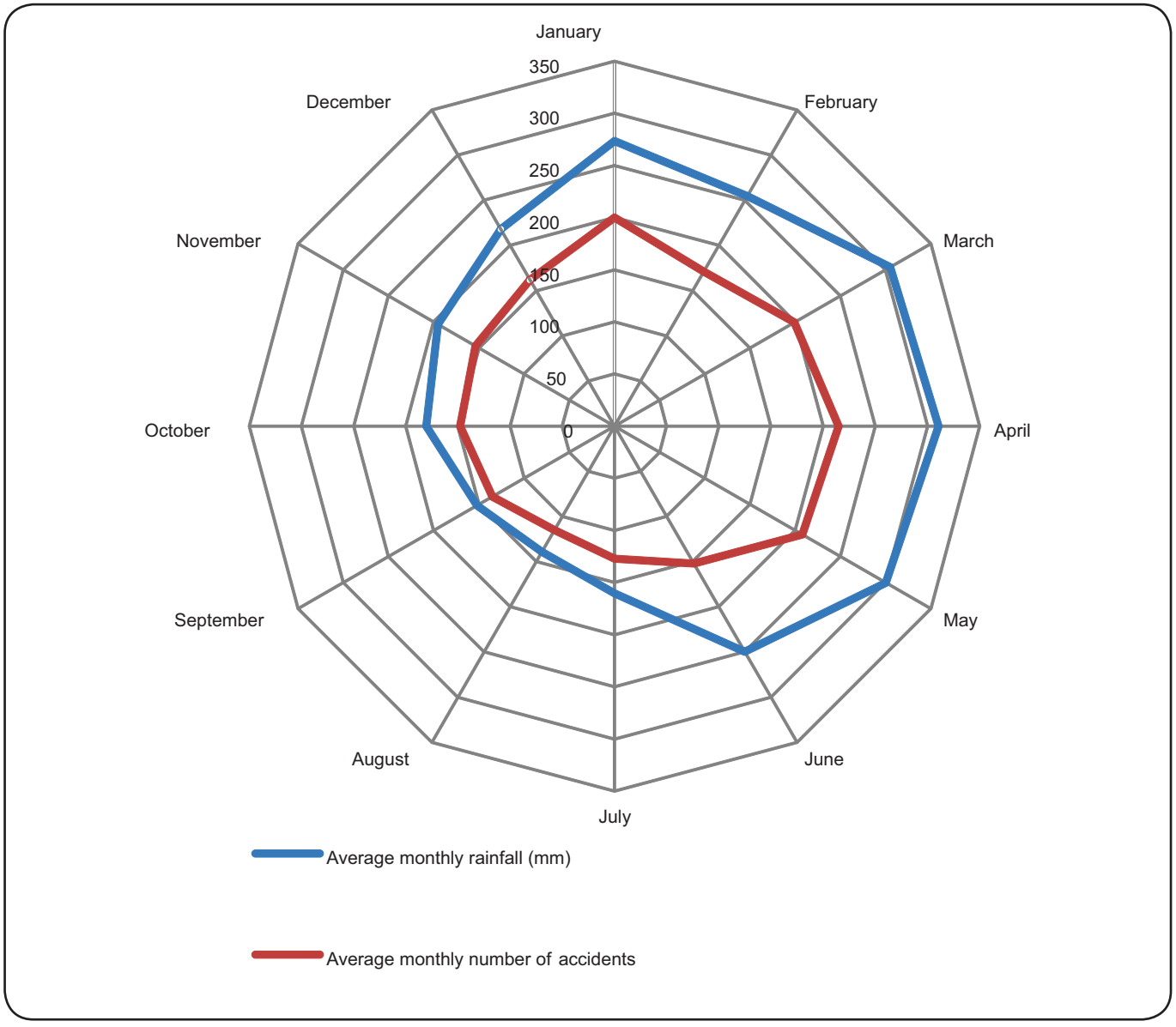

FIGURE 1 - Correlation between average rainfall and scorpion stinging incidents in the State of Amazonas between 2008 and 2014.

TABLE 1 - Variables associated with higher rates of scorpionism in the State of Amazonas, Brazil, between 2008 and 2014 (1,986 envenomation cases).

Variable	Most relevant	Envenomation cases		Friedman test	P value
		n	%		
Geographical region	Rural	1,092	55.0	7.0	0.008
Sex	Male	1,308	65.9	7.0	0.008
Age group	20–34 years old	564	28.4	21.0	0.001
Anatomical region	Upper limbs	933	47.0	19.6	0.001
Level of education	Elementary school	582	29.3	22.4	0.001
Time until medical care	Up to 3 hours	1,316	66.3	19.1	0.001

after the sting; only 6.1% of those injured were hospitalized 13 hours or longer after being stung.

Data on the severity of the sting, administered serotherapy, and clinical outcomes are presented in **Table 2**. The severity of most stings was light, and serotherapy (anti-scorpion serum) was administered in 57.7% of cases. The vast majority of patients healed; the recorded death rate was 0.4%.

TABLE 2 - Frequency of stinging incidents as a function of severity, serotherapy administration, and clinical outcomes of those stung by scorpions in the 13 microregions of the State of Amazonas between 2008 and 2014 (1,986 envenomation cases).

		n	%
Severity of the case	Ignored/blank	96	4.8
	Light	1,294	65.2
	Moderate	509	25.6
	Severe	87	4.4
Serotherapy	Ignored/blank	123	6.2
	Yes	1,147	57.7
	No	716	36.1
Clinical outcome	Ignored/blank	90	4.5
	Healed	1,888	95.1
	Death	8	0.4

Species involved with scorpionism in Amazonas

Tityus metuendus, *Tityus matthieseni*, *Tityus bastosi,* and *Tityus silvestris* were the main species involved in envenomation that required medical intervention in the municipalities of Manaus, Apuí, Tabatinga, and Rio Preto da Eva, respectively.

The average rate of envenomation in the State of Amazonas (8.14 cases per 100,000 inhabitants) was below the Brazilian average of 32 cases per 100,000 inhabitants and the world average of 20 cases per 100,000 individuals[2]. The reason for this lower rate of scorpionism might be related to the predictable and specific ecological habits of the scorpion species that inhabit Amazonas. Another postulate is that scorpions in this state have relatively lower-potency venom. However, these theories require investigation.

The present study demonstrated that, although the average number of scorpion stings in Amazonas is below the country's average, 9 of the 13 microregions presented high levels of scorpionism, as was the case in Madeira. In particular, the municipality of Apuí reported 261 of the 328 events recorded in the Madeira microregion (79.7% of cases). The average annual rate of scorpionism in Apuí was approximately 200 per 100,000 inhabitants; the rate for 2012 alone was 273, which is the highest number of incidents recorded. These high scorpionism rates caught the attention of Apuí's health services, especially as other comparable regions presented much lower rates than those of Apuí[7] [8]. These results may be related to urban sprawl, improved notifications via SINAN, or even to the presence of opportunistic species present in the region (such as *T. matthieseni* and *T. metuendus*), which are characterized by high environmental plasticity.

The records from Manaus contrasted markedly with those from Apuí. With an average annual rate of 3.35 cases per 100,000 inhabitants, Manaus (the capital of Amazonas) presented one of the lowest rates of scorpionism in the state. Notably, Manaus municipality had the highest number of species recorded, and was therefore expected to have a higher incident rate. A possible explanation might be the presence of non-synanthropic species that are not involved in stinging incidents. Other possibilities are the low lethality of the species or severely hostile reactions to the presence of the species by residents of Manaus.

Our data indicated that the number of envenomation incidents increased significantly in 2012, 2013, and 2014 compared to 2008 (Fr=22,420; p=0,001). The reason for this increase in the rate of incidents in Amazonas remains to be investigated.

Our findings of two distinct periods of high vs. low annual envenomation rates are consistent with data from Benmosbah et al.[9]. They and others propose that scorpion activity is directly correlated with rainfall. In Amazonas, it is possible that incidents are associated with river flood dynamics, where rising water levels during the rainy season decrease scorpions' habitable territory, pushing them into riverside households and prompting increased encounters with humans.

The prevalence of injuries in rural areas of Amazonas municipalities is consistent with data from the municipality of Santarém in the Brazilian State of Pará[10]. However, it contrasts with the data for the States of Paraná[11] and Ceará[12], which presented higher rates of incidences in urban areas.

Data from Santarém, Pará, also showed that most incidents occurred among individuals 20-34 years old[10]. However, the data were in contrast to those in other localities in Brazil such as Paraíba and Ceará, where 60% and 58% of such incidents, respectively, involved women[12]. As for anatomical location, our findings that the upper limbs were the anatomical regions most vulnerable to scorpion stings were consistent with data from the municipality of Juiz de Fora, Minas Gerais, Brazil[7]. Additionally, our findings that those with only elementary school education had a higher rate of scorpion stings were similar to results obtained in other Brazilian localities[10] [11].

Our study revealed that 66.3% of those injured were administered medical first aid in the first three hours after being stung; this rate is similar to that found in other studies[7] [9]. Scorpion venom is described as a complex formula capable of causing physiological harm, particularly nervous system paralysis[13]. Thus, medical assistance must be provided as fast as possible to avoid functional deterioration and possibly death.

This study demonstrated that 65.2% of scorpionism events were classified as light; similar results were obtained in Belém, Pará, Brazil[8]. Serotherapy with anti-scorpion venom was administered in 57.7% of the cases, which is a higher rate than that observed in other localities where only 2.1-7.5% of injured patients were administered anti-venom[7] (sometimes unnecessarily according to the Ministry of Health[14]). These data indicate that a review of the evaluation, diagnosis, and treatment criteria for scorpionism is required in the state of Amazonas.

The rate of stinging incidents leading to death was of 0.03 per 100,000 inhabitants, below the national average of approximately 0.04 per 100,000 inhabitants; however, this rate was similar to that found in the State of Pará[8].

Tityus metuendus, *T. matthieseni*, *T. bastosi*, and *T. silvestris* were the species most responsible for severe envenomation incidents in Amazonas. In general, the *T. metuendus* and *T. silvestris* species are most commonly involved in incidents that produce more severe complications in Amazonas[15]. However, that study did not specify the areas in which the incidents occurred. Our study revealed that the species involved in stinging incidents vary by microregion. However, all belong to the genus *Tityus*, confirming data from other studies that point to this particular genus as the main taxon involved in scorpionism in Brazil[7] [8] [15]. The current study, which introduces new information regarding scorpionism in Amazonas and clarifies the profile of the envenomed population as well as the four main species involved, contributes to attaining a better understanding of scorpionism in this state.

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Conflict of interest

The authors declare that there is no conflict of interest.

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