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# Spatial distribution and epidemiological profile of scorpion accidents in Natal/RN

## *Perfil epidemiológico e espacial dos acidentes ocorridos por escorpiões no município de Natal/RN**

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**Abstract**

**Introduction:** Scorpion poisoning constitutes a public health problem due to the high number and severity of cases. **Objective:** To map the areas of occurrence of accidents caused by scorpions in Natal/RN. **Methods:** An epidemiologic study with an ecological descriptive approach was conducted. It uses data registered in the Information System for Notifiable Diseases, which were processing in Excel spreadsheet, and subsequently the areas were mapped with Arcview 3.2 software. **Results:** We identified 1,698 cases of scorpions poisoning throughout the year, and the spatial distribution revealed that the West region was the most affected. The incidence was higher in females, which accounted for a total of 1,103 accidents, corresponding to 65% ($X^2$: 10.87, p = 0.02). The age group between 21 and 30 years was the most affected. **Conclusion:** The identification of critical areas for accidents caused by scorpions is vital for making decisions and implementing prevention and control measures.

**Key words:** Environment; Epidemiology; Public health; Scorpion venoms.

**Resumo**

**Introdução:** O escorpionismo constitui um problema de saúde pública pela alta incidência e gravidade dos casos. **Objetivo:** Mapear as áreas de ocorrência dos acidentes causados por escorpiões no município de Natal (RN). **Métodos:** Realizou-se um estudo epidemiológico do tipo ecológico, utilizando dados registrados no Sistema de Informação de Agravos de Notificação, processados em planilha do Excel, sendo, em seguida, mapeadas as áreas por meio do *software* Arcview 3.2. **Resultados:** Identificaram-se 1.698 notificações de acidentes escorpiônicos durante todo o ano no município e verificou-se que a região Oeste foi a mais afetada. Em relação ao sexo, a maior incidência foi nas mulheres, com um total de 1.103 casos, correspondendo a 65% ($X^2$: 10,87; p= 0,02). A faixa etária entre 21 e 30 anos foi a mais afetada**. Conclusão:** A identificação de áreas críticas de acidentes escorpiônicos é de vital importância para a tomada de decisões e implementação de medidas de prevenção e controle.

**Descritores:** Epidemiologia; Meio ambiente; Saúde pública; Venenos de escorpião.

## Introduction

Scorpion poisoning constitutes a public health problem due to the elevated number of cases and their severity, as well as to difficulties in the management of health services. Every year 1,200,000 cases and over 3,250 deaths are recorded throughout the world[1]. Scorpion poisoning is present in many parts of Brazil, especially in urban areas, as a consequence of unplanned urban growth[2]. Climate change, caused primarily by human action, deforestation for construction purposes, high population density and the disorganized management of settled lands are factors that can alter the epidemiology of these accidents, increasing their incidence in areas where occurrences were previously uncommon or changing the profile of the species involved[3, 4].

These accidents are potentially serious poisoning cases. However, if treated quickly and properly, these injuries have a benign outcome in most cases. Thus, it is vital that the professionals responsible for administering first aid treatment are able to promptly recognize poisoning signs and provide correct treatment. In order to do this, it is important that they be up-to-date with the epidemiological situation of their region[5].

In Brazil, scorpion stings happen in all states, involving mostly three major members of the *Tityus* genus: *T. serrulatus*, found in São Paulo, Espírito Santo, Minas Gerais, Rio de Janeiro, Bahia, Goiás and Paraná; *T. bahiensis*, found in São Paulo, Minas Gerais, Mato Grosso do Sul, Goiás and the Southern states; and *T. stigmurus*, which is very common in the Northeast[5, 6].

The increase in the number of cases in the last few years is directly related to the establishment of the National System of Toxic Pharmacological Information (*Sistema Nacional de Informações Tóxicas Farmacológicas* – SINITOX). Since 1988, there have been an estimated 8,000 accidents/year, with an approximate incidence of 3 cases per 100,000 inhabitants, 50% of them being concentrated in the Southeast[1, 7]. In the Northeast, there were 30,367 poisoning cases caused by venomous animals and 86 deaths[8]. Among the diverse toxic agents considered by SINITOX, poison from venomous animals is responsible for the increase in the number of people who are poisoned[9], causing growing concern for public health, since many of these accidents could be avoided through the adoption of preventive measures, such as environmental education.

Thus, it is necessary to organize health services in terms of epidemiological and environmental surveillance as well as health care provision in order to both reduce the number of deaths caused by poisoning in the country and record the epidemiology of accidents in each region[10]. Natal, capital of the Rio Grande do Norte, was the city chosen for the study. It has a total population of 806,203, distributed in four main regions: North, South, East and West, with a total of 36 neighborhoods that have different territorial, physical, demographic and infrastructure characteristics. The city, situated at an altitude of 31 m and having an average yearly temperature of 28 ºC, has a humid climate, with regular rainfall, which becomes drier and more arid moving west, away from the coast[11].

In view of this situation, it is necessary to investigate and geographically map cases as well as identify areas of risk in order to reduce the waste of financial and human resources. Within this context, this project aimed to analyze the areas of risk and the epidemiological profile of accidents caused by scorpions in Natal/RN in 2009.

## Methodology

This is an epidemiological study with an ecological focus, using secondary data registered in the Information System for Notifiable Diseases (designate by the acronym SINAN in Brazil)[12]. The period (2009) was chosen because of the increasing number of accidents caused by venomous animals in the urban area of Natal/

RN that are treated by the Emergency Service at Hospital Professora Giselda Trigueiro, an authority in the state in the treatment of accidents caused by venomous animals. Cases are investigated by the Control Program of Venomous Animals of the Center for Zoonosis Control.

The selected independent variables were the ones present in the investigation records for accidents caused by venomous animals: sex, age, sting site and yearly frequency.

Socioeconomic, demographic and environmental variables such as income, schooling, population density and coverage area of garbage collection and sewage services were obtained from the Brazilian Institute of Geography and Statistics[11] and used for a secondary analysis as to their association with cases of accidents caused by scorpions. The neighborhood where an accident occurred was considered a dependent variable. The selection of variables was made within the existing theoretical framework on this health hazard and its determinants and in light of the availability of data on those same variables.

The database was built using an Excel spreadsheet, while the construction of the thematic map, which represented the spatial distribution of the occurrence of accidents, was done with Arc View 3.2 software. To compare proportions we used Pearson's Chi-Square Test ($X^2$), adopting a *p* value of 0.05 and 95% confidence interval.

This study used secondary data, respecting the confidentiality and anonymity of subjects in SINAN.

## Results

During the period of the study (2009), there were 2,205 accidents caused by venomous animals. Of all the accidents, 1,698 (77%) were caused by scorpions, followed by unidentified causes (6.10%), caterpillars (3.10%), spiders (2.90%) and others ($X^2$:8.76; p< 0.001).

The distribution of accidents caused by scorpions was also determined for the city's four administrative regions. The West region had the most cases (35.32%), followed by North (32.61%), South (16.33%) and East (15.74%) ($X^2$:15.98; p= 0.032). The neighborhoods "Quintas" (4.57/ 1000 inhab.), "Bom Pastor" (4.29/ 1000 inhab.), "Dix-Sept-Rosado" (4.00/1000 inhab.) and "Cidade da Esperança" (4.1/ 1000 inhab.), all of them located in the West region, had the highest incidence rates of the city, as shown in Figure 1.

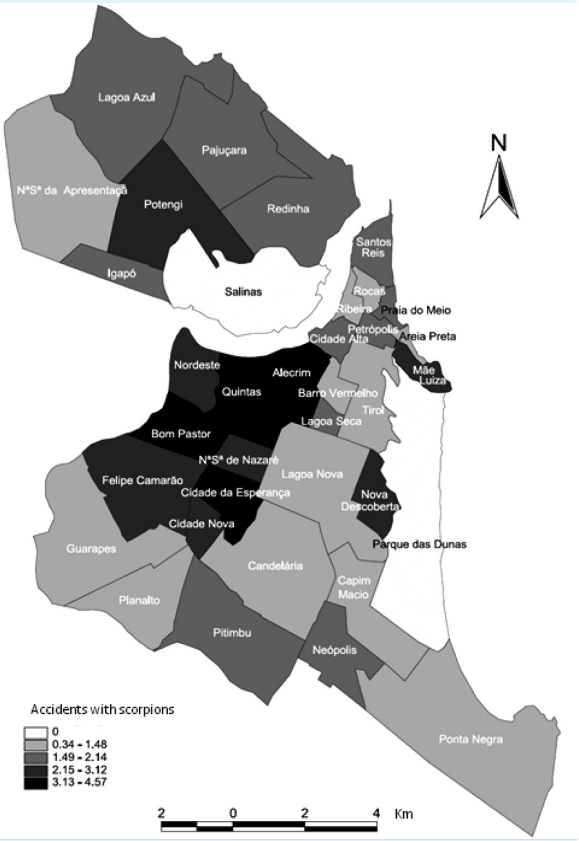


**Figure 1:** Spatial distribution of incidence of scorpion poisoning (per 1000 inhabitants), Natal-RN, Brazil, 2009

The indicators relating to socioeconomic and environmental conditions in the city of Natal are presented in Table 1.

We can see that the percentage of neighborhoods with proper sewage treatment is much lower than those with water supply and garbage collection. As for the population density,

**Table 1:** Indicators related to socioeconomic and environmental conditions, in Natal-RN, Brazil, 2009

| Regions | North | South | East | West |
|---|---|---|---|---|
| demographic density | 51.05 | 42.98 | 53.72 | 83.15 |
| Sewage services (%) | 4.28 | 4.45 | 41.34 | 45.34 |
| Garbage collection (%) | 94.69 | 98.38 | 57.57 | 94.47 |
| Water supply (%) | 95.60 | 98.04 | 56.11 | 96.43 |
| Per capita income (MS) | 2.69 | 10.00 | 6.58 | 3.03 |
| Literacy rate (%) | 78.20 | 91.24 | 52.16 | 78.16 |

MS: Minimum salary (figures represent multiples of one minimum salary).

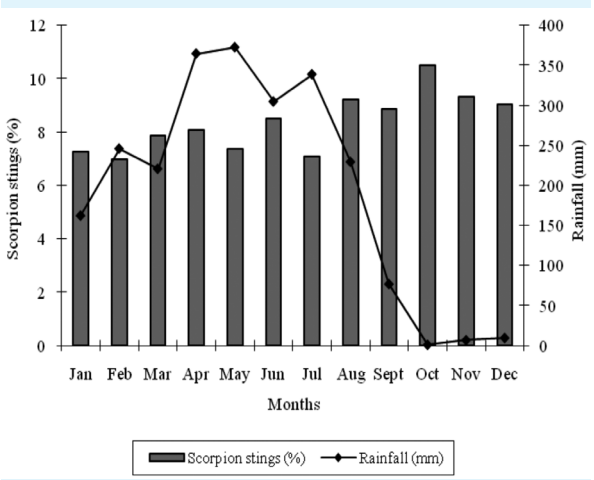


**Figure 2:** Distribution of accidents by scorpions, according to the month of occurrence and rainfall, in Natal-RN, Brazil, 2009

we can observe that the most populated neighborhoods are: "Mãe Luiza", "Rocas", "Dix Sept Rosado", "Quintas" and "Igapó", respectively 165.67; 159.23; 144.93; 140.02 and 125.30 inhab./ha. The population of 12 neighborhoods (out of the 36 in the study) has an average income lower than three minimum salaries per month. "Guarapes" is the neighborhood with the lowest salary. Literacy rates ranged from 64.27% in "Guarapes" to 97.27% in "Capim Macio". The West region stands out from the others because of its population density.

Results show that accidents caused by scorpions happen throughout the year, with no significant monthly variations. When analyzing the rainfall data, we can see a reduction in precipitation from August until December, which coincides with a small increase in the number of scorpion poisoning cases (Figure 2), although without statistical significance ($X^2$: 27.88; p = 0.34).

Incidence levels were higher for females, who accounted for a total of 1,103 accidents, or 65% ($X^2$: 10.87, p = 0.02). The age range between 21 and 30 was the most affected (20.29%) ($X^2$: 11.23, p = 0.04), with an average age of 36 years (dp= ±4.3). The most affected sting site were the feet 27.20% ($X^2$:10.11; p= 0.03) and fingers 26.90% ($X^2$:14.32; p= 0.04) representing 462 and 457 cases respectively (Table 2).

**Table 2:** Distribution of accidents by scorpions, according to the bite site, in Natal-RN, 2009

| Bite site | Number of cases | % |
|---|---|---|
| Head | 40 | 2.40 |
| Trunk | 61 | 3.60 |
| Upper | 724 | 42.63 |
| Arm | 59 | 3.50 |
| Forearm | 36 | 2.10 |
| Hand | 172 | 10.10 |
| Finger | 457 | 26.90 |
| Lower limb | 822 | 48.41 |
| Thigh | 72 | 4.20 |
| Leg | 52 | 3.10 |
| Foot | 462 | 27.20 |
| Toe | 236 | 13.90 |
| Ignored | 51 | 3.00 |
| Total | 1698 | 100.0 |

## Discussion and conclusion

Accidents caused by venomous animals are a public health issue in many tropical and subtropical countries due to their high incidence and potential to lead to severe clinical

conditions, frequently fatal for children and the elderly. Within this group, scorpion stings are the biggest medical concern due to the morbidity/mortality they cause[10, 13].

Except for sporadic records in State Health Departments, scorpion poisoning is largely an unrecognized problem in Northeast Brazil. *Tityus stigmurus* is always referred to as the main etiologic agent in the region[6]. The first records in Bahia, dating to 1980, indicate scorpion poisoning as the main cause of arachnid accidents in the region (81.9%)[3].

The majority of cases of scorpion poisoning in Brazil follow a benign course, with a fatality rate of 0.58%. The deaths are usually associated with accidents caused by *Tityus serrulatus*[1]. *Tityus stigmurus*, the same species found in Bahia, is the main etiologic agent of scorpion poisoning in Natal-RN[12]. This study did not find any severe cases or records of deaths in the city of Natal. However, there are records of death in the state of Rio Grande do Norte in 2005 (1 case), 2007 (1 case) and 2008 (2 cases)[8].

The issue of scorpion poisoning is directly related to geographic aspects such as climate, terrain, type of vegetation and soil and the occupation of urban spaces, as well as to the distribution and organization of sanitation services and equipment[3, 14]. In Natal, the neighborhoods most affected by accidents (Quintas, Dix-Sept-Rosado e Cidade da Esperança) have similar socioeconomic characteristics, such as high population density, uncontrolled growth, poor sanitation and accumulation of garbage and building material waste, offering refuge and food to animals. Moreover, the West District has several clusters of poor communities and many vacant lots where trash is deposited close to homes. An area of mangrove vegetation and another area of environmental preservation surrounding it are some of the determinant factors in the proliferation of synanthropic animals[1].

Analyzing Table 1, we can see that the neighborhoods "Quintas", "Dix-sept Rosado" and "Cidade da Esperança", all of them located in the West region, showed high population density and low per capita income. In a study conducted in Natal-RN, the index of living conditions (ILC) of the four regions that comprise the municipality was calculated using the same variables considered in this study[11]. The West region had six neighborhoods with very low ILC ("Guarapes", "Planalto", "Felipe Camarão", "Cidade Nova", "Bairro Nordeste" and "Bom Pastor"), two neighborhoods with low ILC (Dix Sept Rosado and Quintas) and three neighborhoods with intermediate ILC ("Nossa Senhora de Nazaré" and "Cidade da Esperança"). These conditions favor the incidence of injuries associated with the population's socioeconomic and environmental situation.

In Natal, the accidents happen throughout the year, probably because of deforestation for housing construction. This happens in a disorderly way, without any infrastructure, causing the displacement of scorpions from their natural habitat. The region's morphoclimatic conditions may also be a contributing factor. Ill-defined seasons and a yearly average temperature of 28 ºC are characteristics that match those associated with accidents in the state of Bahia but differ from what is reported in Southeast Brazil, where accidents are more frequent from September to November[15].

Considering climate conditions, accidents caused by scorpions happen in the Southeast of the country during the hot, rainy months[5]. This may happen because the animals are forced to leave their hiding places as a result of rainwater and are more active in searching for food and in reproduction-related activities[15]. During this study, we observed that most of the occurrences happened between August and December, the period with the least amount of rainfall of the year. However, the observation period was too short to confirm this analysis. The absence of a characteristic pattern of seasonality in the study might be related to the favorable conditions of temperature, humidity and availability of food that are offered by the urban environment throughout the year and are necessary for the survival and reproduction of the animals.

This study showed that females were most affected, similar to what we observed in Belém, Pará[5]. The opposite was the case in São Paulo[16]. Women are more prone to scorpion stings because they are the ones chiefly responsible for cleaning areas in homes where scorpions often live[17]. The most affected age group was from 21 to 30 years, similar to São Paulo and Uberlândia (20 to 30 years)[17, 18]. In Belém/Pará, the most affected were those younger than 20[5]. The patient's age is an important variable, since the gravity of the scorpion poisoning is greater for those younger than 15, when the immune system is still developing, or older than 60, when the immune system may be weakened. These subjects are the ones who are most at risk from dying when poisoned. Adults are the most frequent victims of scorpion stings, but morbidity is higher among children and the elderly[14].

The sting site is a factor that has an influence on the gravity of the accident. The closer to vital organs, the more serious will be the complications and sequelae caused by the accident[14]. In this study, we identified the lower limbs as the main location of stings, specially the feet, probably because people tend to walk barefoot. Scorpions are nocturnal animals, spending the day hidden in dark places. They can easily blend in with their environment or appear to be dead. These characteristics contribute to increasing the risks of getting stung[19]. A study conducted in Santarém, Pará, showed different results. The upper limbs were affected in 51.5% of the cases and the lower limbs in 43.1%[5].

Out of all venomous animals, scorpions adapted the best to urban areas. Another factor favoring the occurrence of accidents is the lack of information about the specific scorpion species that cause them. The lack of awareness and of prevention campaigns for the population and the dearth of local health care units explains why people do not take the specimens to health centers. There is also a shortage of specialized doctors aware of the importance of identifying the scorpion species at the beginning of treatment. Despite possessing treatment expertise in this area, health centers are deficient in training specialized personnel[10].

Thus, results showed that there is a high incidence of accidents caused by scorpions throughout the year in Natal. The spatial distribution showed that the West Sanitary District is the most affected by this problem. The identification of the species is fundamental for better understanding the profile of these accidents.

Therefore, we need permanent education in schools to increase understanding and awareness among students and teachers about the biology of scorpions and the accidents they cause and on how to proceed in those cases. This applies as well to health professionals responsible for treating victims, so they can provide better care, with appropriate knowledge, for those who seek assistance at a Specialized Emergency Health Center.

## Note

* Article based on the final monograph for the Course of Epidemiology from the Institute of Tropical Pathology and Public Health, at Federal University of Goiás (Universidade Federal do Goiás), in 2010.

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