ORIGINAL ARTICLE

Temporal trend and epidemiological profile of accidents involving venomous animals in the State of Rio de Janeiro, Brazil (2012-2021)

Tendência temporal e perfil epidemiológico dos acidentes com animais peçonhentos no Estado do Rio de Janeiro, Brasil (2012-2021)

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ABSTRACT

Introduction: Accidents involving venomous animals have significant clinical implications. In Brazil, accidents caused by scorpions (59%), spiders (13.6%), and snakes (10.9%) are the most frequently reported, although proportions vary by region. This study describes the temporal trends and epidemiological characteristics of accidents involving venomous animals in the State of Rio de Janeiro.

Methods: This is an ecological (time series) study of accidents caused by venomous animals over the last 10 years (2012 to 2021) in Rio de Janeiro. Data were collected from the Brazilian Notifiable Diseases Information System. We estimated incidence rates and analyzed time series using Joinpoint regression, according to geographical region, age, and type of animal.

Results: From 2012 to 2021, 17,891 accidents involving venomous animals were reported, with rates increasing from 8.4 to 10.7 per 100,000 inhabitants. Snakes were responsible for the highest number of cases (33.4%), followed by scorpions (27.2%) and spiders (27.0%). Snakebite cases remained stable, while cases of arachnidism and scorpion envenomation increased, marking them as the main types of accidents. The regions with the highest rates were Centro-Sul (65.5 per 100,000 inhabitants), Baía da Ilha Grande (62.3), Médio Paraíba (45.3), and Serrana (43.5). Males and the 40 to 59 age group predominated, but all age groups showed an increase, with a more pronounced rise among children and adolescents. Most accidents were classified as mild, although 51 deaths were recorded.

Conclusions: Rio de Janeiro has relatively low rates of accidents involving venomous animals, but some regions have values higher than the national average. Snakebite accidents remained stable, except in the adolescent group. Accidents involving scorpions and spiders showed an upward trend.

Keywords: Venomous animals, Arachnidism, Scorpion sting, Snakebite.

RESUMO

Introdução: Os acidentes por animais peçonhentos têm significativa repercussão clínica. No Brasil, os acidentes por escorpiões (59%), aranhas (13,6%) e serpentes (10,9%) são os mais relatados, embora as proporções variem de acordo com a região. Este estudo descreve as tendências temporais e as características epidemiológicas dos acidentes por animais peçonhentos no Estado do Rio de Janeiro (RJ).

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Métodos: Trata-se de um estudo ecológico (série temporal) sobre acidentes por animais peçonhentos nos últimos 10 anos (2012 a 2021) no RJ. Os dados foram coletados do Sistema de Informação de Agravos de Notificação (SINAN). Estimamos taxas de incidência e analisamos séries temporais por meio de regressão Joinpoint, de acordo com a região geográfica, idade e tipo de animal.

Resultados: De 2012 a 2021, foram notificados 17.891 acidentes envolvendo animais peçonhentos; as taxas passaram de 8,4 para 10,7 por 100.000 habitantes. As cobras estiveram envolvidas na maioria dos casos (33,4%), seguidas por escorpiões (27,2%) e aranhas (27,0%). Houve estabilidade nos acidentes ofídicos, enquanto aracnidismo e escorpionismo aumentaram, tornando-se os principais tipos de acidentes. As regiões com maiores taxas foram Centro-Sul (65,5 por 100.000 habitantes), Baía da Ilha Grande (62,3), Médio Paraíba (45,3) e Região Serrana (43,5). Predominaram os homens e a faixa etária de 40 a 59 anos, mas todas as faixas etárias apresentaram aumento, mais intenso entre crianças e adolescentes. A maioria dos acidentes foi classificada como leve, embora tenham sido registradas 51 mortes.

Conclusões: O Rio de Janeiro apresenta taxas relativamente baixas de acidentes por animais peçonhentos, mas algumas regiões têm valores superiores à média nacional. Os acidentes ofídicos permaneceram estáveis, exceto no grupo de adolescentes. Os acidentes por escorpiões e aranhas apresentaram tendência de aumento.

Palavras-chave: Animais peçonhentos, Aracnidismo, Acidente escorpiônico, Acidente ofídico.

INTRODUCTION

Accidents involving venomous animals constitute a significant public health problem worldwide, particularly in tropical and subtropical regions. Envenomations can lead to severe medical consequences, such as permanent physical disability and death, especially from snakebites. Additionally, envenomation incidents have substantial socioeconomic repercussions, as most victims are working-age men involved in rural or agricultural activities. This issue is exacerbated by the lack of adequate investment in the production and distribution of antivenoms, given that the affected population is often impoverished and lacks political influence, thus classifying envenomations as neglected tropical diseases (NTDs). Recognizing the public health significance of snakebites, the World Health Organization (WHO) added snakebites to its list of NTDs, as they are responsible for over 100,000 deaths annually worldwide.

Latin America, characterized by its remarkable biodiversity and typical tropical climate, harbors various species of venomous animals and records a significant number of fatal envenomations, though these numbers are surpassed by those in Asia and Africa, where health resources are limited and poorly distributed. An estimated 137,000 to 150,000 snake envenomations occur in Latin America each year, with approximately 30,000 (~20%) occurring in Brazil. In Brazil, accidents involving venomous animals rank among the most frequent notifiable diseases listed in the Brazilian Notifiable Diseases Information System (SINAN), with approximately 260,000 accidents reported annually.

In 2018, a total of 265,643 venomous animal accidents were reported in Brazil, with 59% caused by scorpions, 13.6% by spiders, and 10.9% by snakes, the latter having the highest lethality rate. Snakebite envenomations in Brazil are predominantly caused by pit vipers (*Bothrops* spp.) (90%),

followed by rattlesnakes (*Crotalus* spp.) (7.7%), *surucucus* (*Lachesis* spp.) (1.4%), and true corals (family *Elapidae*) (0.4%). Regarding scorpions, the genus *Tityus* is mainly responsible for medically significant envenomations, particularly *T. serrulatus* (responsible for more severe cases), *T. bahiensis*, *T. stigmurus*, and *T. obscurus*. The genera *Phoneutria* spp., *Loxosceles* spp., and *Latrodectus* spp. are notable contributors to the 13.6% of spider accidents.

According to SINAN, the Southeast region of Brazil recorded the highest number of venomous animal accidents from 2017 to 2021, followed by the Northeast region, the two most populous regions in the country. An analysis of rates shows that the Northeast has the highest incidence, followed by the Southeast. The Legal Amazon region (North and parts of the Central-West region) and the Northeast states report most snakebite notifications, while scorpion envenomations have the highest rates in the Northeast, followed by the Southeast, and spider envenomation notifications are most frequent in the South.

Few studies have examined the panorama of venomous animal accidents in the Southeast region, and even fewer have addressed the epidemiological situation in the State of Rio de Janeiro. The limited available studies on Rio de Janeiro either focus on specific sub-regions or are restricted to snakebites.

The objective of this study was to describe accidents by geographical region, type of venomous animal, age, sex, and severity, and to analyze the time series of rates of accidents involving snakes, scorpions, and spiders over the last 10 years in the state of Rio de Janeiro.

METHODS

Design and Study Area

This is a descriptive, ecological, and time series study. Data were obtained from registered notifications of accidents involving venomous animals in the State of Rio de Janeiro from 2012 to 2021, accessible through the Brazilian Notifiable Diseases Information System (SINAN). We analyzed variables such as type of accident, age, sex, and geographical/health regions of residence. For the variable “type of accident,” reports of envenomations by spiders, scorpions, and snakes were specifically analyzed. The state is divided into nine health regions based on geographic areas and the organization of health services: Baía da Ilha Grande, Baixada Litorânea, Centro-Sul, Médio Paraíba, Metropolitana I, Metropolitana II, Noroeste, Norte, and Serrana.

Source of Data

The data used in this study were retrieved from SINAN, accessed via the TABNET site, through the Information Technology Department of the Brazilian Unified Health System (DATASUS). The tables and graphs were constructed using Excel. Incidence rates were estimated using population estimates provided by the State Health Department of Rio de Janeiro (SES-RJ), available on the Health Information page.

Time Series Analysis

Time series analysis was performed using the publicly accessible software Joinpoint Regression. The temporal distribution of rates was analyzed according to region, age group, and type of accident. The software identifies trend changes (joinpoints) and adjusts linear trends on a logarithmic scale. The annual percentage change (APC)

and respective 95% confidence intervals were estimated. Each p-value was calculated using Monte Carlo methods, with the overall asymptotic significance level maintained through a Bonferroni correction. It is worth noting that, as temporal behavior may differ between variables and between categories within the same variable, the resulting periods are not always consistent. The last year of one period is the first year of the next.

Regional Distribution

Spatial data from the regions of the State of Rio de Janeiro were used to display different incidence rates. This analysis was performed using R software.

Ethical Considerations

This study was conducted using de-identified secondary data, publicly accessible through the DATASUS website, and in compliance with Resolution 466/2012 of the National Health Council. Therefore, it did not require approval by the Research Ethics Committee.

RESULTS

During the period from 2012 to 2021, a total of 17,891 accidents involving venomous animals were reported among residents of the State of Rio de Janeiro, with 17,540 occurring within the state itself. Snakes were responsible for the majority of accidents (33.4%), followed by scorpions (27.2%) and spiders (27.0%). Bees, caterpillars, and other animals accounted for only 10.0%, and the remaining 2.4% were unclassified.

In 2012, snakebite envenomations had the highest rates, while scorpion and spider accident rates were lower and similar. By 2021, scorpion envenomations had the highest rates. Regarding temporal trends, there was a decrease in notifications of snakebites and an increase in other types of accidents, with a notable rise in scorpion envenomations (consistent annual variation of 10.7%) and spider-related incidents (Table 1).

Table 1 – Accidents by venomous animals' rates and trends, according to type of accident, sex and severity, Rio de Janeiro state, 2012-2021.

Variable	2012 N= 1,384	2021 N= 1,866	Annual Percentage Change (95%CI) *	Trend
Total	8.4	10.7	2012-2021: 6,3 (2.3; 10.6)	Increase
Type of accident				
Snakes	3.7	2.9	2012-2021: 0,6 (-2.8; 4.2)	Stable
Scorpions	1.9	3.2	2012-2021:10.7 [a] (4.7; 17.1)	Increase
Spiders	2.0	3.0	2012-2021: 8,1 [a] (3,5; 12,8)	Increase
Other	0.7	1.2	2012-2019: 15.0 [a] (9.5; 15.7) 2019-2021: -13.1 (-39.6; 25.0)	Increase Stable
Sex				
Males	11.9	14.3	2012-2021: 5.5 [a] (1.6; 9.7)	Increase
Females	5.1	7.4	2012-2019: 11.9 [a] (6.5; 17.6) 2019-2021: -10.9 (-38.5; 28.3)	Increase Stable
Severity				

Mild	5.1	6.7	2012-2021: 7.2 [a] (2.9; 11.7)	Increase
Moderate	1.9	2.4	2012-2021: 5.1 [a] (1.9; 8.4)	Increase
Severe	0.3	0.3	2012-2019: 5.4 [a] (1.6; 9.58) 2019-2021: -20.6 (-40.0; 5.1)	Increase Stable

** 95% CI= 95% Confidence Interval*

[a] Annual percent change (APC) significantly different from zero at the alpha = 0,05 level.

Source of data: Sistema de Informações sobre Agravos de Notificação

Although notification rates increased for both sexes, men were consistently more affected throughout the period. However, women experienced a more pronounced increase in the incidence of accidents, with an annual percentage change of 11.9% from 2012 to 2019, followed by stability from 2019 to 2021 (Table 1). Regarding the classification of severity, most accidents were mild, followed by moderate and severe cases. All categories showed an increase in incidence rates, with a more significant rise in mild accidents, while severe accidents remained stable between 2019 and 2021 (Table 1).

The year with the highest number of accidents was 2019, with a total of 2,576 notifications. Of these, 770 were caused by scorpions, 748 by spiders, and 739 by snakes. The total number of mild accidents caused by scorpions increased from 220 in 2012 to 546 in 2019, while those caused by spiders rose from 244 in 2012 to 546 in 2019. The number of moderate accidents caused by scorpions and spiders increased from 48 and 60 to 135 and 128, respectively, from 2012 to 2019. Additionally, the number of accidents not classified according to severity (missing data) also increased, particularly in cases of scorpion envenoming and arachnidism (Figure 1).

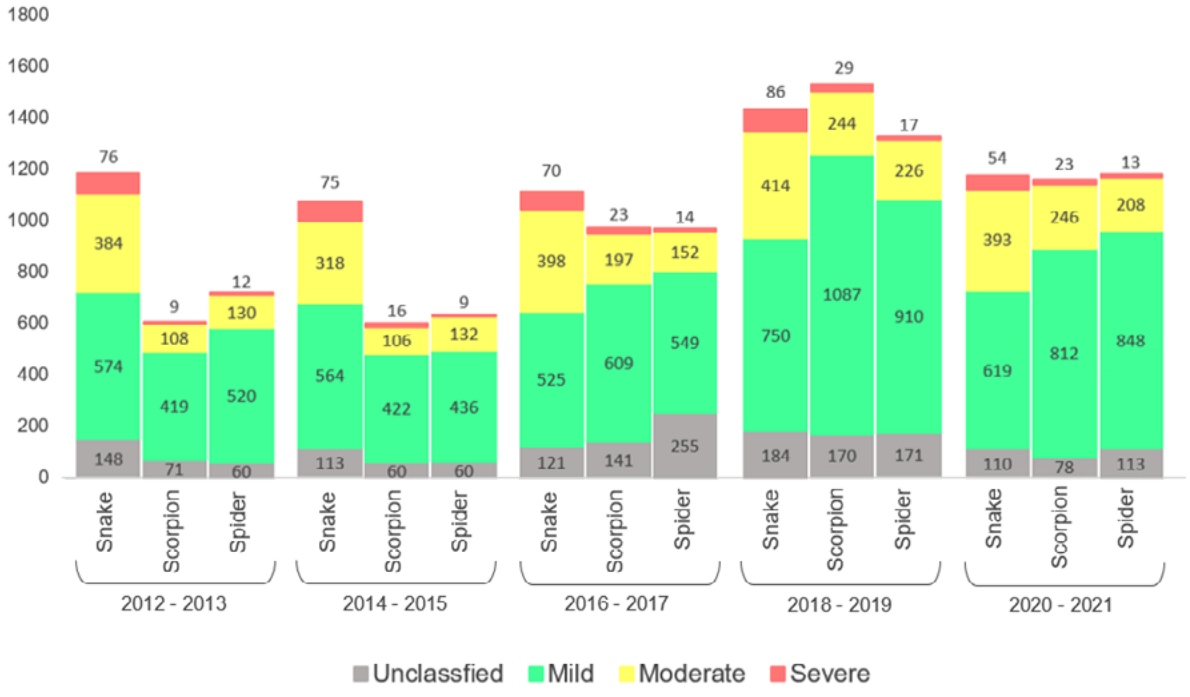

Figure 1 – Severity of accidents by venomous animals (snakes, scorpions, and spiders), State of Rio de Janeiro, 2012-2021.

An analysis of the clinical evolution data revealed that 51 deaths were reported over the ten-year period. Of these fatal cases, 43.1% were classified as mild, 41.2% as severe, 5.9% as moderate, and the remaining cases were unclassified. Snakes and scorpions were responsible for the majority of deaths (17 each), followed by bees and spiders (9 and 7 deaths, respectively). The age group with the highest fatality rate was those aged 40 years or older (28 deaths), followed by individuals aged 20 to 39 years (15 deaths). The lethality rates were 0.35% for scorpions, 0.28% for snakes, and 0.15% for spiders.

In 2012, the Baía da Ilha Grande region had the highest incidence rate, followed by the Centro-Sul and Serrana regions, with all rates exceeding 40/100,000 inhabitants (Table 2). By 2021, the Centro-Sul region recorded the highest incidence, followed by Baía da Ilha Grande, with both regions surpassing 60/100,000 inhabitants. The Metropolitan Regions I and II had the lowest incidence rates.

Snakebites were the most frequent type of accident in the Baía da Ilha Grande, Centro-Sul, Serrana, and Metropolitan regions, while scorpion accidents predominated in the Médio Paraíba and North regions. In the Serrana region, spider accidents were nearly as frequent as snakebites. From 2012 to 2021, the number of notifications increased in most regions, with the exception of Baía da Ilha Grande, Norte, and Serrana. The increase in accidents was primarily driven by scorpion and spider incidents. Snakebite notifications increased only in the Norte and Metropolitana II regions (Table 2). By 2021, scorpion accidents became the most reported type in the Centro-Sul, Médio Paraíba, Noroeste, and Norte regions, replacing snakebite accidents. In the Serrana and Metropolitana II regions, spider accidents saw a significant increase, surpassing snakebites. In the Médio Paraíba and Baía da Ilha Grande regions, spider accidents were the second most frequent. Only in the Baía da Ilha Grande and Metropolitana II regions did bee-related accidents surpass those caused by scorpions (Table 2).

Table 2 - Accidents by venomous animals' rates and trends, according to type of accident and region, Rio de Janeiro state, 2012-2021.

Region		2012 N= 1,384	2021 N= 1,866	Annual Percentage Change (95%CI)	Trend
Baía de Ilha Grande	Total	49.3	62.3	2012-2021: 1.3 (-5.5; 8.7)	Stable
	Snakes	33.0	35.0	2012-2021: 1.6 (-2.8; 6.2)	Stable
	Bees [b]	3.5	7.0	2012-2021: -0.5 (-10.4; 10.4)	Stable
	Spiders	7.4	8.0	2012-2021: -0.8 (-18.8; 21.2)	Stable
Centro-Sul	Total	44.4	65.5	2012-2014: -12.1 (-43.7; 37.3) 2014-2021: 11.8 [a] (5.4;18.7)	Stable Increase
	Snakes	25.8	11.6	2012-2021: -3,3 (-8.7; 2.4)	Stable
	Scorpions	12.2	36.4	2012-2021: 16.7 [a] (10.6; 23.2)	Increase
	Spiders	5.2	13.1	2012-2021: 8.8 [a] (0.4; 17.8)	Increase

Baixada Litorânea	Total	9.7	14.2	2012-2021: 8.5 [a] (3.9; 13.3)	Increase
	Snakes	3.5	4.9	2012-2021: 5,0 (-0.9; 11.1)	Stable
	Scorpions	3.2	2.0	2012-2021: 2,9 (-6.8; 13.6)	Stable
	Spiders	2.5	5.2	2012-2021: 11,0 [a] (0.1; 23.1)	Increase
Médio Paraíba	Total	27.5	45.3	2012-2021: 8.5 [a] (3.9; 13.3)	Increase
	Snakes	8.6	7.3	2012-2021: -0.2 (-3.7; 3.5)	Stable
	Scorpions	9.3	20.2	2012-2021: 10.4 [a] (5.1; 16.0)	Increase
	Spiders	8.7	13.8	2012-2021: 9.3 [a] (4.0; 14.9)	Increase
Metropolitana I	Total	1.8	2.00	2012-2019: 7.6 [a] (2.1; 13.5) 2019-2021: -16.5 (-43.8; 24.1)	Increase Stable
	Snakes	0.9	0.8	2012-2021: -0.2 (-3.7; 3.5)	Stable
	Scorpions	0.2	0.3	2012-2021: 8.2 [a] (1.5; 15.4)	Increase
	Spiders	0.3	0.5	2012-2021: 4.3 (-1.5; 10.4)	Stable
Metropolitana II	Total	1.10	3.60	2012-2021: 15.5 [a] (9.5; 21.9)	Increase
	Snakes	0.8	1.4	2012-2021: 9.2** (0.9; 17.7)	Increase
	Bees [b]	0.0	0.6	2012-2021: 27.1 (-2.1; 65.0)	Stable
	Spiders	2.1	2.6	2012-2021: 41.2 [a] (12.7; 76.7)	Increase
Noroeste	Total	12.4	26.5	2012-2021: 14.5 [a] (4.7;25.3)	Increase
	Snakes	7.7	8.3	2012-2021: 6.2 (-2.0; 15.0)	Stable
	Scorpions	2.4	14.3	2012-2021: 27.1* (9.9; 47.1)	Increase
	Spiders	2.1	2.6	2012-2021: 9.1 (1.7; 13.8)	Stable
Norte	Total	16.30	11.80	2012-2021: 3.8 (-5.6; 14.1)	Stable
	Snakes	1.8	2.3	2012-2021: 8.9 [a] (0.7; 17.9)	Increase
	Scorpions	8.1	7.9	2012-2021: 7.4 (-3.2; 13.8)	Stable
	Spiders	0.7	0.4	2012-2021: 3.4 (-3.7; 11.0)	Stable
Serrana	Total	47.40	43.5	2012-2021: 4.6 (-1.8; 11.4)	Stable
	Snakes	19.9	8.9	2012-2021: -4.5 (-9.0; 0.4)	Stable
	Scorpions	6.5	7.0	2012-2021: 10.2 (4.7; 18.0)	Stable
	Spiders	16.8	21.3	2012-2021: 8.9 [a] (1.7; 16.5)	Increase

**95% CI= 95% Confidence Interval*.

[a] Annual percent change (APC) significantly different from zero at the alpha = 0,05 level.

[b] Regions with higher rates of accidents by bees than by scorpions.

Source: Sistema de Informações sobre Agravos de Notificação – SINAN

Figure 2 allows a better visualization of the regions of RJ state (figure 2A), and the different incidence rates, according to color intensity (figure 2B).

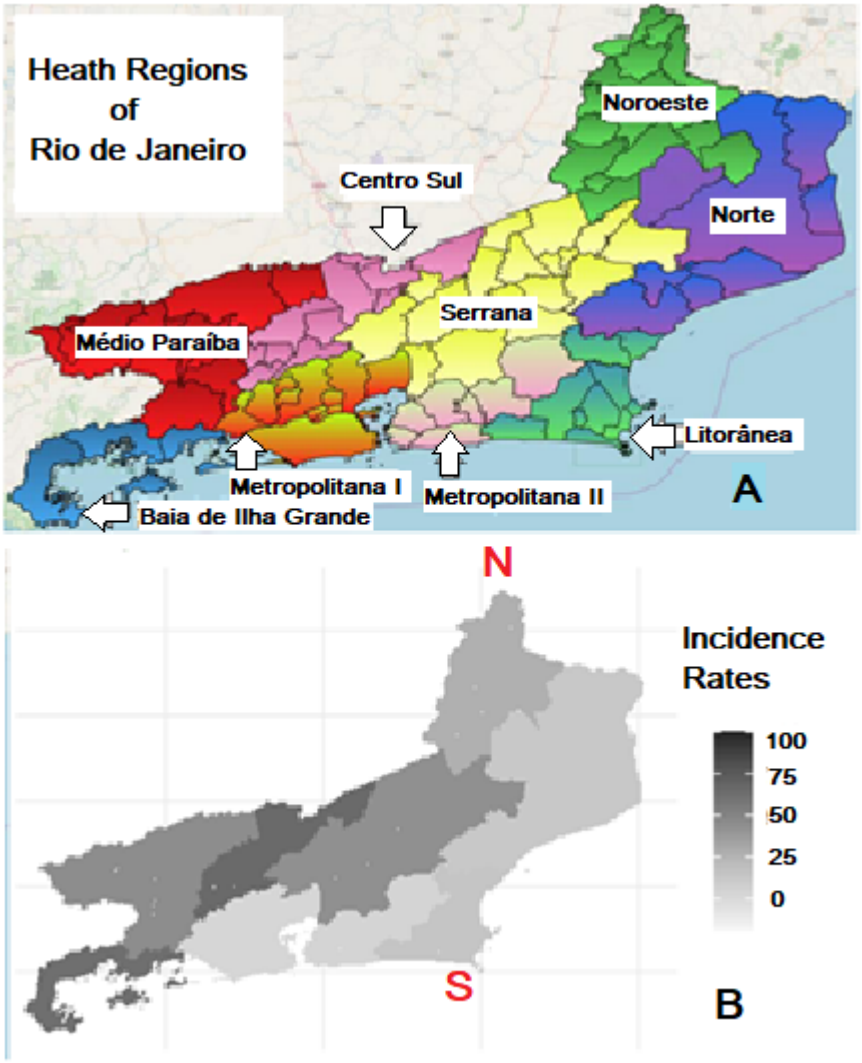

Figure 2 – A) Health regions of Rio de Janeiro state; B) Accidents by venomous animals' incidence rates.

Snakes, scorpions, and spiders accounted for approximately 87% of all accidents involving venomous animals in the State of Rio de Janeiro. Table 3 lists these accidents by age group. Rates were higher in the 40-59 age group, followed by the 20-39 age group, throughout the period. There was an upward trend in all age groups, but much more intense among adolescents and children (APC greater than 10%).

For snakebite accidents, the highest incidence was among the 40 to 59 age group, followed by the group of 60 years and older. Accidents with snakes remained stable in all age groups, except for the 10- to 19-year-old- group, between 2012 and 2018, in which there was an increase (5.3% annually), followed by stability in the years 2019 to 2021. In 2021, snakebites had the highest occurrences only in the 40- to 59-year-old- age group (Table 3).

Table 3 – Accidents by venomous animals (snakes, scorpions, and spiders) rates and trends, according to age, Rio de Janeiro state, 2012-2021.

Age (years)		2012 N= 1,257	2021 N= 1,603	Annual Percentage Variation (95%CI) *	Trend
0 - 9	Total	4.1	6.5	2012-2019: 10.2** (7.2; 13.2) 2019-2021: -13.3 (-29.2;6.2)	Increase Stable
	Snakes	1.5	1.3	2012-2021: -0.8 (-4.9; 3.5)	Stable
	Scorpions	1.3	1.9	2012-2021: 8.7** (3.0; 14.7)	Increase
	Spiders	1.0	2.2	2012-2021: 8.5** (2.6; 14.8)	Increase
10 - 19	Total	6.0	9.0	2012-2019: 10.5** (5.5;15.8) 2019-2021: -13.0 (-38.5;23.1)	Increase Stable
	Snakes	2.9	2.3	2012-2019: 5.3** (0.1; 10.8) 2019-2021:-20.9 (-45.8: 15.4)	Increase Stable
	Scorpions	1.4	3.5	2012-2021: 12.0** (5.9; 18.4)	Increase
	Spiders	1.0	2.3	2012-2021: 8.6** (1.7; 15.9)	Increase
20 - 39	Total	8.6	10.9	2012-2021: 6.6** (2.5; 11.0)	Increase
	Snakes	3.7	2.9	2012-2021: 0.5 (-3.2; 4.4)	Stable
	Scorpions	2.2	3.1	2012-2019: 15.9** (5.6; 27.1) 2019-2021:-18.8 (-59.5; 62.8)	Increase Stable
	Spiders	2.2	3.4	2012-2021: 9.1** (4.4; 14.0)	Increase
40 - 59	Total	11.1	12.9	2012-2021: 6.2** (1.4;11.2)	Increase
	Snakes	5.2	4.0	2012-2021: 1.0 (-3.2; 5.5)	Stable
	Scorpions	2.1	3.9	2012-2021: 11.7** (5.4; 18.4)	Increase
	Spiders	3.2	3.9	2012-2021: 7.6** (1.7; 13.8)	Increase
≥ 60	Total	8.4	9.4	2012-2021: 5.2** (0.9; 9.7)	Increase
	Snakes	3.8	2.9	2012-2021: -0.4 (-3.4; 2.7)	Stable
	Scorpions	1.7	3.1	2012-2021: 11.2** (4.7; 18.0)	Increase
	Spiders	2.2	2.6	2012-2021: 6.2** (1.2; 11.5)	Increase

**95% CI= 95% Confidence Interval.*
[a] Annual percent change (APC) significantly different from zero at the alpha = 0,05 level.
Source: Sistema de Informações sobre Agravos de Notificação – SINAN

Accidents by scorpions were more frequent in 2012, in the 20- to 59-year-old age group. They increased in all age groups (for the 20- to 39-year-old group, there was stability in the years 2019 to 2021). In 2021, this type of animal envenoming was highest among adolescents, a 150% increase from 2012, and older people (60 and more years). In the 40–59-years age group, scorpions and spiders had similar rates. Spider envenoming also increased and recorded the highest rate/occurrences among children and the 20 to 39-year age group (Table 3).

DISCUSSION

This study highlighted that the State of Rio de Janeiro, although with low total rates of accidents by venomous animals, has a heterogeneous distribution of incidences, and some regions show higher rates than national values[5]. We identified an increase in accidents by scorpions and spiders, and stability for snakebites, as reported in most Brazilian macro-regions in recent years[15]. Scorpions, snakes, and spiders were responsible for 86% of accidents, particularly among men of working age.

In addition, a sharp drop in the absolute values of these accidents was recorded in the years 2020 and 2021, which we assume to be an effect of the Covid-19 pandemic, as it limited economic activities in the period, reducing the risk of contact with venomous animals. Another reason could be that people that suffered mild accidents by venomous animals did not access healthcare, because health services were focused on Covid-19 patients[21].

Snakebites

Snakebite accidents commonly affect individuals from lower socioeconomic backgrounds, particularly young adult males engaged in agricultural activities. These incidents often increase during periods of high rainfall, as snakes migrate to drier areas. In Brazil, the majority of cases occur in less urbanized areas with forest habitats. Aside from their impact on public health, snakebites have significant economic repercussions due to productivity losses from permanent disabilities. From 2007 to 2019, snakebites were the second most common type of venomous animal accident, representing 17.4% of cases. In our study, snakebite accidents represented 33.4% from 2012 to 2021. Initially, snakebites had the highest number of cases in the State of Rio de Janeiro but fell to third place by 2021.

The Baía da Ilha Grande region had a much higher incidence of snakebite accidents compared to the national average (20.3/100,000 inhabitants). This higher rate can be attributed to factors such as the region's Atlantic Forest biome, deforestation, and economic activities like ecological tourism, agriculture, and livestock. Economically active individuals are particularly at risk, with a strong association between snakebites and agricultural work.

In 2021, the State of Rio de Janeiro had the lowest incidence rate of snakebites in the southeastern region of Brazil (3.28/100,000 inhabitants). This low rate is due to the high urbanization of the Metropolitana I and Metropolitana II regions, which reduces contact with venomous animals. The pattern of ophidism in most regions studied was consistent with national trends, although an increasing trend was observed in the Norte and Metropolitana II regions.

Generally, individuals aged 40 to 59 years are most commonly affected by snakebites. In our study, this age group had the highest rates, with a notable increase in the 10 to 19-year-old age group, which is unusual compared to other regions in the country, including the Southeast, where rates remained stable or decreased. Understanding the reasons for this increase in snakebites among adolescents is crucial for planning targeted preventive measures.

The risk of death from snakebite depends on several factors, including the type

of snake, severity of the bite, amount of venom, and time to treatment. In our study, the highest number of deaths occurred among cases classified as mild, which is contrary to the expectation of greater lethality in more severe cases. This discrepancy suggests possible errors in the classification of accidents at admission or during the investigation process, which may have led to inadequate treatment. Additionally, information on the type of snake was missing in over 70% of records, limiting the ability to conduct a more detailed analysis.

Scorpions

From 2000 to 2012, scorpion accidents in Brazil quadrupled, particularly in the Northeast and Southeast regions, which accounted for about 90% of cases. This upward trend continued until 2019, when scorpion envenoming became the most frequent type of venomous animal accident. Males, individuals up to nine years old, and those in rural areas are at higher risk. Factors such as high temperatures, low precipitation, climate change, poor vegetation, and scorpions' adaptability to urban environments contribute to increased rates. Our study found that scorpion accidents increased from 2012 to 2021, representing 27.2% of all accidents in the State of Rio de Janeiro, surpassing snakebites in four of the nine regions analyzed.

The scorpion species most involved in accidents in Brazil is Tityus serrulatus (yellow scorpion), which is widely distributed and adaptable to both urban and rural environments. Its ability to reproduce parthenogenetically supports its rapid population growth. In our study, the incidence of scorpion envenoming was highest in less urbanized regions, with the Centro-Sul region having the highest rates.

This study also found a general increase in scorpion accidents across all age groups, with higher rates among adolescents and individuals aged 40 to 59 years. In contrast, Brazilian adolescents from the Northeast and Southeast regions had the highest incidences among their age group. Older adults (>60 years) in Brazil generally have higher incidences than those aged 40 to 59 years, which was not observed in the State of Rio de Janeiro.

Spiders

Spider accidents represent a significant public health issue in Brazil, with around 33,000 cases reported annually from 2017 to 2021 and a rate of 13.6 per 100,000 inhabitants in 2021. The medically relevant spider genera include Phoneutria (armed spider), Latrodectus (black widow), and Loxosceles (brown recluse), with Loxosceles being the most frequently reported. The South region has the highest rates, followed by the Southeast. The annual incidence of spider accidents doubled from 2000 to 2012 and continued to increase until 2019. Our study reported an increase in spider accidents in the State of Rio de Janeiro, particularly in the Centro-Sul, Baixada Litorânea, Médio Paraíba, Metropolitana II, and Serrana regions.

In 2021, the Serrana region had a rate of 21.3 per 100,000 inhabitants, much higher than the national average. Its climate, characterized by abundant summer rainfall and dry winters, is similar to other regions with increased spider accidents, such as Centro-Sul, Baixada Litorânea, Médio Paraíba, and Metropolitana II. These regions have experienced growth in tou-

rism and industrial activities, which may increase exposure to spiders.

The increase in reported spider accidents could reflect either a higher distribution of venomous spiders or improvements in notification systems, reducing underreporting. Information on the type of spider was missing in over 90% of records, limiting the ability to define the profile of spider accidents in the state.

Efforts by the Ministry of Health to encourage the public to seek medical care instead of relying on traditional remedies for spider envenomings may be contributing to the increased number of notifications.

Lethality

Lethality from venomous animal accidents ranged from 0.1% for spiders to 0.3% for both snakes and scorpions. However, this data diverges from the Mortality Information System (SIM), which recorded 47 deaths during the same period. The majority of these deaths were caused by bees (25 deaths), followed by snakes (15 deaths) and scorpions (7 deaths). No spider-related deaths were recorded in the SIM.

CONCLUSION

This study revealed that while the incidence of venomous animal accidents in the State of Rio de Janeiro is the lowest among southeastern Brazilian states, there is an unusual increasing trend in specific groups, particularly for scorpions and, to a lesser extent, spiders. These findings may indicate potential shortcomings in health and environmental policies, particularly in less urbanized areas of the state, which may affect economically and socially vulnerable populations.

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CONFLICT OF INTEREST
The authors declare that they have no competing interests.

AUTHORS' CONTRIBUTION
GHF, SSL and **BM**, under the guidance of **SCF** and **EBM**, were responsible for the design, analysis, discussion and interpretation of results. **SCF** critically reviewed the manuscript. **EBM** collaborated in the whole process. **BM** revised the text. All authors read and approved the final manuscript.

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