

SURVEILLANCE IN HEALTH: ACCIDENTS AND DEATHS CAUSED BY VENOMOUS ANIMALS IN THE SOUTHEAST REGION – BRAZIL, 2005-2015

Vigilância em saúde: acidentes e óbitos provocados por animais peçonhentos na região sudeste – Brasil, 2005-2015

Vigilancia en salud: accidentes y muertes provocadas por animales venenosos en la región sudeste – Brasil, 2005-2015

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ABSTRACT

Objective: to describe the occurrence of accidents and deaths caused by venomous animals in the Southeast region of Brazil. **Method:** epidemiological, ecological and analytical study. The NET-Notification of Injury Information System was searched for accidents and deaths occurring in the period from 2005 to 2015. Descriptive analyzes were carried out, followed by a bivariate analysis to compare the averages between states in the Southeast ($p < 0.05$). **Results:** a total of 471,403 accidents and 684 deaths caused by venomous animals in the Southeast region were observed, with most accidents recorded in 2014 (58,544) and deaths in 2015 (99). There was a greater average of accidents and deaths by scorpion: 5.694,14 and 7.45. Minas Gerais concentrated the largest number of accidents and deaths, compared to the other states ($p < 0.05$). **Conclusion:** a high frequency of accidents and deaths caused by venomous animals was evidenced, delineating a worrisome reality that must be effectively managed.

Descriptors: External causes; Morbidity; Public health surveillance; Epidemiology.

RESUMO

Objetivo: descrever a ocorrência de acidentes e óbitos provocados por animais peçonhentos, na região Sudeste, Brasil. **Método:** estudo epidemiológico, ecológico e analítico. Efetuou-se busca no Sistema de Informação de Agravos de Notificação-NET sobre acidentes e óbitos ocorridos no período de 2005 a 2015. Efetuaram-se análises descritivas, seguidas de análise bivariada para comparar as médias entre estados do Sudeste ($p < 0,05$). **Resultados:** observou-se um total de 471.403 acidentes e de 684 óbitos causados por animais peçonhentos na região

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Sudeste, com a maior parte dos acidentes registrada em 2014 (58.544) e de óbitos em 2015 (99). Houve maior média de acidentes e óbitos por escorpião: 5.694,14 e 7,45. Minas Gerais concentrou a maior quantidade de acidentes e óbitos, comparada aos demais estados ($p < 0,05$). Conclusão: evidenciou-se elevada frequência de acidentes e óbitos provocados por animais peçonhentos, delineando uma realidade preocupante que deve ser efetivamente gerenciada.

Descritores: Causas externas; Morbidade; Vigilância em saúde pública; Epidemiologia.

RESUMEN

Objetivo: describir la ocurrencia de accidentes y muertes provocadas por animales venenosos, en la región Sudeste, Brasil. **Método:** estudio epidemiológico, ecológico y analítico. Se realizó una búsqueda en el Sistema de Información de Agravios de Notificación-NET sobre accidentes y muertes ocurridos en el período de 2005 a 2015. Se realizaron análisis descriptivos, seguidos de análisis bivariado para comparar las medias entre estados del Sudeste ($p < 0,05$). **Resultados:** se observó un total de 471.403 accidentes y de 684 muertes causadas por animales venenosos en la región Sudeste, con la mayor parte de los accidentes registrados en 2014 (58.544) y de muertes en 2015 (99). Se observó un mayor promedio de accidentes y muertes por escorpión: 5.694,14 y 7,45. Minas Gerais concentró la mayor cantidad de accidentes y muertes, comparada a los demás estados ($p < 0,05$). **Conclusión:** se evidenció una elevada frecuencia de accidentes y muertes provocadas por animales venenosos, delineando una realidad preocupante que debe ser efectivamente administrada.

Descriptores: Causas Externas; Morbilidad; Vigilancia en salud pública; Epidemiología.

INTRODUCTION

In many tropical countries, accidents involving venomous animals are a matter of public health. Although estimates have become more accurate, there is still no standardized methodology for assessing the actual magnitude and mortality of poisoning by venomous animals with reasonable relevance and reliability.^{1,2}

In Brazil, a greater occurrence of cases is concentrated in the Southeast region, although there has been a significant increase in the States of the Northeast, particularly *Bahia*, *Rio Grande do Norte*, *Pernambuco*, *Alagoas*, and *Ceará*.³ Brazil is a continental country, encompassing 515,767,049 km² divided into five regions, each with geographic, environmental, socioeconomic, cultural and political variations.⁴ In this sense, there are challenges imposed to face this public health problem, therefore, it is worth noting that there are basic aspects that involve health surveillance policies. Changes in animal behavior and human activities affect morbidity at various levels, evidencing the impact of environmental factors on the occurrence of accidents by venomous animals.^{5,6}

Hence, the need for effective health surveillance of accidents involving venomous animals must be underlined, especially through the *SINAN* [Information System of Aggravation Notification].⁷ To that end, the planning of the needs for antivenoms is linked to epidemiological information from the *SINAN* accident reports. The antivenoms used in Brazil are produced by four official laboratories, contracted to the Ministry of Health, and distributed to the State Health Offices,

which define the strategic points for the care of the injured. The following different regional realities and needs must be taken into account: a) the presence of venomous animals of importance in health and accident records; b) travel time of the various probable accident sites to the nearest reference medical attention point; c) structure of the health service to approach the various clinical situations in accidents involving venomous animals, including the administration of antivenoms and the handling of the injured person in the event of an adverse reaction to the antivenom; d) refrigeration network structure, for storage of immunobiological substances.⁸

Thus, based on health surveillance using the *SINAN*, the study of the morbimortality of illness from the reports related to it can reflect its magnitude and consequences, and help health managers towards action planning. Studies on the epidemiology of accidents caused by venomous animals are an important tool for health surveillance and evaluation of health services. They collaborate not only for the adequacy and improvement of their functions, but also for the design of public policies that aim to reduce the occurrence and morbidity and mortality caused by these accidents.⁹

In the Southeast region of Brazil there are no previous studies documented in the literature that have addressed accidents and deaths by venomous animals reported throughout this region. Despite limitations on underreporting, it is hoped that in a region that has not previously investigated this type of research, it may be expected to add new insights and contribute to a more consistent picture of the context in which accidents occur deaths caused by venomous animals.

This work meant to describe the occurrence of accidents and deaths caused by venomous animals in the Southeast region of Brazil.

METHODS

It is an epidemiological research showing an ecological and analytical approach. It was performed the analysis of aggregate data related to accidents and deaths by venomous animals in the following federative units of the Southeast region: *Minas Gerais (MG)*, *Espírito Santo (ES)*, *Rio de Janeiro (RJ)* and *São Paulo (SP)*, Brazil.

The data analyzed were extracted from the *SINAN* Net, through a search conducted in December 2016 on an official website of the Ministry of Health (<http://portalsaude.saude.gov.br/index.php/o-ministerio/principal/secretarias/svs/acidentes-por-animais-peconhentos>). And they refer to cases reported in the period from 2005 to 2015.¹⁰ This period was chosen because it was the time interval that presented all the necessary data for this investigation and because it is a decade of analysis.

In the aforementioned website, there are data that group accidents and deaths caused by all types of venomous animals, which are described as follows: snakes; scorpions; spiders; Lepidoptera (moths and their larvae); Hymenoptera (bees, ants and wasps); Coleoptera (beetles); Chilopoda (centipede); fish; Cnidarian (jellyfish and caravels), among others. Specifically,

there are data on accidents and deaths by bees, spiders, scorpions, caterpillars, and snakes.¹⁰

The variables selected for the present study are related to accidents and deaths by the following: all types of venomous animals (which group the occurrences caused by the animals above-mentioned), snakes, scorpions, and spiders. It was decided to study these three animals, in particular, because they show higher epidemiological importance in Brazil.⁶

Data organization and statistical analysis were performed using IBM SPSS Software version 22.0 for Windows[®]. The description of the results was presented in both absolute and percentage values. Bivariate analyses were carried out to compare the averages of accidents and deaths by venomous animals among the States from the Southeast region. After checking the data normal distribution, by the Kolmogorov-Smirnov normality test, the data did not follow a normality pattern ($p < 0.001$). Thus, the Kruskal-Wallis nonparametric

test was executed. In all analyses, the level of significance was set at 5% ($p < 0.05$).

This study was performed in agreement with the Resolution from the National Health Council No. 466 from December 12th, 2012. There was no need for appreciation by a research ethics committee involving human beings because it was based exclusively on consolidated secondary data in the SINAN Net, which is of public domain and without nominal identification.

RESULTS AND DISCUSSION

The results of this investigation show a high number of occurrences of accidents and deaths caused by venomous animals in the Southeast region between 2005 and 2015. There was also an increase during the investigation period, with a concentration of occurrences in the most recent years. High frequencies were observed in Brazil, and the Southeast region is responsible for an important percentage when compared to the country (**Table 1**).

Table 1 - Accidents caused by venomous animals in Brazil, and also in the Southeast region and its representativity, 2005-2015.

Year	Brazil (number of cases)	Southeast region (number of cases)	Southeast region representativity (%)
2005	94,482	32,308	33.1
2006	95,999	30,541	31.8
2007	101,759	30,170	29.6
2008	106,066	34,244	33.2
2009	123,666	40,503	32.7
2010	127,099	40,308	31.7
2011	140,284	44,571	31.7
2012	143,732	50,717	31.7
2013	162,847	58,055	33.8
2014	171,567	58,544	34.1
2015	150,004	53,617	35.7

Source: SINAN-Net, 2016.

Over the period from 2005 to 2015, a total of 471,403 accidents and 684 deaths caused by venomous animals were observed in the Southeast region, with the highest number of accidents registered in 2014 (58,544), and the highest number of deaths in 2015 (99). The State of MG concentrated the largest number of occurrences of both accidents and deaths, in all considered years (**Table 2**).

Regarding the accidents and deaths caused by snakes, there were a total of 74,443 accidents and 192 deaths in the Southeast. In 2011, there were the majority of both accidents (7,524) and deaths (24). In the State of MG, the largest amount occurred in the studied period (**Table 2**).

In the Southeast region, most of the accidents (35,130) caused by scorpions were identified in 2014, while a greater number of deaths (52) predominated in 2009. In all considered years, both accidents and deaths predominated in the State of MG (**Table 2**).

Concerning the occurrence of accidents and deaths involving spiders, most accidents (9,160) were identified in 2013, while a larger number of deaths (10) predominated in 2015. From 2005 to 2015, the State of São Paulo concentrated the majority of the accidents (34,786), whereas the prevalence of deaths was in the State of MG (27) (**Table 2**).

Table 2 - Distribution of accidents and deaths caused by venomous animals according to the year and federative units from the Southeast region. Brazil, 2005-2015

Accidents and deaths caused by venomous animals in general										
Federative unit and region										
Year	Minas Gerais		Espírito Santo		Rio de Janeiro		São Paulo		Southeast region	
	Accidents	Deaths	Accidents	Deaths	Accidents	Deaths	Accidents	Deaths	Accidents	Deaths
	n/%	n/%	n/%	n/%	n/%	n/%	n/%	n/%	n/%	n/%
2005	16,841/52.1	33/63.5	2,490/7.7	6/11.5	1,042/3.2	3/5.8	11,935/37.0	10/19.2	32,308/100	52/100
2006	16,329/53.4	17/68.0	2,108/6.9	0/0.0	1,131/3.7	0/0.0	10,973/36.0	8/32.0	30,541/100	25/100
2007	16,108/53.4	25/53.2	2,302/7.6	10/21.3	1,109/3.7	3/6.4	10,651/35.3	9/19.1	30,170/100	47/100
2008	17,770/51.9	50/75.8	2,770/8.1	3/4.5	1,119/3.3	3/4.5	12,585/36.7	10/15.2	34,244/100	66/100
2009	21,299/52.6	69/81.2	2,778/6.8	4/4.7	1,175/3.0	1/1.2	15,251/37.6	11/12.9	40,503/100	85/100
2010	20,063/50.7	46/76.7	2,981/7.5	3/5.0	1,168/3.0	3/5.0	15,379/38.8	8/13.3	39,591/100	60/100
2011	22,538/51.3	52/69.3	3,944/9.0	5/6.7	1,006/2.3	3/4.0	16,413/37.4	15/20.0	43,901/100	75/100
2012	25,109/50.3	48/70.6	4,083/8.2	4/5.9	1,375/2.7	2/2.9	19,362/38.8	14/20.6	49,929/100	68/100
2013	29,420/50.7	26/54.2	4,517/7.8	7/14.6	1,411/2.4	1/2.0	22,707/39.1	14/29.2	58,055/100	48/100
2014	29,931/51.1	40/67.8	4,735/8.1	1/1.7	1,295/2.2	5/8.5	22,583/38.6	13/22.0	58,544/100	59/100
2015	27,538/51.4	63/63.6	3,639/6.8	3/3.0	1,062/1.9	8/8.1	21,378/39.9	25/25.3	53,617/100	99/100
Total/n	242,946	469	36,347	46	12,893	32	179,217	137	471,403	684
Accidents and deaths involving snakes										
Federative unit and region										
Year	Minas Gerais		Espírito Santo		Rio de Janeiro		São Paulo		Southeast region	
	Accidents	Deaths	Accidents	Deaths	Accidents	Deaths	Accidents	Deaths	Accidents	Deaths
	n/%	n/%	n/%	n/%	n/%	n/%	n/%	n/%	n/%	n/%
2005	3,892/53.0	12/63.2	1,068/14.6	2/10.5	568/7.7	0/0.0	1,812/24.7	5/26.3	7,340/100	19/100
2006	4,075/54.7	5/45.5	1,019/13.7	0/0.0	641/8.6	0/0.0	1,713/23.0	6/54.5	7,448/100	11/100
2007	3,495/53.1	7/38.9	1,063/16.1	4/22.2	573/8.7	1/5.6	1,459/22.1	6/33.3	6,590/100	18/100
2008	3,519/50.8	14/82.3	1,142/16.5	1/5.9	568/8.2	0/0.0	1,695/24.5	2/11.8	6,924/100	17/100
2009	2,986/46.0	13/68.4	901/13.8	2/10.5	641/9.8	1/5.3	1,975/30.4	3/15.8	6,503/100	19/100
2010	3,288/49.8	11/68.8	855/12.9	2/12.5	615/9.3	1/6.2	1,846/28.0	2/12.5	6,604/100	16/100
2011	3,982/53.0	13/54.1	1,002/13.3	1/4.2	542/7.2	1/4.2	1,998/26.5	9/37.5	7,524/100	24/100
2012	3,747/52.5	12/63.1	889/12.5	0/0.0	605/8.5	1/5.3	1,890/26.5	6/31.6	7,131/100	19/100
2013	3,676/51.7	7/58.3	972/13.6	3/25.0	580/8.1	0/0.0	1,894/26.6	2/16.7	7,122/100	12/100
2014	2,817/46.5	11/61.1	714/11.8	1/5.6	532/8.8	1/5.6	1,994/32.9	5/27.7	6,057/100	18/100
2015	2,530/48.7	7/36.8	614/11.8	1/5.3	429/8.2	3/15.8	1,627/31.3	8/42.1	5,200/100	19/100
Total-n	38,007	112	10,239	17	6,294	9	19,903	54	74,443	192
Accidents and deaths involving scorpions										
Federative unit and region										
Year	Minas Gerais		Espírito Santo		Rio de Janeiro		São Paulo		Southeast region	
	Accidents	Deaths	Accidents	Deaths	Accidents	Deaths	Accidents	Deaths	Accidents	Deaths
	n/%	n/%	n/%	n/%	n/%	n/%	n/%	n/%	n/%	n/%
2005	9,946/63.9	18/69.3	981/6.3	3/11.5	240/1.5	3/11.5	4,412/28.3	2/7.7	15,579/100	26/100
2006	8,761/62.0	7/87.5	745/5.3	0/0.0	227/1.6	0/0.0	4,402/31.1	1/12.5	14,135/100	8/100
2007	8,393/61.0	15/65.2	764/5.5	5/21.7	244/1.8	1/4.4	4,370/31.7	2/8.7	13,771/100	23/100
2008	9,731/59.2	23/71.9	1,122/6.8	2/6.2	259/1.6	2/6.2	5,321/32.4	5/15.7	16,433/100	32/100
2009	13,078/61.4	49/94.2	1,445/6.8	1/2.0	246/1.2	0/0.0	6,519/30.6	2/3.8	21,288/100	52/100
2010	12,259/57.6	27/93.2	1,529/7.2	1/3.4	257/1.2	0/0.0	7,227/34.0	1/3.4	21,272/100	29/100
2011	13,460/58.8	32/84.2	2,013/8.8	3/7.9	217/1.0	1/2.6	7,201/31.4	2/5.3	22,891/100	38/100
2012	14,261/55.1	23/79.4	2,138/8.3	3/10.3	308/1.2	0/0.0	9,166/35.4	3/10.3	25,873/100	29/100
2013	17,384/55.2	11/55.0	2,256/7.2	3/15.0	310/1.0	1/5.0	11,503/36.6	5/25.0	31,453/100	20/100
2014	19,442/55.3	18/75.0	2,852/8.1	0/0.0	281/0.8	3/12.5	12,555/35.8	3/12.5	35,130/100	24/100
2015	17,889/54.7	31/66.0	2,066/6.3	2/4.2	227/0.7	4/8.5	12,535/38.3	10/21.3	32,717/100	47/100
Total -n	144,604	254	17,911	23	2,816	15	85,211	36	250,542	328

Accidents and deaths involving spiders										
Federative unit and region										
Year	Minas Gerais		Espírito Santo		Rio de Janeiro		São Paulo		Southeast region	
	Accidents n/%	Deaths n/%	Accidents n/%	Deaths n/%	Accidents n/%	Deaths n/%	Accidents n/%	Deaths n/%	Accidents n/%	Deaths n/%
2005	1,338/30.4	2/66.7	238/5.4	0/0.0	194/4.4	0/0.0	2,635/59.8	1/33.3	4,405/100	3/100
2006	1,404/33.5	1/100.0	168/4.0	0/0.0	215/5.1	0/0.0	2,403/57.4	0/0.0	4,190/100	1/100
2007	1,782/40.2	0/0.0	269/6.1	0/0.0	214/4.8	0/0.0	2,167/48.9	0/0.0	4,432/100	0/0.0
2008	1,720/36.8	7/87.5	257/5.5	0/0.0	208/4.5	0/0.0	2,487/53.2	1/12.5	4,672/100	8/100
2009	2,260/36.1	2/66.7	252/4.0	0/0.0	237/3.8	0/0.0	3,508/56.1	1/33.3	6,257/100	3/100
2010	1,842/33.2	0/0.0	277/5.0	0/0.0	242/4.4	0/0.0	3,189/57.4	0/0.0	5,550/100	0/100
2011	2,216/36.3	2/100.0	354/5.8	0/0.0	193/3.2	0/0.0	3,332/54.7	0/0.0	6,095/100	2/100
2012	2,875/40.4	3/75.0	369/5.2	0/0.0	342/4.8	1/25.0	3,534/49.6	0/0.0	7,120/100	4/100
2013	3,879/42.4	1/50.0	416/4.5	1/50.0	396/4.3	0/0.0	4,469/48.8	0/0.0	9,160/100	2/100
2014	2,975/41.3	0/0.0	355/5.0	0/0.0	303/4.2	1/100	3,566/49.5	0/0.0	7,199/100	1/100
2015	2,933/42.1	9/90.0	272/4.0	0/0.0	260/3.7	0/0.0	3,496/50.2	1/10.0	6,961/100	10/100
Total -n	25,224	27	3,227	1	2,804	2	34,786	4	66,041	34

Source: SINAN Net, 2016.

In **Table 3**, there were statistically significant associations when comparing the averages of the State of MG and the other federative units ($p < 0.05$), with higher average values for MG, except for accidents involving spider, which had the highest average in the State of *São Paulo*.

Table 3 - Comparison of the averages of the accidents and deaths caused by venomous animals among the federative units from the Southeast region. Brazil, 2005-2015.

Variable	Federative unit	Average (\pm SD)	Median	p-value*
Accidents	Minas Gerais	22,079.64 (\pm 5,236.818)	21,229.00	
	Espírito Santo	3,304.27 (\pm 917.114)	2,981.00	<0.001
	Rio de Janeiro	1,172.09 (\pm 133.603)	1,131.00	
	São Paulo	16,292.45 (\pm 4,591.198)	1,5379.00	
Deaths	Minas Gerais	42.64 (\pm 16.237)	46.00	
	Espírito Santo	4.18 (\pm 2.786)	4.00	<0.001
	Rio de Janeiro	2.91 (\pm 2.166)	3.00	
	São Paulo	12.45 (\pm 4.845)	11.00	
Accidents involving snakes	Minas Gerais	3,455.18 (\pm 500.342)	3,519.00	
	Espírito Santo	930.82 (\pm 158.492)	972.00	<0.001
	Rio de Janeiro	572.18 (\pm 59.587)	573.00	
	São Paulo	1,809.36 (\pm 170.441)	1,846.00	
Deaths	Minas Gerais	10.18 (\pm 3.093)	11.00	
	Espírito Santo	1.55 (\pm 1.214)	1.00	<0.001
	Rio de Janeiro	0.82 (\pm 0.874)	1.00	
	São Paulo	4.91 (\pm 2.427)	5.00	
Accidents involving scorpions	Minas Gerais	13,145.82 (\pm 3,820.353)	13,078.00	
	Espírito Santo	1,628.27 (\pm 688.248)	1,529.00	<0.001
	Rio de Janeiro	256.00 (\pm 31.556)	246.00	
	São Paulo	7,746.45 (\pm 3,222.425)	7,201.00	
Deaths	Minas Gerais	23.09 (\pm 11.623)	23.00	
	Espírito Santo	2.09 (\pm 1.514)	2.00	<0.001
	Rio de Janeiro	11 (\pm 1.36)	1.00	
	São Paulo	11 (\pm 3.27)	2.00	

Variable	Federative unit	Average (\pm SD)	Median	p-value*
Accidents involving spiders	Minas Gerais	2.293,09 (\pm 789,371)	2,216.00	
	Espírito Santo	293,36 (\pm 71,672)	272.00	<0.001
	Rio de Janeiro	254,91 (\pm 65,823)	237.00	
	São Paulo	3.162,36 (\pm 676,033)	3,332.00	
Deaths	Minas Gerais	2.45 (\pm 2.945)	2.00	
	Espírito Santo	0.09 (\pm 0.302)	0.00	<0.002
	Rio de Janeiro	0.18 (\pm 0.405)	0.00	
	São Paulo	0.36 (\pm 0.505)	0.00	

Source: SINAN-Net, 2016.

*Kruskal-Wallis nonparametric test

The present study evidenced a considerable amount of accidents and deaths caused by venomous animals in the Southeast region, including when comparing this region to Brazil, and its increase during the investigation period, as well as the concentration in more recent years.

In other countries, a reality similar to that observed in the present study is observed. In the African continent, the incidence of snakebite is underestimated because there is no precise reporting system.¹ Considering the 500,000 cases of snakebite accidents, 40.0% were hospitalized, leading to 20,000 deaths per year. In Asia, mainly in India, Burma, and Pakistan, the snake causes between 25,000 and 35,000 deaths per year. In other countries, such as the United States of America, Canada, and European countries, snakebite accidents are relatively rare.¹ At those places, about 90.0% of the 8,000 poisonings per year require hospitalization, 30 fatal cases. In Japan, the incidence is about 1/100 thousand citizens and the lethality is less than 1.0%.^{1,11}

Study on poisoning by snakes, scorpions, and spiders that occurred in the period from 2009 to 2013 in Brazil recorded an annual average of 60,370.8 accidents caused by scorpions, 28,812 cases of snakebites and 25,786.⁴ accidents involving spiders. Most deaths were caused by snakes (average of 119 per year), followed by scorpions (79.6) and spiders (13.2).² In the Northeast region of Brazil, research on snakebite showed that incidence and mortality increased progressively from 2000 to 2009. During this period, 57,699 cases were reported,¹² fewer than the total identified in the present investigation.

The results found here are also close to other studies carried out in the State of Bahia/Brazil,¹³ in the State of Rio Grande do Norte/Brazil,⁶ in a general hospital from the Bahia countryside,⁹ in the Poison Control Center of the Regional University Hospital of Maringá city, Paraná State/Brazil,¹⁴ and in previous investigations done in the State of MG.^{15,16}

As for the animals causing the accidents investigated, a higher frequency of accidents and deaths caused by scorpions was observed, followed by those caused by snakes, especially in the State of MG. Scorpionism has been growing significantly throughout the country, especially

in urban areas,¹⁷ where the scorpion is well adapted and finds the right conditions to proliferate.⁸ They represent a serious problem not only in the Southeast but in other regions in Brazil, due to the high number of cases reported annually.¹⁴

Most accidents involving scorpions are classified as mild and do not require serum therapy, can be treated at the health unit closest to the place of occurrence.⁸ However, scorpions are arthropods that can cause a sting of human poisoning, whose severity and evolution can vary widely and there are cases of death or temporary sequelae to work.^{18,19} In the State of MG, the most frequent species of scorpion is *Tityus serrulatus*, which causes the most serious accidents,¹⁶ which may explain the fact that the State presented the highest number of accidents and deaths by this type of animal.

Environmental aspects that may be associated with scorpions include the hydrographic network, irregular occupations, green areas, vacant lands, logging, sewage network, vegetation/land use, highway, ironworks, railroads, buildings, and cemeteries. Due to this reality, especially at the municipal level, the public authorities should analyze the real situation of the accidents involving scorpions, in order to prioritize efforts to reduce the number of accidents.¹⁷ It is possible that these aspects characterize vulnerabilities in the State of MG, frequency of accidents and deaths by scorpions. Thus, basic sanitation and environmental monitoring actions need to be reinforced, with community orientations and scorpion proliferation control.¹³

Accidents involving snakes are registered in all Brazilian regions and States, so they are not geographically restricted to some locations.¹¹ Nonetheless, this study evidenced a high number of accidents and deaths caused by snakes in the Southeast region, mainly in the State of MG. In popular wisdom, they indicate the most serious accidents, so the affected individuals seek assistance more frequently,¹⁴ being one of the reasons contributing to the notification. Therefore, such accidents must be a constant object of public actions, aiming at environmental health surveillance, basic sanitation and greater clarification of the population.^{18,19}

The occurrences involving spiders were responsible for the least number of accidents and deaths. Due to the fragile oral apparatus, the small size of the animals and the activity of the poison is more directed against insects, most spiders cannot cause harm to humans. Additionally, although these animals have synanthropic habits, both in rural and urban areas, they represented the lowest frequency in this study. Most accidents are mild and do not require the use of specific serum therapy, which causes many victims to seek no assistance. It is possible that the frequency of involvement is greater than is reported.^{8,20} However, in this study, the number of accidents can be considered alarming and the frequency of deaths in the analyzed period is also worrying.

The venomous animals, mainly snakes and scorpions investigated in this study, can lead to serious accidents, sequelae, many of them incapacitating, and even evolve to death, 21 more negative outcome, the frequency observed in the current work requires meticulous attention. Often, the diseases in question are classified as of low severity. And because they have a relatively resolute treatment, the occurrence of deaths may be related to the time spent to cross the distance between the accident site and the hospital care unit of the victims.²² This may explain the considerable number of deaths verified in the present investigation.

Furthermore, it corroborates the need for a quick interval between the time of the accident and the care,⁹ which also implies access to antivenoms. Although venomous animal poisoning is a frequent public health concern in many countries, this problem remains neglected, especially in tropical and subtropical countries. In addition to the considerable costs of antivenom, there is a need for standardized and effective treatment and qualification of health professionals.²³

The results identified in the present study and in the others corroborate a trend of increasing notifications of accidents caused by venomous animals in Brazil in recent years.⁶ There are still high underreporting rates, and record failures and losses are also large. But, over the years, it is expected that these rates will gradually decline in the country. This is because there is a clear increase in the capacity of data capture by the *SINAN*.^{7,11} In addition to the improvement in the notification system, there has been greater access of users to the health system, which could be related to the increase of notifications in the *SINAN*.²⁴ In this way, the qualification of accident information will contribute to the real knowledge of the epidemiology of these injuries, subsidizing the quality of attendance to occurrences and the promotion of prevention measures appropriate to the local reality.¹¹

The reality observed through this research, especially in the State of *MG* where the highest frequencies occurred, might result from improvements in the management and feeding of the *SINAN* in the States. Health surveillance actions have been reinforced in recent years, with the creation of responsible sectors, including environmental

health surveillance. The cooperative practice was sought with the reference sectors of planning and management, with a view to the continuous adjustment between demand and supply of information and the application of epidemiology in the monitoring of diseases and diseases. There have been advances in new management technologies, with an emphasis on improving information systems, including the *SINAN*.²⁵ This may have involved improving the *SINAN*'s capacity for data capture and less underreporting of accidents by venomous animals in the State of *MG*.

Nevertheless, it is appropriate to consider whether this trend of increasing occurrences, observed in the scenario of this research, corresponds to reality. Such an increase should be viewed with caution, as it can be explained by different perspectives. This is because there are several factors that may be related: cases that were not previously known and attended by the health services are now being, due to improved access to the public health system; professionals and managers may now be more aware of the *SINAN* notification and feeding; due to environmental changes and anthropogenic action, people may be more exposed to accidents by venomous animals.^{2,21}

Given this framework, despite the multifactor nature of accidents by venomous animals, the interference of environmental changes in the still high number of such diseases is undeniable. Disorganized urban growth, the indiscriminate use of natural resources, inadequate housing, lack of basic sanitation, the disorderly expansion of industrialization, ecological imbalance caused by deforestation, and climate change over a number of years,²¹ among other factors, predispose the proliferation of venomous animals and provide an overlap between spaces used by man and animals, affecting the quality of life and human health.²⁶

The State of *MG*, among the others from the Southeast region, has concentrated the largest number of accidents and deaths, both in general and for each animal, except in cases of accidents caused by spiders. On the other hand, the States of *ES* and *RJ* were responsible for the lower frequency of occurrences. Such finding is relevant, and its assessment should be made with caution. This State has a territorial extension superior to the other States from the Southeast region, besides having varied geographic and environmental conditions that can favor a greater diversity of venomous animals and appropriate conditions for them to develop.^{15,24}

A survey performed in the State of *Rio de Janeiro* has shown that the losses of the *SINAN* records in this area are still high. Data discrepancies were found in municipalities and regions from the State.⁷ There is still a lack of information on injuries with venomous animals at the *SINAN* in several Brazilian municipalities, indicating the need to review and qualify regional registration systems, as well as training of municipal health secretariats.⁷

Hence, in order to ensure the population's access to care and treatment with antivenoms, measures need to be

taken to ensure the reliability of the information. This is because, although the estimates have become more precise, there is still no standardized methodology for assessing the real incidence and mortality from poisoning by venomous animals with reasonable relevance and reliability.⁵

Conclusively, it is informed that the results of the present investigation should be analyzed in light of certain limitations: the results do not allow declarations of cause and effect; there is a possibility of ecological bias, in other words, failure of ecological associations to reflect the biological effect at the individual level; and underreporting, preventing the actual extent of the problem from being known. Therefore, the analyzes should consider the coverage and quality limitations of the *SINAN* information. Moreover, few works in the literature on the subject that investigated an entire Brazilian region were identified, which made it difficult to compare the results. Despite this, this research was a pioneer in the scenario investigated and the results are relevant in health surveillance. The limitations lead to further research on the subject in question and improvements in the structure of the *SINAN*, so that it can be investigated more thoroughly and reliably.

CONCLUSIONS

Herein, it was possible to evidence a high frequency of accidents and deaths caused by venomous animals and their rise along with the historical series analyzed, especially in more recent years. The State of *MG* concentrated the largest number of occurrences of both accidents and deaths, a finding that requires meticulous attention. Another noteworthy aspect is the fact that a high average number of accidents and deaths caused by scorpions were observed, followed by those caused by snakes.

A worrying reality has been outlined and should be carefully pondered, considering that several factors might be involved. The problem studied must not be neglected, but rather effectively managed targeting to promote an effective articulation between epidemiology, management of the *Sistema Único de Saúde (SUS)* [Brazilian Unified Health System] services, health surveillance and assistance, with a view to preventing accidents and deaths, which have a negative impact on the population's health.

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