EPIDEMIOLOGY OF SCORPION STINGS IN THE STATE OF MATO GROSSO DO SUL, BRAZIL (2012-2022)

EPIDEMIOLOGIA DOS ACIDENTES COM ESCORPIÕES NO ESTADO DE MATO GROSSO DO SUL, BRASIL (2012-2022)

EPIDEMIOLOGÍA DE LOS ACCIDENTES POR ESCORPIONES EN EL ESTADO DE MATO GROSSO DO SUL, BRASIL (2012-2022)

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ABSTRACT

Scorpionism represents a significant public health issue in Brazil, particularly in urban environments, and has shown a marked increase in the state of Mato Grosso do Sul, where long-term epidemiological investigations remain limited. This study aimed to analyze the epidemiological profile of scorpion sting accidents reported in the state between 2012-2022, based on secondary data obtained from the Notifiable Diseases Information System (SINAN), encompassing temporal and clinical variables. During the study period, a total of 21,017 cases were recorded, with a progressive increase in notifications over time. A slight predominance of female individuals was observed, along with a higher concentration of cases among the economically active population and a seasonal pattern characterized by increased occurrence during the warmer months of the year. Most accidents were classified as mild, with a consistently low proportion of severe cases and a case fatality rate below 1% throughout the historical series. Additionally, an increase in the proportion of patients receiving medical care within one hour after the accident was identified, suggesting improved timely access to health services. These findings indicate that, despite the rising incidence of scorpionism in Mato Grosso do Sul, clinical severity remains limited, underscoring the importance of continuous epidemiological surveillance, improvements in the quality of reporting systems, and the implementation of preventive strategies targeted at the most vulnerable population groups.

Keywords: Scorpionism. Venomous Animals. Public Health.

RESUMO

O escorpionismo constitui um importante problema de saúde pública no Brasil, especialmente em contextos urbanos, e apresenta crescimento expressivo no estado de Mato Grosso do Sul, onde ainda são escassos estudos epidemiológicos de longo prazo. Este estudo teve como objetivo analisar o perfil epidemiológico dos acidentes por escorpiões notificados no estado entre 2012-2022, com base em dados secundários do Sistema de

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Informação de Agravos de Notificação (SINAN), considerando variáveis temporais e clínicas. No período analisado, foram registrados 21.017 casos, observando-se aumento progressivo das notificações ao longo dos anos. Verificou-se discreta predominância do sexo feminino, maior concentração dos casos em indivíduos em idade economicamente ativa e padrão sazonal caracterizado por maior ocorrência nos meses mais quentes do ano. A maioria dos acidentes foi classificada como leve, mantendo-se baixa a proporção de casos graves e a letalidade, inferior a 1% em toda a série histórica. Observou-se ainda aumento da proporção de atendimentos realizados em até uma hora após o acidente, indicando maior acesso oportuno aos serviços de saúde. Os resultados evidenciam que, embora a incidência do escorpionismo no Mato Grosso do Sul esteja em ascensão, a gravidade clínica permanece reduzida, reforçando a importância do monitoramento epidemiológico contínuo, do aprimoramento da qualidade das notificações e da implementação de estratégias preventivas direcionadas aos grupos populacionais mais vulneráveis.

Palavras-chave: Escorpionismo. Animais Peçonhentos. Saúde Pública.

RESUMEN

El escorpionismo constituye un importante problema de salud pública en Brasil, especialmente en contextos urbanos, y presenta un crecimiento significativo en el estado de Mato Grosso do Sul, donde aún son escasos los estudios epidemiológicos de largo plazo. Este estudio tuvo como objetivo analizar el perfil epidemiológico de los accidentes por escorpiones notificados en el estado entre 2012-2022, a partir de datos secundarios del Sistema de Información de Agravos de Notificación (SINAN), considerando variables temporales y clínicas. Durante el período analizado se registraron 21.017 casos, observándose un aumento progresivo de las notificaciones a lo largo de los años. Se verificó una discreta predominancia del sexo femenino, una mayor concentración de los casos en individuos en edad económicamente activa y un patrón estacional caracterizado por una mayor ocurrencia en los meses más cálidos del año. La mayoría de los accidentes fue clasificada como leve, manteniéndose baja la proporción de casos graves y la letalidad, inferior al 1 % en toda la serie histórica. Asimismo, se observó un aumento en la proporción de atenciones realizadas dentro de la primera hora posterior al accidente, lo que indica un mayor acceso oportuno a los servicios de salud. Los resultados evidencian que, aunque la incidencia del escorpionismo en Mato Grosso do Sul se encuentra en ascenso, la gravedad clínica permanece reducida, lo que refuerza la importancia del monitoreo epidemiológico continuo, del perfeccionamiento de la calidad de las notificaciones y de la implementación de estrategias preventivas dirigidas a los grupos poblacionales más vulnerables.

Palabras clave: Escorpionismo. Animales Ponzoñosos. Salud Pública.

1 INTRODUCTION

Scorpions are chelicerate arthropods (Chelicerata) included among the arachnids and belonging to the order escorpiones (Scorpiones) (Vasconez-Gonzalez *et al.*, 2025; Moura *et al.*, 2020). They are among the first animals on earth with fossils dating back up to 400 million years (Carvalho; Franco-Assis, 2016). There are about 2,772 species of scorpions worldwide (Hernandez-Muños; Zavala-Sanchez, 2024), with the exception of Antarctica, and its adaptation allows the occupation of most *terrestrial habitats* and micro-habitats (Carvalho; Franco-Assis, 2016) which makes them excellent biological indicators of environmental degradation (Pinheiro *et al.,* 2025).

Due to their habitat preference and their life history strategies, scorpions can be divided into two ecological categories: those of balance and those of opportunism (Lourenço; Cuellar, 1995; Lourenço *et al.*, 1996). Equilibrium species have a pattern of low population density, low mobility and high endemism. On the other hand, opportunistic species are those that, among other characteristics, have the ability to easily invade environments disturbed by humans, have a high population density and are widely distributed. Among the best known opportunistic species, the representatives of the genera *Centruroides, Tityus and Isometrus* (Lourenço; Cuellar, 1995).

The embarrassment resulting from the encounter of humans with these animals, or scorpionism, has become a global health problem that mainly affects countries such as Mexico, Brazil, Algeria, Iran and Morocco (Lourenço; Cuellar, 1995; Lourenço *et al.*, 1996; Hernandez-Muños; Zavala-Sanchez, 2024; Vasconez-Gonzalez *et al.*, 2025). Because of this and taking into account its complications, the World Health Organization classifies this type of accident as a neglected tropical disease (NTD) (Vieira *et al.*, 2025).

Among the various species described, only 104 (3.8%) of the total are considered to be of medical interest, i.e., those with the potential to generate severe poisoning in humans. Zavala-Sanchez, 2024; (Vasconez-Gonzalez *et al.*, 2025). Most of the species of medical interest are ecologically opportunistic and belong, from a taxonomic point of view, to the *Buthidae* family, especially the species of the genus *Tityus* in Brazil.

The classification of scorpionism occurs in three different ways that reflect the severity of the reactions affected by the victim, in this way they are called mild, moderate or severe. Concomitantly, it is important to highlight that the evolution is linked to several factors related to the victim (comorbidity, age, weight, exposure, among others) and to the animal involved (toxicity/composition of the venom, amount of venom applied, species involved, among others) (Costa *et al.*, 2025; Dias *et al.*, 2020; Furtado *et al.*, 2016).

According to the IBGE (2022), Mato Grosso do Sul is one of the 27 Brazilian federative units located in the Midwest region, occupying approximately 357,142.082 km² with about 2,757,013 people. This state is the birthplace of biomes such as the Pantanal, Cerrado and Atlantic Forest that have great biodiversity. In this context, the scorpiofauna stands out, which, despite being diverse, is underestimated due to the lack of taxonomic and systematic studies of the region and the whole country (Carvalho *et al.*, 2017).

According to Carvalho (2017), in Mato Grosso do Sul there are 16 species and one subspecies of scorpions, of which 12 species belong to the *Buthidae family,* two of which are representatives of the genus *Ananteris* Thorell and ten of the genus *Tityus* C. L. Koch. This richness further favors the encounter with these animals and the occurrence of accidents with them.

Since 1993, the Diseases and Notification Information System (SINAN) has made it mandatory to notify and register cases involving venomous animals, thus favoring access to information for better treatment of the injured person and distribution/application of the serums to be used (Lisboa *et al.*, 2020).

According to the Information System for Diseases and Notifications, in Brazil there was an increase of about 110 thousand cases of scorpionism between the years 2012 and 2022, while in Mato Grosso do Sul these numbers reach 2,800 cases reported in the same period. Due to this exponential increase and the scarcity of studies that analytically address scorpionism in this sample space, the present study sought to carry out an epidemiological survey in the state of Mato Grosso do Sul.

2 METHODOLOGY

This is a descriptive, retrospective, quantitative study, based on secondary data from the Notifiable Diseases Information System (SINAN), referring to cases of accidents due to scorpionism reported in the state of Mato Grosso do Sul, from 2012 to 2022. All records available in the system in the analyzed time interval were included, without the application of exclusion criteria.

It should be noted that the data corresponding to the years 2020, 2021 and 2022 are subject to updating and revision by the information system, according to the routine of the Ministry of Health. Data extraction was carried out on November 27, 2025.

Statistical analyses were conducted with the aid of the JASP software (version 0.95.4), using the chi-square test for adherence to evaluate the temporal distribution (seasonality) and the distribution of cases according to sex. Descriptive analyses, including

the calculation of epidemiological indicators, as well as the elaboration of tables and figures, were performed in Microsoft Excel.

The variables of this study can be divided into two categories that include not only individual aspects - age, education, race/color and gender - but also characteristics related to the accident - seasonality, time of care and case classification.

All surveys were carried out according to (1) a base variable, the year of the accident, and (2) the specific variables for each thematic axis analyzed. Thus, and exploring the variables (2), the age group was distributed as: children under 1 year old (< 1 year), from one to four years old (01 - 04), from five to nine years old (05 - 09), from 10 to 14 years old (10 - 14), 15 to 39 years old (15-39), 40 to 59 years old (40-59), 60 to 64 years old (60-64), 65 to 69 years old (65-69), 70 to 79 years old (70-79) and from 80 years old onwards (80 >). Color/race variables were described as: Ign/White (data ignored or without information), white, brown, black, yellow and indigenous.

For schooling, the following were considered: Ign/White, for data that were unknown or without information; Illiterate, for those without schooling; 1st to 4th grade, for those with incomplete elementary education; 4th grade, for those with complete elementary school; 5th to 8th grade, for those with incomplete elementary education; Complete elementary school; Incomplete high school; Complete high school; Incomplete higher education; Complete higher education; and Not Applicable. In another category, the data available for both genders, female and male, were analyzed.

Regarding seasonality, variable (2) considered the twelve months of the year. The hours of help considered were: Ign/White, for unknown or uninformed data; 0 to 1 hour, for accidents that took up to one hour to seek medical help; 1 to 3 hours, for accidents that took from one to three hours to seek medical help; 3 to 6 hours, for accidents that took from three to six hours to seek medical help; 6 to 12 hours, for accidents that took from six to 12 hours to seek medical help; 12 to 24 hours, for accidents that took from 12 to 24 hours to seek medical help; 24+ hours, for accidents that took from 24 hours onwards to seek medical help. For the classification of scorpionism, variable (2) considered cases classified as Ign/White, mild, moderate and severe.

Regarding the ethical issues of this research, since the data obtained from SINAN are part of a Brazilian database of public access and do not contain identification of the victims, being available on the website of the Department of Informatics of the Unified Health System (DATASUS), it is not necessary to evaluate it by an Ethics Committee in Research with Human Beings. according to the rules of the National Health Council (National Health Council, 2023).

3 RESULTS

In the period from 2012 to 2022, 21,017 cases of accidents caused by scorpions were reported in the state of Mato Grosso do Sul. The analysis of the temporal distribution showed a progressive increase in the number of cases of scorpionism over the period studied. In the initial years of the series, the records presented lower values, with a gradual increase from 2017 onwards and maintenance of an increasing trend until 2022 (Figure 1).

When analyzing the incidence per 100,000 inhabitants, calculated for all years using the estimated population of the state in 2022 as the denominator (IBGE 2022), a behavior similar to that of the absolute numbers was observed, with a continuous increase in rates over the period, reaching the highest values in the most recent years of the series (Table 1).

Table 1

Number of incidence per hundred thousand inhabitants, percentage of lethality of cases, percentage of severe cases and percentage of care performed within one hour of the accident.

Ano	Incidência (100mil/hab)	% atendimento até 1h	% letalidade	% casos graves
2012	38,2	67,4	0,0	0,3
2013	31,4	66,7	0,2	0,1
2014	39,0	65,2	0,1	0,3
2015	39,7	62,4	0,5	0,6
2016	36,2	67,5	0,6	0,2
2017	57,1	68,0	0,1	0,4
2018	76,3	68,6	0,1	0,7
2019	91,8	69,0	0,0	0,5
2020	99,3	71,3	0,0	0,3
2021	112,9	76,5	0,2	0,2
2022	140,4	76,2	0,0	0,2

Source: Authors.

Figure 1

Cases of scorpionism in Mato Grosso do Sul in the years 2012 to 2022

Source: Adapted from SINAN data

Of the total number of cases analyzed, 10,961 (52.16%) occurred in females and 10,053 (47.83%) in males, and there were also three records (0.01%) with unknown or blank information. The distribution of cases according to sex differed significantly from a uniform distribution, as evidenced by the chi-square test for adherence ($\chi^2 = 39.23$; gl = 1; $p < 0.001$), indicating that the cases were not randomly distributed among the categories analyzed. Thus, the slight predominance of females does not represent a random fluctuation, but rather a consistent pattern, possibly related to demographic, behavioral, occupational, or exposure factors.

For the seasonality category, the monthly distribution of cases was analyzed for the years with complete records, corresponding to the period from 2012 to 2018. The chi-square test for adherence indicated a statistically significant difference in relation to a uniform distribution of cases between the months ($\chi^2 = 685.2$; gl = 11; $p < 0.001$). Most of the accidents occurred during the hottest months of the year (Exhibit 2).

Table 2

Seasonality of accidents caused by scorpions in Mato Grosso do Sul (2012-2022)

Ano	Jan	Fev	Mar	Abr	Mai	Jun	Jul	Ago	Set	Out	Nov	Dez	Total
2012	137	120	118	103	72	41	47	44	57	106	100	109	1.054
2013	101	87	91	65	77	51	51	49	52	79	91	72	866
2014	127	112	127	114	64	45	48	63	69	106	97	103	1.075
2015	134	92	114	65	73	63	43	65	91	104	131	119	1.094
2016	100	137	122	93	54	31	61	53	47	89	102	110	999
2017	140	138	129	122	111	77	80	112	108	199	181	176	1.573
2018	178	202	251	173	128	117	114	97	155	222	239	227	2.103
2019	-	-	-	-	-	-	-	-	-	271	251	265	2.531
2020	-	-	-	-	-	-	-	-	-	276	193	236	2.737
2021	-	-	-	-	-	-	-	-	-	344	457	418	3.114
2022	-	-	-	-	-	-	-	-	-	397	371	334	3.871

Source: Adapted from SINAN data

As of 2019, the incompleteness of the monthly records made it impossible to apply formal statistical analysis of seasonality, and these data were considered only descriptively.

Regarding the severity of the accident, the proportion of cases classified as serious remained low over the years, with values below 1% in most of the period, with no increase proportional to the increase in the total number of cases. Lethality also remained low throughout the time series, with the occurrence of deaths in specific years, with no upward trend (Table 1).

Regarding care and search for specialized medical help, a progressive increase in the proportion of visits was observed within one hour after the accident. (Table 1)

The distribution of cases according to age group showed a higher concentration among individuals of economically active age, with a predominance in the age groups of 20 to 39 years, followed by the groups of 40 to 59 years (Table 3).

Table 3

Age group of the affected victims

Ano acidente	<1 Ano	01-04 anos	05- 09 anos	10- 14 anos	15-19	20-39	40-59	60-64	65-69	70-79	80>	ig/em branco	Total
2012	10	55	52	89	104	402	242	39	28	26	7	-	1.054
2013	7	50	56	52	60	330	218	37	22	21	12	1	866
2014	19	47	66	71	109	388	266	28	36	34	11	-	1.075
2015	18	62	65	78	94	371	279	49	38	29	11	-	1.094
2016	11	41	43	61	101	370	248	43	25	38	18	-	999
2017	20	68	107	100	125	557	399	74	60	49	14	-	1.573
2018	23	96	121	141	146	738	557	106	74	74	27	-	2.103
2019	21	129	144	176	185	845	683	116	95	103	34	-	2.531
2020	34	156	166	175	225	866	730	142	89	117	37	-	2.737
2021	32	158	177	195	262	1.000	828	166	94	149	53	-	3.114
2022	47	189	237	239	329	1.208	973	230	168	183	68	-	3.871

Source: Adapted from SINAN data

Regarding education, a higher frequency of cases was observed among individuals with incomplete elementary education. It is noteworthy that a significant portion of the

notifications had records classified as unknown/blank or not applicable, which limits more detailed analyses of this variable (Table 4).

Table 4

Education level of affected victims

Ano	Ign/Branco	Analfabeto	1ª a 4ª série incompleta do EF	4ª série completa do EF	5ª a 8ª série incompleta do EF	Ensino fundamental completo	Ensino médio incompleto	Ensino médio completo	Educação superior incompleta	Educação superior completa	Não se aplica	Total
2012	384	12	89	35	147	58	73	128	17	27	84	1.054
2013	355	11	61	25	120	53	44	81	8	20	88	866
2014	441	9	77	45	131	47	90	106	20	22	87	1.075
2015	434	7	59	47	137	58	68	128	20	27	109	1.094
2016	423	12	58	32	137	38	88	93	20	27	71	999
2017	613	10	143	54	213	74	112	149	26	43	136	1.573
2018	639	26	182	103	340	116	149	250	52	69	177	2.103
2019	771	27	243	106	394	130	230	300	49	75	206	2.531
2020	1.046	29	214	87	397	130	146	306	57	72	253	2.737
2021	1.377	29	207	98	381	130	186	324	53	74	255	3.114
2022	1.655	32	277	115	523	147	244	408	48	100	322	3.871

Source: Adapted from SINAN data

The most affected breeds are Brown and White, respectively. However, it is important to emphasize that, as with the schooling variable, the number of cases classified as unknown/white is also high (Table 5).

Table 5

Self-declaration of color/race of the affected victims

Ano acidente	Ign/Branco	Branca	Preta	Amarela	Parda	Indigena	Total
2012	194	366	38	10	421	25	1.054
2013	154	331	37	10	312	22	866
2014	209	341	43	11	454	17	1.075
2015	230	349	38	7	447	23	1.094
2015	175	363	28	12	398	23	999
2017	229	605	79	17	631	12	1.573
2018	105	960	128	66	798	46	2.103
2019	133	1.128	113	49	1.067	41	2.531
2020	230	1.290	128	46	1.005	38	2.737
2021	555	1.242	140	57	1.073	47	3.114
2022	617	1.479	168	64	1.481	62	3.871

Source: Adapted from SINAN data

4 DISCUSSION

Accidents with venomous animals are a relevant problem of public health problem in Brazil, with a significant increase in the number of notifications in the last decade, according to recent studies (Lacerda *et al.*, 2024) (Silva *et al.*, 2020). Among these diseases, scorpionism stands out as the most common in the country, surpassing other types of accidents and assuming a central role in the national epidemiological scenario (Martinelle *et al.*, 2025; Silva *et al.*, 2023).

In this context, the results of the present study corroborate the trend observed at the national level by demonstrating a significant increase in the number of cases of scorpionism in the state of Mato Grosso do Sul, with a sharper growth from 2017 onwards. Similar data have been described in different regions of Brazil (Dias *et al.*, 2020; Feitosa *et al.*, 2020; Lisboa *et al.*, 2020; Carmol *et al.*, 2019; Furtado *et al.*, 2016). In addition, this increase is discussed in other literatures that point to a complex causality of sociodemographic, environmental, and biological factors (Pucca *et al.*, 2025; Silva *et al.*, 2023; Almeida *et al.*, 2021; Kotviski; Barbola, 2013).

The analysis of the monthly distribution of cases showed a statistically significant seasonal pattern in the years with complete records, with concentration of accidents at certain times of the year with high temperatures and rainy periods. Suasnábar *et al* (2022) in a retrospective cross-sectional pediatric epidemiology study done in Argentina, demonstrated similar patterns in their results with a total of 83% of accidents happening in the spring and summer intervals. It was also possible to find similar results in the work of Alcantara *et al* (2023).

As in de Dias et al (2020), Carmol *et al* (2019), Carvalho *et al* (2016) and Furtado *et al* (2016), the cases in this study revealed a slight predominance of females (52.16%). With the application of the chi-square test of adherence, there was an indication that the gender distribution differed significantly from the expected distribution ($\chi^2 = 39.23$; gl = 1; $p < 0.001$), with a statistically significant predominance of females, thus rejecting the hypothesis of equal gender distribution. Concomitantly, surveys carried out in other regions show that males are more affected (Silva et al., 2023; Alcantara; Silva Jr, 2023; Almeida *et al.*, 2021; Cavalcanti et al., 2021; Suasnábar *et al.*, 2021; Feitosa *et al.*, 2020; Lisboa *et al.*, 2020). These divergences suggest an urban aspect of the accidents analyzed, indicating a complex multifactorial causality, related not only to occupational exposure, but also to behavioral factors and the home environment and their interactions (Camara; Santello, 2025; Almeida *et al.*, 2021; Carmol *et al.,* 2019; Furtado et al., 2016). The literature also highlights that, unlike scorpion accidents, which are often associated with the home

environment, snakebites are more frequent among men, being more directly related to work activities, especially in rural and occupational contexts with greater exposure (Silva *et al.*, 2015).

The most affected age group is 20 to 39 years old, a similar result present in studies such as de Alcantara *et al* 2023 and Dias *et* al, 2019. This distribution may be related to greater mobility, greater environmental exposure, and participation in domestic and work activities that favor contact with scorpions. Despite these results, the extreme age groups, with the lowest absolute number of cases, deserve special attention due to the higher risk of unfavorable outcome described in other studies (Camara; Santello, 2025; Vieira *et al.*, 2025; Cavalcanti et al., 2021; Suasnábar *et al.*, 2021; Lisboa *et al.*, 2020; Carmo et al., 2019).

As for education - incomplete elementary school - and race/correspondents - brown and white - the results should be interpreted with caution, considering the large presence of incomplete or ignored records. In addition, the predominance observed in certain groups reflects, in part, the sociodemographic composition of the population in the sample area, in the case of the state of Mato Grosso do Sul, and reinforces the importance of adequately filling out the notification forms for more refined analyses.

Despite the significant increase in the number of accidents over the years analyzed, the proportion of severe cases remained low, as well as the lethality, remaining below 1% of the total number of cases in all years of the period studied. This pattern indicates that, although mortality associated with scorpionism is reduced, challenges persist in the clinical management of these accidents. In this sense, Santana *et al.* (2018) highlight the occurrence of inadequate prescription of antivenom serums, suggesting low or insufficient adherence to pre-established treatment protocols.

On the other hand, the increase in the percentages in the proportion of care provided within one hour after the accident demonstrates greater awareness of the population about the importance of immediately seeking health services, as well as improvements in the organization of the care network and in the response capacity of emergency services. This data is extremely important because rapid care is one of the factors associated with the reduction of clinical severity and subsequent evolution.

As a study based on the use of secondary data, the limitations were the possibility of underreporting, inconsistencies in the completion of the forms and a high proportion of unknown fields in some variables, characteristics that are inherent to this type of analysis. In addition, the data for the years 2019, 2020, 2021 and 2022 are subject to review by the information system, which may impact temporal analyses.

5 CONCLUSION

The data collection carried out in this study plays a fundamental role in combating this public health condition. By analyzing the epidemiological profile of scorpion scorpion cases, including variables such as age group, education, gender, and seasonality, we can identify important patterns and determinants that guide effective prevention, intervention, and clinical management strategies. This information allows us to direct resources and efforts to more vulnerable areas and population groups, implementing pest control measures and promoting public awareness of the associated risks. In addition, continuous monitoring of this data over time is essential to assess the effectiveness of interventions and adapt existing combat strategies as needed, with the ultimate goal of reducing the incidence of cases, minimizing public health impacts, and improving the quality of life of affected communities.

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