



Scorpionism in children and adolescents: clinical and epidemiological factors associated with severe cases

Escorpionismo em crianças e adolescentes: fatores clínicos e epidemiológicos associados a casos graves

Escorpionismo en niños y adolescentes: factores clínicos y epidemiológicos asociados a los casos graves

Yanca Curty Ribeiro Christoff Ornelas¹, Victor Bruno da Silva¹, Maria Alice Miranda Fortes¹, Stéfany Allaide Fasolak Alves¹, Daniella Soeira Silva¹, Karina Andrade de Prince², Antônio Lincoln de Freitas Rocha¹, Josiane Santos Brant Rocha^{1,2}, Daniela Araújo Veloso Popoff^{1,2}.

RESUMO

Objetivo: Analisar a associação entre fatores epidemiológicos e clínicos à gravidade dos acidentes escorpionicos em crianças e adolescentes. **Métodos:** Trata-se de estudo retrospectivo transversal quantitativo analisou 648 prontuários de pacientes de zero a doze anos. A variável-desfecho foi a gravidade do escorpionismo, com análises bivariadas (teste Qui-Quadrado de Pearson) e multivariadas de Poisson para identificar fatores associados. **Resultados:** Evidenciou-se que 34,7% dos casos foram graves, predominando em crianças do sexo feminino, menores de três anos, de cor não branca, urbanas e de Montes Claros. A maioria dos acidentes ocorreu antes das 17h, em membros inferiores, com atendimento após 1h. Sequelas (RP=1,75; IC95% 1,00-3,05) e UTI (RP=2,45 IC95% 1,23-4,88) associaram-se à gravidade, enquanto picadas em membros inferiores reduziram a prevalência de acidentes graves (RP= 0,76; IC95 0,6-2,94). **Conclusão:** O perfil epidemiológico indicou que a maioria das picadas ocorreu antes das 17h, com atendimento após 1h, e picadas em membros inferiores associaram-se a menor prevalência. O perfil clínico relacionou-se à internação em UTI e ao uso de amins vasoativas. Dada a importância do escorpionismo em crianças, é crucial esclarecer a população para prevenir acidentes e aprimorar o prognóstico.

Palavras-chave: Picadas de escorpião, Venenos de escorpião, Pediatria, Crianças, Toxicologia.

ABSTRACT

Objective: To analyze the association between epidemiological and clinical factors and the severity of scorpion accidents in children and adolescents. **Methods:** This is a retrospective cross-sectional quantitative study that analyzed 648 medical records of patients aged between zero and twelve years. The outcome variable was the severity of scorpionism, with bivariate analysis (Pearson's chi-square test) and Poisson multivariate analysis to identify associated factors. **Results:** A total of 34.7% of the cases were severe, predominantly in female children, under three years old, non-white, urban and from Montes Claros. The majority of accidents occurred before 5pm, on the lower limbs, with care provided after 1am. Sequelae (PR=1.75; 95%CI 1.00-3.05) and ICU (PR=2.45; 95%CI 1.23-4.88) were associated with severity, while bites to the lower limbs reduced the prevalence of serious accidents (PR= 0.76; 95%CI 0.6-2.94). **Conclusion:** The epidemiological profile indicated that the majority of bites occurred before 5pm, with care after 1am, and bites to the lower limbs were associated with a lower prevalence. The clinical profile was related to ICU admission and the use of vasoactive amines. Given the importance of scorpionism in children, it is crucial to educate the population in order to prevent accidents and improve prognosis.

Keywords: Scorpion stings, Scorpion venoms, Pediatrics, Children, Toxicology.

¹ Universidade Estadual de Montes Claros (UNIMONTES), Montes Claros - MG.

² Centro Universitário FIPMoc (UNIFIPMoc), Montes Claros - MG.

RESUMEN

Objetivo: Analizar la asociación entre factores epidemiológicos y clínicos y la gravedad de los accidentes por escorpión en niños y adolescentes. **Métodos:** Estudio cuantitativo retrospectivo transversal con 648 historias clínicas de pacientes de cero a doce años. La variable de resultado fue la gravedad del escorpionismo, con análisis bivariados (chi-cuadrado de Pearson) y multivariados de Poisson. **Resultados:** 34,7% de casos graves, principalmente en niñas menores de tres años, no blancas, urbanas y de Montes Claros. La mayoría de los accidentes ocurrió antes de las 17h, en miembros inferiores, atendidos después de 1h. Secuelas (PR=1,75; IC 95%: 1,00-3,05) y UCI (PR=2,45; IC 95%: 1,23-4,88) se asociaron a la gravedad, y picaduras en miembros inferiores redujeron prevalencia de casos graves (PR=0,76; IC 95%: 0,6-2,94). **Conclusión:** Perfil epidemiológico muestra picaduras antes de las 17h, atención después de 1h, y picaduras en miembros inferiores con menor prevalencia. Perfil clínico vinculado a UCI y aminas vasoactivas. Por la importancia del escorpionismo en niños, es crucial educar para prevenir accidentes y mejorar el pronóstico.

Palabras-clave: Picaduras de escorpión, Venenos de escorpión, Pediatría, Niños, Toxicología.

INTRODUCTION

Scorpionism consists of poisoning caused by the inoculation of toxins, through the inoculating apparatus of scorpions in the body of humans, and can determine local and systemic changes. The occurrence of scorpionic accidents has grown so alarmingly in tropical countries that its repercussions led the World Health Organization (WHO) to include it as a neglected tropical disease in the years 2009 and 2017 (SOUZA CM, 2018). There are an estimated 1.5 million stings per year worldwide and 2,600 deaths as a result (CARMO EA, et al., 2019), with scorpion poisoning being a serious health challenge in tropical and subtropical regions, especially in Latin America (TANIELE-SILVA J, et al., 2020). Many cases of scorpionism involve children. According to data from the Notifiable Disease Information System (SINAN, as per its Portuguese acronym), between 2010 and 2014, 16,183 and 24,521 cases of poisoning were recorded among children and adolescents in Brazil (BRASIL, 2022).

In Brazil, scorpion stings are an emerging public health problem, mainly due to the adaptation of some species to the urban environment (TANIELE-SILVA J, et al., 2020). The expressive and disorganized growth of urban areas favors the habitation of scorpions, instigating these animals to face and accommodate themselves in this new environment, offering risk to humans (LISBOA NS, et al., 2020). Populated and impoverished places favor the proliferation of scorpions, and their occurrence is expressly registered inside homes. Other aspects that shape the appearance of scorpions in urban areas are the lack of infrastructure and the poor quality of housing (SOUZA CM e BOCHNER R, 2018; CHIPPAUX JP, et al., 2020).

Because it is typically an urban and peridomiliary event, scorpionism has clinical and epidemiological relevance in children, since the proximity of the scorpion to the household makes the playful activity potentially dangerous (BRASIL, 2017b). Scorpionism is especially serious for children under 10 years of age, especially when caused by the species *Tityus serrulatus* (yellow scorpion, with a higher risk of evolution to death (CAMPOS L, 2020; LISBOA NS, et al., 2020; CARMO EA, et al., 2019).

Most deaths are related to age group (BASEER KA e NASER MA, 2019), multidimensional poverty and lack of knowledge or reliable information about scorpions and scorpionism before or after the occurrences, continuity of exposure to the disease and the absence of guarantee of the right of access to public health policy in its equity (SOUZA CM e BOCHNER R, 2018). Complications, which usually result in death, include systemic symptoms such as cardiogenic shock and acute pulmonary edema, which may lead to respiratory failure (CAMPOS L, 2020).

The treatment of scorpionism provides for a specific serum therapy, and the serum should be applied intravenously and in the number of ampoules depending on the classification of the case (CAMPOLINA D, 2006; CUPO P, 2015) and, according to the Brazilian Ministry of Health, in children under 7 years of age stung by the scorpion, regardless of the clinical presentation, where the application of serum therapy is already recommended given the potential severity. To that end, it is important to stimulate and intensify

programs for the prevention and control of scorpionic accidents (FRACOLLI LA, 2008). Therefore, while scorpionism configures a public health problem, there will be the need to study more precisely the clinical and epidemiological behavior of this phenomenon (DABAS A, 2019), as well as to seek understanding beyond the biological agent, considering the related structural elements, such as a better discussion of modes of urban development and the guarantee of human rights, especially regarding health (FRACOLLI LA, 2008).

In view of the above, and especially considering the high probability of the clinical picture evolving to a higher level of severity in children, it is necessary to study these aspects, so that scorpionism can be discussed in its full complexity, as a public health problem, sometimes neglected, but which deserves to be understood based on all the factors that contribute to its occurrence in a vulnerable portion of the population, namely children. Accordingly, the objective of this study was to analyze the association between epidemiological and clinical factors to the severity of scorpionic accidents in children and adolescents.

METHODS

Study design

This is a cross-sectional, retrospective and analytical study with a quantitative and documentary approach.

Population and sample

The study population consisted of children and adolescents, aged between 0 and 12 years, respectively, who had cases reported for scorpionism during the period from July 2015 to July 2020 and who were admitted to a public hospital located in the north of Minas Gerais for a period equal to or greater than 12 hours in the Emergency Room, Pediatric Intensive Care Unit (PICU) and pediatric ward. Exclusion criteria were children with other morbidities that could interfere with the outcome and poorly completed medical records.

Study procedures and variables

Data were collected directly from the clinical records of 648 children and adolescents, which were made available in digitized form by the HUCF research sector after signing the Term of Agreement of the Institution. Data collection took place through an objective questionnaire formulated from the data contained in the Epidemiological Investigation Forms of the Notifiable Diseases Information System (SINAN, as per its Portuguese acronym) of the Brazilian Ministry of Health and from the main demographic, epidemiological and clinical factors related to scorpionism, according to a literature review.

In this study, the severity of the cases was considered as a dependent variable (outcome), and this classification was assigned by the health care professional who evaluated the case and filled out the investigation form. In order to carry out the classification of the cases, the professional followed the recommendations of the Brazilian Ministry of Health, classifying the cases of scorpionism in: mild, where only local symptoms are present, such as pain, edema, erythema and paresthesia; moderate, those in which some systemic manifestations appear, such as nausea, sweating, occasional vomiting, tachycardia, tachypnea, agitation and mild arterial hypertension; or severe, when they present one or more intense systemic manifestations, such as profuse sweating, incoercible vomiting, excessive salivation, alternating agitation with prostration, bradycardia, heart failure, pulmonary edema, shock, convulsions and coma (BRASIL, 2017).

Dichotomization was performed in: severe cases (only the severe cases) and non-severe cases (mild and moderate cases). It was decided to group the mild cases with the moderate cases, which is justified by the greater possibility of comparing the results with the pertinent literature and increasing the possibilities of finding factors associated with a more severe outcome. As independent variables (exposure), the following demographic characteristics were considered: gender (male, female); age group (age less than or equal to 3 years and age greater than 3 years); zone of occurrence (urban, rural); birthplace of the patient (Montes

Claros or other region) and color (white, non-white); epidemiological aspects of scorpionism: Aspects related to the sting event: time of the sting (period equal to or less than 5 PM and after 5 PM), time between sting and care (time of occurrence less than or equal to 1 hour or more than 1 hour); location of the sting (upper or lower limbs) and aspects related to the clinical evolution, where the events of the clinical evolution and laboratory factors were related to the clinical evolution.

The clinical evolution events considered were: number of administered serum ampoules (up to 3 ampoules and use of 4 or more ampoules), orotracheal intubation (yes or no); ICU admission (yes or no); vasoactive amine (administered or not administered); chest X-ray (with or without infiltration); intravenous furosemide (not administered or administered), abnormal electrocardiogram (ECG), (present or absent), sequelae (present or absent); signs or symptoms (present or absent) and systemic complications (present or absent).

The analyzed laboratory factors related to the clinical evolution were routine urine (altered or not altered); capillary blood glucose (altered or not altered); amylase (altered or not altered); sodium (altered or not altered) and potassium (altered or not altered). This study respected all the necessary ethical standards and was approved by the Research Ethics Committee (CEP) of the Faculdades Integradas Pitágoras of Montes Claros (opinion nº 4.742.501 and CAAE 46561621.1.0000.5109).

RESULTS AND DISCUSSION

This work showed a high prevalence of severe scorpionic accidents in girls under 3 years of age, with non-white skin color, occurring in urban areas, until 5 PM, treated more than 1 hour after the sting, and the severity being associated with stings on lower limbs. It was also observed a high prevalence of sequelae and ICU admission in scorpionism victims, factors directly related to severe cases. Characterization of the demographic and epidemiological profile of scorpion accident victims treated at a hospital in the north of Minas Gerais and analysis of the data collected are shown in **tables 1 to 5**.

Table 1 - Characterization of the demographic and epidemiological profile of scorpionic accident victims.

Variables	N (%)
Demographic variables	
Gender	
Female	336 (52.0)
Male	310 (48.0)
Age	
≥ 3 years	311 (48.0)
< 3 years	335 (52.0)
Zone of occurrence	
Urban	536 (82.7)
Rural	110 (17.3)
Birthplace of the patient	
Montes Claros	440 (67.9)
Other city	206 (31.8)
Skin color	
White	27 (04.5)
Non-white	619 (95.5)
Epidemiological aspects of scorpionism	
Time of the sting	
Until 5 PM	420 (64.8)
After 5 PM	228 (35.2)
Time between sting and care	
Up to 1 hour	284 (43.8)
> 1 hour	364 (56.2)
Location of the sting	
Upper limbs	233 (36.0)
Lower limbs	415 (64.0)

Source: Ornelas YC, et al., 2024.

Table 2 - Bivariate analysis of demographic factors with scorpionism severity from 2015 to 2020 (n=422).

Mild/Moderate Severe	N %		PR (95% CI)	P-value
Gender/Sociodemographic variables				
Female	219 (65.2)	117 (34.8)	1.00	
Male	203 (65.5)	107 (34.5)	0.99 (0.80-1.22)	0.935
Age				
> 3 years	199 (64.0)	112 (36.0)	1.00	
< 3 years	223 (66.6)	112 (33.4)	0.92 (0.75-1.14)	0.491
Zone of occurrence				
Urban	351 (65.5)	185 (34.5)	1.00	
Rural	71 (64.5)	39 (35.5)	1.02 (0.77-1.35)	0.850
Birthplace of the patient				
Montes Claros	289 (65.7)	151 (34.3)	1.00	
Other	133 (64.6)	199 (35.4)	1.03 (0.82-1.29)	0.780
Skin color				
White	17 (63.0)	10 (37.0)	1.00	
Non-white	405 (64.4)	214 (34.6)	0.93 (0.56-1.54)	0.789

Note: PR: Crude prevalence ratio at the 0.25 level; CI: 95% Confidence Interval.

Source: Ornelas YC, et al., 2024.

Table 3 - Bivariate analysis of the epidemiological and clinical aspects of scorpionism with the severity of cases from 2015 to 2020 (n=422).

Mild/Moderate Severe	N%		PR (95% CI)	p-value
Time of the sting / Epidemiological aspects of scorpionism				
Until 5 PM	277 (66.0)	143 (34.0)	1.00	
After 5 PM	145 (64.2)	81 (35.8)	1.05 (0.84-1.31)	0.647
Time between sting and care				
Up to 1 hour	194 (68.3)	90 (31.7)	1.00	
> 1 hour	228 (63.0)	134 (37.0)	1.17 (0.94-1.45)	0.148
Number of administered serum ampoules				
Up to 3 ampoules	245 (64.1)	137 (35.9)	1.00	
> 4 ampoules	177 (67.0)	87 (33.0)	0.91 (0.73-1.14)	0.447
Location of the sting				
Upper limbs	139 (59.7)	94 (40.3)	1.00	
Lower limbs	283 (68.5)	130 (31.5)	0.77 (0.63-0.96)	0.020
Orotracheal intubation				
No	410 (65.5)	216 (34.5)	1.00	
Yes	12 (60.0)	08 (40.0)	1.15 (0.67-2.00)	0.597
ICU admission				
No	416 (65.8)	216 (34.2)	1.00	
Yes	06 (42.9)	08 (57.1)	1.67 (1.04-2.66)	0.031
Chest X-ray				
Without infiltration	397 (65.5)	209 (34.5)	1.00	
With infiltration	25 (62.5)	15 (37.5)	1.08 (0.71-1.64)	0.692
Intravenous furosemide				
Not administered	392 (65.1)	210 (34.9)	1.00	
Administered	30 (68.2)	14 (31.8)	0.91 (0.58-1.42)	0.686
ECG alterations				
Absent	399 (65.2)	213 (34.8)	1.00	
Present	23 (67.6)	11 (32.4)	0.93 (0.56-1.53)	0.774
Routine urine				
Not altered	408 (65.2)	218 (34.8)	1.00	
Altered	14 (70.0)	06 (30.0)	0.86 (0.43-1.69)	0.666
Blood glucose				
Not altered	61 (66.3)	31 (33.7)	1.00	
Altered	361 (65.2)	193 (34.8)	1.03 (0.75-1.40)	0.832
Amylase				
Not altered	165 (65.2)	88 (34.8)	1.00	
Altered	257 (65.4)	136 (34.6)	0.99 (0.80-1.23)	0.963
Sodium				
Not altered	220 (66.1)	113 (33.9)	1.00	
Altered	202 (64.5)	111 (35.5)	1.04 (0.84-1.29)	0.683

Mild/Moderate Severe	N%		PR (95% CI)	p-value
Potassium				
Not altered	307 (64.1)	172 (35.9)	1.00	
Altered	115 (68.9)	52 (31.1)	0.86 (0.67-1.11)	0.274
Sequelae				
Absent	418 (65.7)	218 (34.3)	1.00	
Present	04 (40.0)	06 (60.0)	1.75 (1.04-2.93)	0.034
Signs and symptoms				
Absent	114 (63.0)	67 (37.0)	1.00	
Present	308 (66.2)	157 (33.8)	0.91 (0.72-1.14)	0.431
Systemic complications				
Absent	364 (64.8)	198 (35.2)	1.00	
Present	58 (69.0)	26 (31.0)	0.87 (0.62-1.23)	0.453

Note: PR: Crude prevalence ratio at the 0.25 level; CI: 95% Confidence Interval.

Source: Ornelas YC, et al., 2024.

Table 4 - Bivariate analysis of the symptoms and systemic complications with the severity of cases from 2015 to 2020 (n=422).

Mild/Moderate Severe	N%		PR (95% CI)	P-value
Types of symptoms present				
Sleepiness				
No	334 (66.0)	172 (34.0)	1.00	
Yes	88 (62.9)	52 (37.1)	1.09 (0.85-1.39)	0.482
Nausea				
No	362 (66.4)	183 (33.6)	1.00	
Yes	60 (59.4)	41 (40.6)	1.20 (0.92-1.57)	0.159
Vomiting				
No	193 (65.6)	101 (34.4)	1.00	
Yes	229 (65.1)	123 (34.9)	1.01 (0.82-1.25)	0.875
Sweating				
No	322 (65.7)	168 (34.3)	1.00	
Yes	100 (64.1)	56 (35.9)	1.04 (0.82-1.33)	0.711
Alteration in Blood Pressure				
No	407 (65.6)	213 (34.4)	1.00	
Yes	15 (57.7)	11 (42.3)	1.23 (0.77-1.95)	0.377
Dyspnea				
No	386 (65.5)	203 (34.5)	1.00	
Yes	36 (63.2)	21 (36.8)	1.06 (0.74-1.52)	0.715
Convulsion				
No	418 (65.3)	222 (34.7)	1.00	
Yes	04 (66.7)	02 (33.3)	0.96 (0.30-2.99)	0.945
Fever				
No	417 (65.2)	223 (34.8)	1.00	
Yes	05 (83.3)	01 (16.7)	0.47 (0.08-2.87)	0.420
Bradycardia				
No	417 (65.6)	219 (34.4)	1.00	
Yes	05 (50.0)	05 (50.0)	1.45 (0.77-2.72)	0.245
Types of systemic complications				
Kidney failure				
No	415 (65.3)	221 (34.7)	1.00	
Yes	07 (70.0)	03 (30.0)	0.86 (0.33-2.23)	0.762
Acute pulmonary edema				
No	403 (65.6)	211 (34.4)	1.00	
Yes	19 (59.4)	13 (40.6)	1.18 (0.86-1.82)	0.449
Sepsis				
No	421 (65.5)	222 (34.5)	1.00	
Yes	01 (33.3)	02 (66.7)	1.93 (0.86-4.32)	0.110
Shock				
No	378 (65.1)	203 (34.9)	1.00	
Yes	44 (67.7)	21 (32.3)	0.92 (0.63-1.33)	0.677

Note: PR: Crude prevalence ratio at the 0.25 level; CI: 95% Confidence Interval.

Source: Ornelas YC, et al., 2024.

Table 5 - Multivariate analysis of the variables associated with the severity of cases in the period from 2015 to 2020.

	PR (95% CI)	P-value
Sting on the Lower Limbs	0.76 (0.62-0.94)	0.012
Presence of sequelae	1.75 (1.00-3.05)	0.047
ICU admission	2.45 (1.23-4.88)	0.011

Note: PR: Crude prevalence ratio at the 0.25 level; CI: 95% Confidence Interval.

Source: Ornelas YC, et al., 2024.

Scorpionism occurs more frequently in regions where the climate is tropical or subtropical, with Mexico, India and Brazil being the countries with the highest prevalence (GHORBANI A, et al., 2021; QUEIROZ AM, et al., 2015). According to the Scorpion Control Manual, there are more than 36,000 cases of scorpionism in Brazil every year. The north of the state of Minas Gerais is one of the Brazilian geographic regions with the highest prevalence of *Tityus serrulatus*, a scorpion of great clinical importance due to the more intense action of the venom (BARROS RM, et al., 2014; CARMO EA, et al., 2019).

In addition to being a habitat region for *Tityus serrulatus*, the climatic issues surrounding the northern region of Minas Gerais are strongly influencing factors for the occurrence of stings, which may explain the high prevalence of serious accidents in this study. Scorpions are most active during the hottest months of the year, predominantly from October to January, with warm and humid weather (BARBOSA AP, et al., 2012; SOARES RA, et al., 2020; ARAÚJO KA, et al., 2017; SILVA EP, et al., 2018; RECKZIEGEL GC e JUNIOR VL, 2014; FRACOLLI LA, 2008). The territory of Minas Gerais is particularly exposed to intense rains, droughts and heat waves. Drought situations mostly affect the north of the state, while disasters due to rains occur more in the center, southern territory and Zona da Mata (FEAM, 2014).

The prevalence of about 35% of severe cases is an important finding because of the severe clinical manifestations and complications, especially in children. Another study conducted in the state of Minas Gerais in children and adolescents up to 19 years old found 7% of severe cases, most of which (77%) occurred in children under 9 years old, where the younger the age, the more severe the accident (GUERRA CM, 2008). This finding agrees with a recent study conducted in southern Bahia, where most deaths occurred in children up to 9 years of age (70%) (LISBOA NS, 2020).

In severe cases, complications and/or death may arise within the first 24 hours, and there are risk factors that worsen the prognosis, such as age under 7 years, especially under 4 years (VAUCEL J, et al., 2020). This study detected a higher prevalence of scorpionism in girls than in boys. Unlike reported in other studies developed in the state of Minas Gerais, with prevalence rates of 53%, 53.5% and 55% in males, respectively (LIMA CA, 2021; HORTA FM, et al., 2007; GUERRA CM, 2008). However, this difference in this study is in line with the proportions between men and women in the city of the study (IBGE, 2019), where there is a prevalence of females.

Unlike the findings of other studies, whose most affected age group comprises ages between 5 and 9 years (Who, 2007; RECKZIEGEL GC e JUNIOR VL, 2014 GUERRA CM, 2008; SOARES RA, et al., 2020), this research showed a predominance of accidents in children under 3 years of age, which may explain the large proportion of severe cases found in the study. The severity of scorpionism in children is related to the amount of venom inoculated in relation to the body surface, with studies verifying a positive relationship between the proportion of venom in the plasma and the severity of the accident (CARMO EA, 2017). In this context, younger children, with a smaller body surface, have higher concentrations of poisons, resulting in faster and more intense clinical manifestations.

Moreover, high mortality rates from scorpionism in children are explained by low immune capacity and greater absorption of venom by the heart and other organs (CAVAZOS ME, et al., 2002). This study also showed a higher prevalence of accidents among non-white children (95.5%). This finding may be due to the number of individuals classified as non-white in the state of Minas Gerais, according to the result of the 2010 Demographic Census carried out by the Brazilian Institute of Geography and Statistics, as, in Minas Gerais, much of the population self-declares as brown (44.3%). In addition, socioeconomic and educational

conditions associated with racial status may corroborate this result, considering that low education and socioeconomic precariousness, according to IBGE, in 2019, were associated with brown skin color and are also associated with scorpionism (CARMO EA, et al., 2019; LISBOA NS, 2020).

It was observed that most cases occurred in an urban environment (82.7%) and in Montes Claros (67.9%), data corroborated by another recent study where it was also observed that most patients lived in the urban area and that the accident occurred in his/her own residence (Junglos, 2021). These data are consistent with the classification of the cases being mostly mild and moderate, since accidents occurring in places far from health services, such as rural areas, are directly related to a worse clinical status, because they take longer to receive adequate treatment (CARMO EA, et al., 2019). Regarding the anatomical region of the sting, most of the population was stung in the lower limbs (64%).

Other recent studies revealed the lower and upper limbs, respectively, as the most frequent in scorpionism, with the extremities of the body being the most affected by the sting, probably because they are the structures that are more evident (JUNGLOS P, et al., 2021; CARMO EA, et al., 2019; GOMES RV, et al., 2020; FURTADO AA, et al., 2020). The time of occurrence of the sting was mostly until 5 PM. This finding is different from another study carried out in the same region (HORTA FM, et al., 2007) and also different from the time attributed to the search for food on the part of the scorpion. Nevertheless, it can be related to the age group of the victims, mostly children up to 3 years old who are usually active and playing, typical of their innate curiosity, which makes them prone to approach the shelters used by scorpions and be stung at that time of the day (CAVALCANTI NB, 2021).

Most of the studied population (56.2%) received medical care more than 1 hour after the sting. This finding is similar to that of another study conducted in the same region (HORTA FM, et al., 2007) and may be related to the high prevalence of severe cases because, soon after the sting, venom absorption begins rapidly, reaching maximum concentration in 60 minutes. The biggest clinical question for scorpionism care refers to the recognition of severity at zero time of care for pediatric victims, associated with adequate clinical management in view of the severity classification (ORTIZ MM, et al., 2021). The time elapsed between the sting and the start of treatment has a great influence on the prognosis of a scorpionic accident. The chance that a child will die increases by 9% for each hour of delay in receiving treatment, and the same chance increases by 13% for each year the age of the child decreases. Accordingly, it is assumed that the shorter the time elapsed between the accident and the care, the greater the chances of improvement for the patient (CARMO EA, et al., 2019).

The sequelae of scorpionism were associated with severe cases, an event already mentioned in protocols as a prognostic possibility for the most serious cases (BRASIL, 2017b). These sequelae are described as atrioventricular conduction blocks, congestive heart failure, cerebral infarcts possibly due to adrenergic vasoconstriction and alterations resulting from hypoxia; and in recent national studies, they have also been associated with later and more severe stages of scorpionism (CAVAZOS ME, et al., 2012).

International studies corroborate these findings, describing myocardial ischemia as a particularly relevant pathophysiological mechanism when considering the clinical picture of severe scorpionic accidents. In this context, the presence of electrocardiographic alterations compatible with ischemia and myocardial injury and the elevation of serum levels of enzymes indicative of damage to cardiac fibers have drawn the attention of many investigators (BASEER KA e NASER MA, 2019; HOROZ OO, et al., 2020; VAUCEL J, et al., 2020).

Cardiorespiratory manifestations, particularly circulatory shock and acute pulmonary edema, are the main causes of death after scorpionic accidents. Several studies have already described electrocardiographic, enzymatic, echocardiographic and hemodynamic alterations compatible with cardiac aggression, contractile dysfunction and acute left ventricular failure in this clinical syndrome (BASEER KA e NASER MA, 2019; HOROZ OO, et al., 2020; VAUCEL J, et al., 2020).

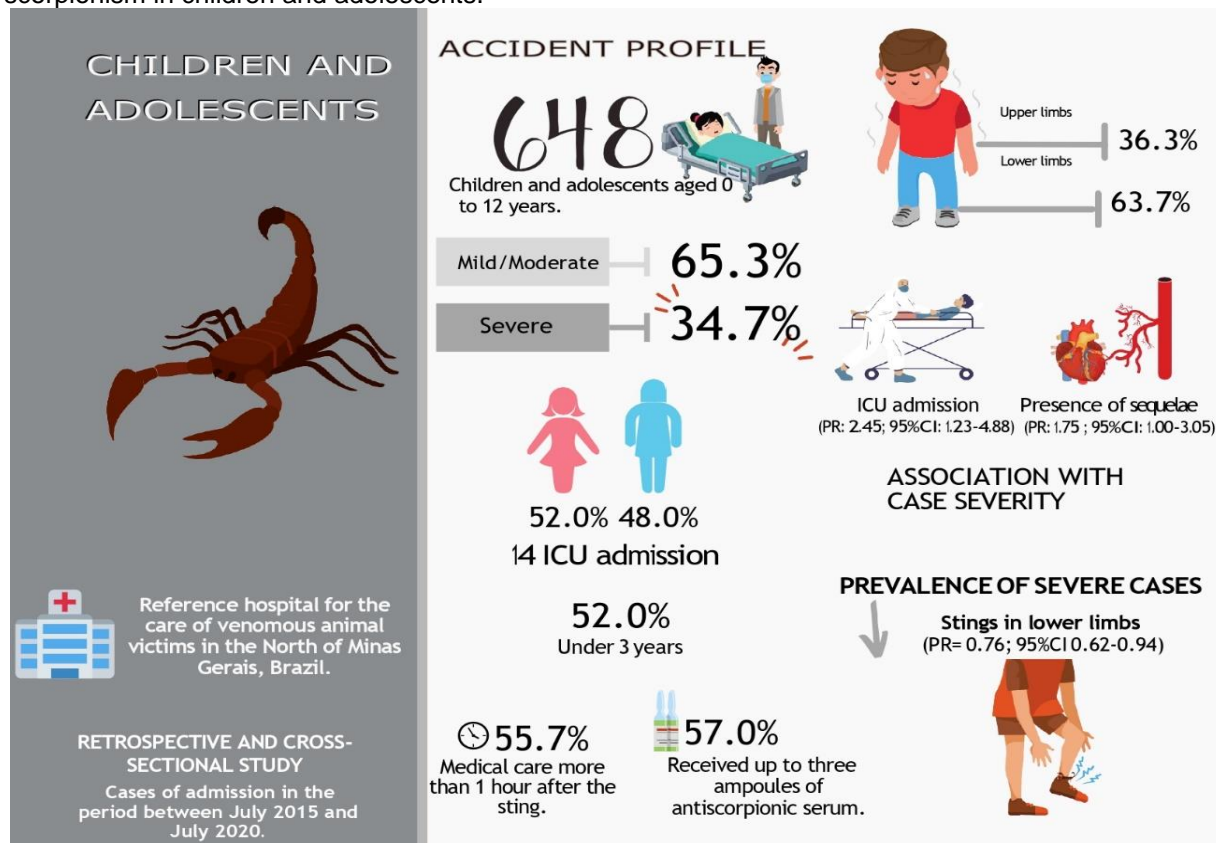
Thus, the sequelae of scorpionism emerge as factors related to the more severe prognosis of the disease. In this study, ICU admission was an outcome related to severe cases and already mentioned in protocols as an indication for management of the most severe cases. The severe cases of scorpionism have an indication

for life support in the intensive care unit, hoping that the scorpionic accidents are correctly classified and properly conducted with reduced time in relation to admission in emergency care units (KHATTABI A, et al., 2011). A recent national study admits the need for intensive care beds for supportive treatment, according to the clinical assistance presented for high complexity care, as scorpionic accidents are everyday health emergencies in the 2020s (ORTIZ MM, et al., 2021).

After the multivariate analysis, it was observed that children with stings on the lower limbs had a less unfavorable evolution than those with stings in other parts of the body, reducing the prevalence of severity. This fact can be explained by the slower venous return from the lower limbs to the heart. This occurs due to the increase in pressure exerted on the venous capillaries of the lower limbs, which cannot overcome the force of gravity (BELCZAK CE, et al., 2008). In addition, it is known that there is venous hemodynamic variation in the lower limbs throughout the day, as a result of the removal of the valve cusps, which promotes an increase in venous reflux (KATZ ML, 1994), slowing down the flow and arrival of the scorpionic venom to the heart.

The composition of the venom is a mixture of different concentrations of histamines, hyaluronidases, phosphodiesterase, serotonin and cytokine releasers, in addition to neurotoxins and cardiotoxins that act directly on nerve and heart endings (PETRICEVICH VL, 2010). When the lower limbs are stung, slowing the flow will specifically delay the effect of the cardiotoxic toxin, making the outcome less unfavorable for the victim affected by scorpionism. This work must be seen in the light of some limitations because, despite having been developed in a reference hospital for care in the north of Minas Gerais, and having a considerable sample, some individuals may have been left out because they were not referred for care at that institution. On the other hand, the large number of moderate/severe accidents identified here may also be due precisely to the fact that the referral of the most severe cases occurs preferentially to the institution where the study occurred.

Figure 1 – Graphical summary of clinical and epidemiological factors associated with severe cases of scorpionism in children and adolescents.



Source: Ornelas YC, et al., 2024. Figure created in Canva Pro.

CONCLUSION

This study recorded about one third of serious scorpionic accidents. There was a slight predominance of the female gender and of the age group up to 3 years old, also occurring a higher prevalence in children of non-white skin color. Most cases occurred in the urban area and in the city of Montes Claros. Most children were stung in the lower limbs until 5 PM and received medical care more than 1 hour after the time of the sting. ICU admission and the presence of sequelae were associated with severe accidents. On the other hand, the sting in the lower limbs represented a less unfavorable evolution, acting as a protective factor against the severity of scorpionism. Accordingly, given the clinical and epidemiological importance of scorpionism, especially in the younger population (children and adolescents), prevention and control measures are necessary to better inform the population about the forms of prevention and control of scorpionism, as well as to decentralize treatment and make anti-scorpionic serum more widely available.

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