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Snakebites in the Mato Grosso State, Brazil: from 2007 to 2019

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Abstract. Snakebites are considered a serious public health problem due to its incidence and severity; in 2017 it was considered a neglected tropical disease. Mato Grosso state have a large territorial extension, composed by a tropical forest and semi-humid climate, and this could contributed for accidents with snakes, principally in rural areas. Regarding the state, epidemiological studies of accidents with snakes are scarce, so the present study aimed to evaluate the clinical-epidemiological aspects of snakebites in Mato Grosso state from 2007 to 2019. It was a retrospective descriptive study with data obtained from the Health Information Notification System (SINAN). In the analyzed period, there were 13,754 cases of snakebites, 90.77% were caused by *Bothrops* genus. The profile of individuals were male with age from 20 to 59 years old. The time that had elapsed between the accident and care being administered in 66.19% of the cases was up to 3 hours, the cases were considered mild or moderated (86.76%) with 89.25% evolution to cure. The incidence rate varied from 41.2 (in 2010) to 25.4 (in 2018) cases per 100,000 inhabitants with a central tendency to reduction of the cases over the years, and according to the macro-regions were observed higher incidences in East. Future investigations are necessary to explain the variation of incidence according to the macro-regions of Mato Grosso state.

Keywords: *Bothrops*, epidemiology, snakes, venomous animals.

Introduction

Snakebites incidents represent a public health problem since they have high frequency and severity, with annual mortality ranging from 81,000 to 138,000, and accidents leaving about 400,000 victims with permanent physical and psychological disabilities (Williams et al., 2019). Snakebites envenoming were re-include in 2017 by the World Health Organization (WHO) as neglected tropical diseases (Gutiérrez et al., 2017).

Brazil has a record of 412 species of snakes (Nogueira et al., 2019). The center-west region has 215 species and subspecies, of which 169 are in the state of Mato Grosso (Costa & Bernélis, 2018). Snakebites envenoming have being caused by the snakes in the *Bothrops* ("jararaca, jararacuçu, urutu, caiçaca, combóia"), *Crotalus* ("cascavel"), *Lachesis* ("surucucu-pico-de-jaca") and *Micrurus* ("coral") genera (Ferreira et al., 2020).

The clinical manifestations may vary from local symptoms as pain, edema, swelling, or necrosis;

or even systemic manifestations leading to bleeding, bleeding at a distance such as in the gums, nausea, vomiting, sweating, hypotension and shock (Pinho & Pereira, 2001; Frare et al., 2019).

In the Amazon region, the cases are associated with the rainy season and high temperature, which favor the overflow of rivers and consequently the movement of snakes, contributing to contacts with humans (Feitosa et al., 2015; Roriz et al., 2018; Williams et al., 2019). The most affected population is usually the one that works or lives in rural areas, in which usually the health services are precarious and insufficient; limiting the ability to establish the best conduct (Bertolozzi, Scatena & Franca, 2015). Furthermore, the difficulty in obtaining the antiserum and the lack of training of professionals to recognize the clinical trial and, consequently, to make the correct diagnosis of the genus that caused the accident, are other conditions that contribute to this situation (Bertolozzi, Scatena & Franca, 2015).

Epidemiological studies in the region of the High Juruá (Amazon) during July 2017 to June 2018 revealed 133 cases of snakebites, representing 76.2 cases per 100,000 inhabitants (Silva et al., 2020). In Rio Branco (Acre) from March 2018 to February 2019 were recorded 165 cases representing 29 cases per 100,000 inhabitants (Oliveira et al., 2020). At the Rondonia Center for Tropical Medicine (Rondonia) 92 cases were followed up from September 2008 to September 2010 (Roriz et al. 2018). Regarding the state of Mato Grosso, epidemiological studies of incidents with snakes are scarce, so the present study aimed to evaluate clinical-epidemiological variables related to snakebites notified in the Health Information Notification System about the state of Mato Grosso during the period of 2007 until 2019.

Methods

This is a retrospective descriptive study carried out with data from the state of Mato Grosso. This state has a territorial area of 903,207,019 km² and population estimated at 3,526,220 people (IBGE, 2020a).

Clinical and epidemiological data were obtained from the Health Information Notification System (SINAN - Net) (<<http://tabnet.datasus.gov.br/cgi/tabcgi.exe?sinanet/cnv/animaismt.def>>), belonging to the Ministry of Health, Secretary of Health Surveillance.

Data collected were from the period of January 2007 to December 2019, related with snakebites by *Bothrops*, *Crotalus*, *Micrurus* and *Lachesis* genera, were excluded cases of ignored genus and non-venomous animals. The search for the data took place from February to August 2020.

The variables obtained from SINAN were age, gender, macro-region, snake genus, severity, evolution of the accident, and time between the bite and care being administered. Incidence rate (per 100,000 inhabitants) was calculated based on the population of the period obtained through the Brazilian Institute of Geography and Statistics (<https://sidra.ibge.gov.br/pesquisa/estimapop/tabelas>) (IBGE, 2020b).

Ethical principles and good practices in experimentation

The research is according to Resolution National Health Council (CNS) N^o. 510/2016, however it was sent to ethical appreciation and approved (approval number 3.851.513) by the Ethics Research Committee with Human Beings of Sinop (CEP/UFMT/Sinop).

Results and discussion

In the period from 2007 to 2019 were recorded 13,754 cases of snakebites in the state of Mato Grosso, Brazil, of which 12,485 (90.77%) corresponded to accidents caused by *Bothrops* genus. The *Crotalus*, *Lachesis* and *Micrurus* genera represented 6.35%, 2.52% and 0.36%, respectively

(Table 1). A study realized in the period from 1948 to 1993 observed that 99% of the cases recorded in Mato Grosso were botropic (Carvalho & Nogueira, 1998), this genus remains predominantly in the state.

Other studies carried out in Brazil also reported that the genus *Bothrops* were responsible for the highest number of snakebites. In the Alto Juruá region (Amazon) corresponded to 88.7% (Silva et al. 2020), in Rio Branco (Acre) 71.52% (Oliveira et al., 2020) and in Porto Velho (Rondonia) 95.6% (Roriz et al. 2018).

A systematic review realized by Feitosa et al. (2015) found that in the state of Amazonas, between 1974 and 2012, it had an incidence of 200 cases per 100,000 inhabitants, which also had a predominance of the *Bothrops* genus (67.3%).

The incidence in our study varied from 41.2 (in 2010) to 25.4 (in 2018) cases per 100,000 inhabitants with a central tendency to reduction of the cases over the years (Figure 1). Other studies observed higher incidence, in the Alto Juruá region (Amazonia) was 76.2 cases per 100,000 inhabitants during 2017 and 2018 (Silva et al. 2020). In the Cacoal city (Rondonia) the incidence also varied with 18.4 cases per 100,000 inhabitants in 2007 and 58.8 cases per 100,000 inhabitants in 2017, in this case the incidence increased (Ferreira et al. 2020).

The distribution of cases by snake genera according to sociodemographic variables demonstrated that accidents occurred more often among men (77.19%), in the age group of 20 to 59 years (65.93%). Regarding the macro-regions, 4,595 (33.40%) cases were in Center-North, followed by the North with 2,876 (20.91%) cases (Table 1).

Studies have shown that the major involvement is in men, the reports varied from 64.85% to 88% of the cases (Feitosa et al. 2015; Santos et al., 2017; Roriz et al., 2018; Vieira & Machado, 2018; Oliveira, 2020), corroborating with our finding. Age also varied, Santos et al. (2017) reported 56.04% of accidents between 11 and 50 years, and Roriz et al. (2018) between 20 and 49 years (75%). The fact that accidents occurred in adult men may be related to the risk factors to which they are often exposed, such as work in agriculture and livestock, housing in rural areas, and leisure activities (Bochner & Struchiner, 2004; Chippaux, 2017; Vieira & Machado, 2018).

The average incidence of snakebites in America between 2010 and 2016 was reported as 6.34 cases per 100,000 inhabitants (Chippaux, 2017). In the period evaluated in this study, a variation was found over the years, with the highest rates in East macro-region during all periods studied, being 67.48 cases per 100,000 inhabitants in 2019. Only in 2012 this macro-region was overtaken by the West macro-region. The Central-North macro-region had the lowest incidence rate since 2008, registering 22.82 cases per 100,000 inhabitants in 2019 (Figure 2).

Table 1. Distribution of the frequency of cases categorized by snake genus from 2007 to 2019 according gender and age group of patients, and macro-region of Mato Grosso state.

Parameter	<i>Bothrops</i> N (%)	<i>Crotalus</i> N (%)	<i>Lachesis</i> N (%)	<i>Micrurus</i> N (%)	Total N (%)
Sex					
Male	9567 (69,56)	733 (5,33)	281 (2,04)	36 (0,26)	10617 (77,19)
Female	2916 (21,20)	140 (1,02)	65 (0,47)	14 (0,10)	3135 (22,79)
Ignored	2 (0,01)	-	-	-	2 (0,01)
Age group (years)					
0-9	987 (7,18)	46 (0,33)	21 (0,15)	6 (0,04)	1060 (7,70)
10-19	1931 (14,04)	120 (0,87)	48 (0,35)	7 (0,05)	2106 (15,31)
20-59	8194 (59,58)	601 (4,37)	237 (1,72)	37 (0,27)	9069 (65,93)
>60	1373 (9,98)	106 (0,77)	40 (0,29)	-	1519 (11,04)
Macro-region					
South	1994 (14,50)	131 (0,95)	45 (0,33)	8 (0,06)	2178 (15,83)
West	1692 (12,30)	143 (1,04)	13 (0,09)	2 (0,01)	1850 (13,45)
North	2539 (18,46)	161 (1,17)	162 (1,18)	14 (0,10)	2876 (20,91)
East	2042 (14,85)	182 (1,86)	22 (0,76)	9 (0,12)	2255 (16,39)
Central-North	4218 (30,67)	256 (6,35)	104 (2,52)	17 (0,36)	4595 (33,40)

Source: Ministry of Health. Notifiable Diseases Information System - Sinan Net.

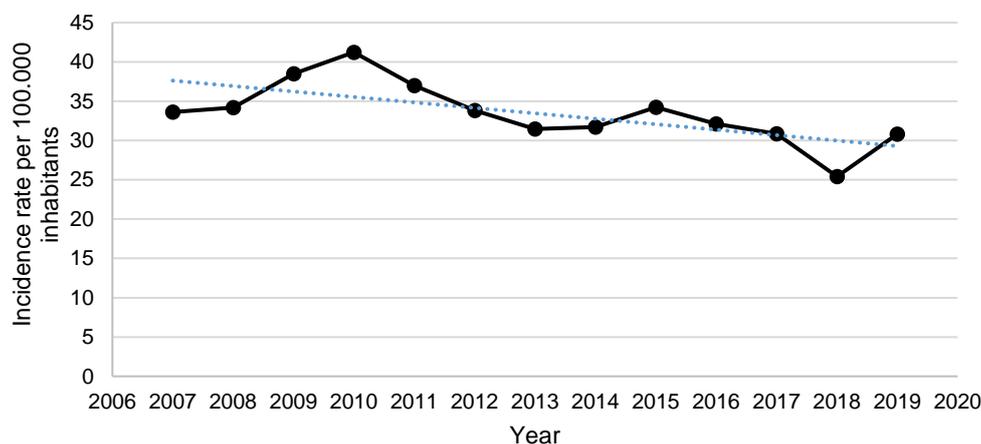


Figure 1. Distribution of snakebites incidence from 2007 to 2019 in the Mato Grosso state, Brazil.

In the state of Rio de Janeiro (Brazil), between 2007 and 2015, there were also a variation in incidence, with 6.36 cases per 100,000 inhabitants in the city of Cordeiro and 114.11 per 100,000 inhabitants in Semidouro (another city) (Vieira & Machado, 2018).

Regarding the severity of the snakebites, most of the cases were considered mild (44.55%) or moderate (42.21%). The time that had elapsed between the accident and care being administered, in 66.19% of the cases, was up to 3 hours, which may have contributed to the evolution of cases, with the majority considered cured (89.25%), and only 0.74% of deaths due to snakebites (Table 2). These results corroborated with other studies carried out in Brazil where service time occurred up to 3 hours was associated with mild cases (Bonan et al. 2010;

Feitosa et al., 2015; Rita et al., 2016 ; Vieira & Machado, 2018; Silva et al., 2020; Oliveira et al., 2020). Roriz et al. (2018) observed that the service time was more than 6 hours (72.7%), resulting in 50% of serious cases, the authors reported that the delay occurred due to the distance between the accident site and the center of treatment.

Mise et al. (2018) carried out a retrospective study from 2007 to 2015 and found that the time of treatment is strongly associated with the severity of the snakebite, showing that access to specialized services and antivenom therapy are essential. Besides that, the most effective way of prevention continues to be education in areas of risk, and it is necessary to discourage the use of alternative therapies for better evolution of cases (Gutierrez et al., 2017).

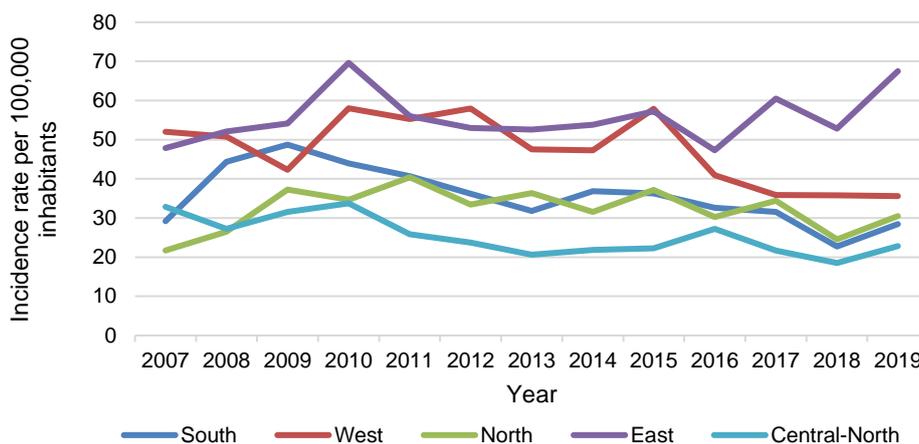


Figure 2. Distribution of incidence rate of snakebites according to the macro-region of Mato Grosso state, Brazil during 2007 to 2019.

Table 2. Distribution of the frequency of cases categorized by snake genus from 2007 to 2019 according to classification of envenomation, time to hospital care (hours) and evolution of the case in Mato Grosso state

Parameter	<i>Bothrops</i> N (%)	<i>Crotalus</i> N (%)	<i>Micrurus</i> N (%)	<i>Lachesis</i> N (%)	Total N (%)
Classification of envenomation					
Ignored	595 (4,33)	41 (0,30)	3 (0,02)	13 (0,09)	652 (4,74)
Mild	5576 (40,54)	419 (3,05)	20 (0,14)	113 (0,82)	6128 (44,55)
Moderate	5298 (38,52)	316 (2,30)	11 (0,08)	180 (1,30)	5805 (42,21)
Severe	1016 (7,39)	97 (0,70)	16 (0,12)	40 (0,03)	1169 (8,5)
Time to hospital care (hours)					
Ignored	596 (4,33)	42 (0,30)	3 (0,02)	11 (0,08)	652 (4,74)
0-3	8253 (60,00)	591 (4,30)	31 (0,22)	229 (1,66)	9104 (66,19)
3-6	2205 (16,03)	157 (1,14)	6 (0,04)	69 (0,50)	2437 (17,72)
6-12	763 (5,54)	39 (0,28)	9 (0,06)	18 (0,13)	829 (6,03)
>12	668 (4,86)	44 (0,32)	1 (0,007)	19 (0,14)	732 (5,32)
Evolution					
Ignored	1254 (9,12)	112 (0,81)	6 (0,04)	26 (0,19)	1398 (10,16)
Cure	11167 (81,19)	750 (5,45)	44 (0,32)	314 (2,28)	12275 (89,25)
Death	60 (0,44)	8 (0,06)	-	6 (0,04)	74 (0,54)
Death (another cause)	4 (0,03)	3 (0,02)	-	-	7 (0,05)

Source: Ministry of Health / SVS - Notifiable Diseases Information System - Sinan Net.

Conclusion

Clinical-epidemiological data showed that in the period from 2007 to 2019, the *Bothrops* genus was responsible for the highest number of accidents in Mato Grosso, Brazil, and these occurred mostly in male and adult individuals, with a favorable clinical evolution. The incidence rate varied between the macro-regions of the state of Mato Grosso, being higher in the East.

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