



## Profile of Snakebite Accidents in the State of Rio de Janeiro, Brazil, from 2001 to 2012: An Epidemiological Study

Isabel Cristina Melo Mendes<sup>1\*</sup> and Maria José Conceição<sup>2,3</sup>

<sup>1</sup>Faculty of Medicine, Universidade Federal do Rio de Janeiro – UFRJ, Rio de Janeiro, Brazil.

<sup>2</sup>Department of Preventive Medicine, Infectious and Parasitic Diseases of Clementino Fraga Filho University Hospital, Universidade Federal do Rio de Janeiro – UFRJ, Rio de Janeiro, Brazil.

<sup>3</sup>Laboratory of Parasitic Diseases, Instituto Oswaldo Cruz – IOC, Fundação Oswaldo Cruz – FIOCRUZ, Rio de Janeiro, Brazil.

### Authors' contributions

*This work was carried out in collaboration between both authors. Authors ICMM and MJC designed and managed the analyses of the study. Author ICMM managed the literature searches, performed the statistical analysis and wrote the first draft of the manuscript. Author MJC revised and co-wrote the final version of the manuscript. Both authors read and approved the final manuscript.*

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### ABSTRACT

**Aims:** The present study aimed to epidemiologically characterize snakebite accidents in Rio de Janeiro, from 2001 to 2012.

**Study Design:** This was an ecological study, using secondary data.

**Place and Duration of Study:** The data used referred to cases notified in the state of Rio de Janeiro in the official database SINAN between the years of 2001 to 2012.

**Methodology:** Data registered in SINAN were obtained through the online platform DATASUS, consisting of the number of notified cases, snake genera involved, accident classification, victim age group, time elapsed between accident and medical care, and case evolution.

\*Corresponding author: Email: [melo.ic@hotmail.com](mailto:melo.ic@hotmail.com);

**Results:** The analysis was impaired by the great amount of data not informed in notifications. From the registered data, it can be seen that the total number of notified cases has been increasing, which may be due to greater contact with snakes among individuals over the course of the years and/or better notification. In all the years, the genus most frequently involved was *Bothrops*, as occurs at national level. The individuals affected were most frequently aged between 20 and 59 years. Most cases were classified as mild and evolved to cure without sequelae.

**Conclusions:** It is concluded that snakebites in Rio de Janeiro have been gaining importance as a public health issue, especially due to the increasing numbers of cases and their potential severity, and because they mainly affect individuals of productive age. Investments in prevention programs and in training healthcare professionals are recommended in order to recognize and treat these accidents. The need for better data entry on the compulsory notification form is highlighted, with the aim of improving data quality and enabling reliable analysis on the country's health problems.

*Keywords:* Snakebite; accidents; epidemiology.

## 1. INTRODUCTION

Snakebite accidents are an important cause of morbidity and mortality globally, especially in tropical and underdeveloped countries [1,2]. It is estimated that there are around 2.4 million venomous snake accidents every year worldwide, resulting in 94,000 to 125,000 deaths annually. In addition, snakebite accidents are responsible for 400,000 cases of amputations and other consequences with an impact on individuals' health, such as infections, tetanus, scarring, contractures and psychological sequelae [3], thus showing the burden of morbidity due to this type of injury. Despite these data, snake incidents continued to be an underestimated issue throughout the world. In April 2009, snakebites were included in the category of neglected tropical diseases of the World Health Organization (WHO) [4].

In Brazil, data from the Ministry of Health have shown that there are around 20,000 cases on average per year [1,2], with a death rate of approximately 0.4% [2]. It is noteworthy that it has been recognized that venomous animal accidents in the country are underreported [5] which leads to the deduction that the number of cases must be much higher. Among the 70 species of venomous snakes found in the country, the ones most involved in notified accidents belong to the genera *Bothrops*, *Crotalus* and, more rarely, *Lachesis* and *Micrurus* [1,2,6]. Most accidents affect rural workers and occur in the vicinity of houses and/or crop areas [2].

Based on all these factors, the present study aimed to epidemiologically characterize snakebite accidents in the state of Rio de Janeiro, from 2001 to 2012.

## 2. MATERIALS AND METHODS

### 2.1 Study Location

The state of Rio de Janeiro is one of the four states that compose the southeast region of Brazil. It has 92 municipalities, in an area of 43,780.172 km<sup>2</sup>, and an estimated population of 16,461,173 people [7].

### 2.2 Study Design

This was an ecological study, using secondary data. Data registered in the Information System for Notifiable Diseases (SINAN) were obtained using the DATASUS online platform. Only cases from the state of Rio de Janeiro were selected, notified between the years 2001 and 2012 [8,9].

### 2.3 Variables Studied

The parameters investigated were the number of notified cases, snake genera involved, accident classification, victim age group, time elapsed between accident and medical care, and case evolution.

### 2.4 Data Analysis

The data gathered were tabulated and subjected to descriptive statistical analysis. Graphs were plotted using Microsoft Excel, version 2007.

## 3. RESULTS AND DISCUSSION

From the analysis on the registered data, an increase in the number of notified cases was found over the course of the years. While 600 snakebite cases were registered in 2001, this number increased to 1,354 in 2012 (Fig. 1). Over

the whole period studied, 12,164 cases were notified. However, there were differences in the total number of cases when some categories were analyzed separately. When the data registered in the “age group”, “bite-to-care time” and “case evolution” categories were summed, this total differed from the total numbers of notified cases over the same period of time (6,568, 6,378 and 6,568, respectively). As notification is made by the professional responsible for the first care, this may indicate that some of the fields are left in blank during notifications, resulting in different number of cases for each category.

In relation to the snake genera involved, the high number of cases in which this information

was notified as unknown stands out. Out of the 12,164 cases, 6,617 (54.4%) were identified as such. The genus most frequently involved was *Bothrops*, with higher prevalence in all years, representing 43.27% of the total number of cases notified over the period. Other genera involved included *Crotalus* (1.26%), *Micrurus* (0.16%) and *Lachesis* (0.13%). Non-venomous species accounted for 0.78% of the cases (Table 1).

From 2001 to 2010, the age group most affected was from 20 to 39 years of age. However, over the last two years of the period studied, there was a change in the pattern, and the age group most affected became 40 to 59 years of age (Table 2).

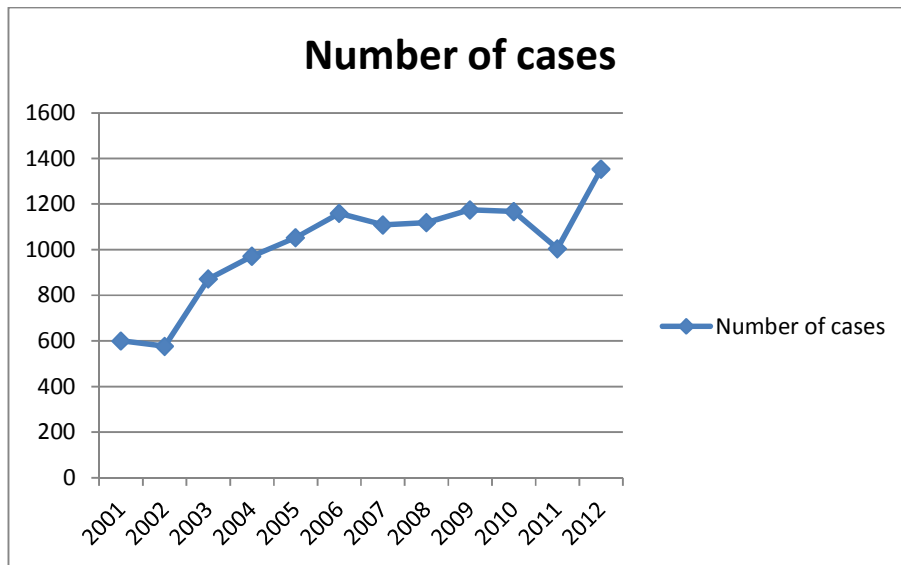


Fig. 1. Number of notified snakebite cases between the years 2001 and 2012 in Rio de Janeiro

Table 1. Number of snakebite accident cases, according to snake genus involved, in Rio de Janeiro from 2001 to 2012

	Unknown	Bothrops	Crotalus	Micrurus	Lachesis	Non-venomous	Total
2001	270	308	16	1		5	600
2002	270	290	12	1		4	577
2003	455	402	6	3	1	5	872
2004	538	419	6	1	2	6	972
2005	586	440	13	3	1	10	1053
2006	654	480	13	4	1	8	1160
2007	602	482	15	1		9	1109
2008	618	475	15	3	3	6	1119
2009	619	528	11		2	15	1175
2010	655	490	12		2	9	1168
2011	532	450	14		1	8	1005
2012	818	500	20	3	3	10	1354
Total	6617	5264	153	20	16	95	12164

According to the clinical and laboratory alterations found, snakebite accidents are classified as mild, moderate or severe [1]. Most of the notified cases over the period studied were classified as mild (55.28%), followed by moderate cases (24.35%). Again, the high number of cases notified as unknown stands out (15.22%) (Table 3).

In relation to the time that elapsed between the accident and medical care, most of the cases received care within 3 hours after the event (37.99% within 1 hour and 33.80% from 1 to 3 hours after the event). Only 5.7% of the registered cases received medical care starting more than 6 hours after the event (Table 4).

Regarding case evolution, among the 6,568 records, 4,557 evolved to cured status without sequelae (69.38%), 1,958 were registered as

unknown (29.81%), 48 evolved to cured status with some type of sequelae (0.73%) and only 5 evolved to death (0.08%) (Table 5).

Venomous animal accidents are health problems that have been subject to compulsory notification in Brazil since 1986. Nonetheless, as early as 1901, Vital Brazil was already seeking to register data on snakebite accidents that occurred in the state of São Paulo, through the journal *Boletins para Observação de Accidente Ophidico* (Newsletters on Snakebite Observation) [10,11]. With the implementation of SINAN in 1993, this type of health hazard began to be registered in this system, thus maintaining its characteristic of compulsory notification. However, underreporting is present, including in the state of Rio de Janeiro [12], which makes accurate analysis difficult with regard to the real epidemiology of snakebites.

**Table 2. Number of snakebite accident cases, by age group, in Rio de Janeiro from 2001 to 2012**

	Unknown	< 1 year	1-9 years	10 - 19 years	20-39 years	40-59 years	60 - 69 years	70-79 years	80 years or more
2001		3	19	57	178	110	25	10	4
2002		3	21	52	136	115	32	7	3
2003		2	32	88	209	139	43	18	1
2004	1	8	34	81	202	165	35	16	3
2005	1	2	26	92	219	166	49	19	2
2006		3	39	114	241	179	58	21	1
2007	2	7	30	108	207	171	30	18	
2008		5	29	90	217	174	30	14	9
2009	1	7	37	96	225	205	36	15	4
2010		5	36	79	224	183	31	16	4
2011		5	29	75	171	189	40	19	1
2012	2	5	27	73	188	215	57	25	2

**Table 3. Number of snakebite accident cases, according to accident classification, in Rio de Janeiro from 2001 to 2012**

	Unknown	Mild	Moderate	Severe	Total
2001	109	284	160	47	600
2002	75	309	148	45	577
2003	125	446	238	63	872
2004	182	498	251	41	972
2005	175	601	228	49	1053
2006	252	586	266	56	1160
2007	109	647	294	59	1109
2008	146	641	280	52	1119
2009	170	686	260	59	1175
2010	191	637	283	57	1168
2011	155	563	235	52	1005
2012	163	826	319	46	1354

**Table 4. Number of snakebite accident cases, according to the time that elapsed between the accident and medical care, in Rio de Janeiro from 2001 to 2012**

	Unknown	0-1 hours	1-3 hours	3-6 hours	6-12 hours	12 hours or more
2001	57	128	170	34	17	
2002	44	124	150	31	13	7
2003	70	198	183	56	13	12
2004	64	211	194	44	19	13
2005	85	222	188	50	15	16
2006	107	241	203	62	15	28
2007	66	218	207	43	18	21
2008	63	210	21	47	16	21
2009	103	228	221	47	11	16
2010	106	198	220	41	13	16
2011	64	200	193	41	16	15
2012	81	245	206	29	9	24

**Table 5. Number of snakebite accident cases, according to case evolution, in Rio de Janeiro from 2001 to 2012**

	Unknown	Cured	Cured with sequelae	Death	Total
2001	166	232	7	1	406
2002	115	249	3	2	369
2003	155	363	14		532
2004	176	361	8		545
2005	191	379	6		576
2006	240	410	6		656
2007	169	403	1		573
2008	132	436			568
2009	153	472	1		626
2010	158	435	1		594
2011	128	399	1	1	529
2012	175	418		1	594
Total	1958	4557	48	5	6568

The present study found a total of 12,164 notified cases in Rio de Janeiro over a period of 12 years, with a tendency towards increasing numbers of notifications over the course of the years. This trend is compatible with what has been seen in other areas of the country [2,6]. This increase may be the result of greater contact between individuals and snakes over the course of the years, as a result of environmental changes consequent to the process of urban growth. Improvements in notification by professionals and access to care – with a consequent increase in the number of cases attended – are also possibilities for explaining the growth trend found. The genera most frequently involved were *Bothrops* and *Crotalus*, followed by the non-venomous snakes, *Micrurus* and *Lachesis*. Higher frequency of *Bothrops* and *Crotalus* accidents has also been observed at national level, albeit in different proportions [6]. The high proportion of cases in which the genus was identified as unknown stands out (54.4%).

The consequence of this is that the results found may not reflect the real epidemiological situation of the state of Rio de Janeiro. Although the snake that caused the accident is not always taken to the healthcare site, the differences in the clinical and laboratory characteristics of each type of accident should allow better notification and improvement of data quality.

In relation to age group, the victims were most frequently aged between 20 and 59 years, i.e. they were young adults, of productive age. This characteristic reinforces the importance of snakebites as a public health issue, since, in addition to potentially bringing a burden of disease to very young individuals (who will require healthcare for long periods of time), snakebites may have a negative impact on the economic activities of a given region.

Most of the accidents were classified as mild or moderate. Moreover, most of the cases received

care within 3 hours and the outcome most commonly notified was that the individual had been cured without sequelae. Early and correct care is fundamental for favorable evolution of snake poisoning cases. The prognosis is known to be generally good for mild and moderate cases and for patients who receive care within 6 hours of the snakebite [1]. In the state of Rio de Janeiro, specific medical treatment for snakebites is made in specialized health centers to where the victims are referred after receiving primary care and where they can receive the antivenom. According to Brazil's Ministry of Health official website, there are currently 64 hospitals that can provide specialized care to snakebite accidents' victims in the state of Rio de Janeiro [13]. This decentralization of care can be one of the reasons for the early care and the overall low mortality of accidents observed, once that the patient is immediately referred to a hospital where treatment is given by trained and specialized professionals that can recognize the specific characteristics associated with each genus and, therefore, administer the correct antivenom. It can also be an explanation to the great number of not recorded data, since notification must be made for the professional that provides the first care. Because of the decentralization, these professionals may not recognize some of the features asked or not know the denouement of the patient's case, as they don't participate of the specific treatment.

In 2001, the Ministry of Health has published a guideline for the diagnosis and treatment of accidents involving venomous animals, including snakebites. The type and quantity of antivenom are given according to the genus of the snake involved and to the classification of the accident, respectively (Appendix 1, 2, 3 and 4). It's noteworthy that the anti-*Crotalus-Bothrops* antivenom, available in the country, is active against the two genera more frequently involved in accidents in the state. Also there is one antivenom active against the venoms of both *Bothrops* and *Lachesis*, that produce similar symptoms. These provide the possibility of correct care even in cases of doubt of the snake genus involved [14].

The combination of mostly non-severe accidents and organization of care, that can be provided in a timely manner, is probably responsible for the high proportion of cures and lack of sequelae among the notified cases, although the great number of unknown data harms the analysis.

#### 4. CONCLUSION

A trend of increasing numbers of snakebite accident cases in Rio de Janeiro could be seen. This may represent a public health issue in this state, given that snakebites are a potentially serious health hazard that mostly affects young individuals of productive age.

Another important point found in the present study is that large amounts of data that should have been registered in the notification records input to SINAN were in fact never recorded. This undermines the data analysis. Lack of knowledge among healthcare professionals regarding matters such as accident classification and the specific clinical and laboratory characteristics for each type of accident may be one of the reasons why a large amount of the information about notified cases was described as unknown. Also, the care in specialized emergency services and clinics may contribute to the incomplete notifications of cases, once that their denouement is unknown to the health care professionals that offer first care and are responsible for the notification.

Therefore, not only is surveillance of snakebite cases in the state of Rio de Janeiro necessary, but also investment in the training of healthcare professionals is recommended, so that they can correctly recognize and treat these cases, in order to avoid the adverse consequences of this type of health issue. Monitoring of victims after they are transferred, in order to obtain a more accurately notification of the denouement of cases, and a better integration between different health care facilities, are also needed. At last, educational actions aimed at the population should not be forgotten, with focus in accident prevention and education against the use of tourniquets and other domestic measures, reinforcing the need for immediate medical care.

#### CONSENT

It is not applicable.

#### ETHICAL APPROVAL

It is not applicable.

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This study didn't receive financial support by any organization.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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## APPENDIX 1

### Protocol for specific treatment of accidents involving *Bothrops* snakes according to severity

Manifestations and treatment	Classification		
	Mild	Moderate	Severe
Local: pain, edema, bruises	Absent or discrete	Evident	Intense
Sistemic: severe bleeding, shock, anuria	Absent	Absent	Present
Coagulation time	Normal or altered	Normal or altered	Normal or altered
Number of ampoules of antivenom (anti- <i>Bothrops</i> , anti- <i>Bothrops-Crotalus</i> or anti- <i>Bothrops-Lachesis</i> )	2 - 4	4 - 8	12

## APPENDIX 2

### Protocol for specific treatment of accidents involving *Crotalus* snakes according to severity

Manifestations and treatment	Classification		
	Mild	Moderate	Severe
Miastenic face/ blurred vision	Absent or late presentation	Discrete or evident	Evident
Myalgia	Absent or discrete	Discrete	Intense
Red or brown urine	Absent	Absent or discrete	Present
Oliguria/anuria	Absent	Absent	Absent or present
Coagulation time	Normal or altered	Normal or altered	Normal or altered
Number of ampoules of antivenom (anti- <i>Crotalus</i> or anti- <i>Bothrops-Crotalus</i> )	5	10	20

## APPENDIX 3

### Protocol for specific treatment of accidents involving *Lachesis* snakes according to severity

Treatment	Number of ampoules of antivenom (anti- <i>Lachesis</i> or anti- <i>Bothrops-Lachesis</i> )
Severity is evaluated according to local manifestations and intensity of vagal manifestations (bradycardia, arterial hypotension, diarrhea)	10 - 20

## APPENDIX 4

### Protocol for specific treatment of accidents involving *Micrurus* snakes according to severity

Treatment	Number of ampoules of antivenom (anti- <i>Micrurus</i> )
Rare accidents. Because of the risk of respiratory failure, should always be considered as potentially severe.	10

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