ABCS HEALTH SCIENCES

ORIGINAL ARTICLE

OPEN ACCESS

Epidemiological study of bee stings in the state of Paraiba, Northeastern Brazil, from 2015 to 2019

Januse Míllia Dantas de Araújo[1], Kaliany Adja Medeiros de Araújo[2], Renner de Souza Leite[1]

[1]Universidade Federal de Campina Grande (UFCG) - Cuité (PB), Brazil
[2]Universidade Federal do Rio Grande do Norte (UFRN) - Natal (RN), Brazil

ABSTRACT

Introduction: In Brazil, envenomation by bee sting is a public health problem due to its incidence in all regions of the country, as well as the severity of cases. Despite the medical and sanitary importance, the literature on this topic in Brazil is scarce, in the Northeast region. **Objective:** To describe the epidemiological characteristics of bee stings in Paraíba, in the Northeast region of Brazil, from 2015 to 2019. **Methods:** The current study is a descriptive and retrospective epidemiological investigation conducted through the recovery of secondary data made available by the database from the Ministry of Health Notification Information System. **Results:** A total of 1,151 cases were analyzed, and they were reported during all the months of the period of the study and were more frequent in the regions *Agreste* and *Sertão* of the Paraíba. The victims were men aged 20 to 59 years. Most individuals received medical assistance within 3 hours of the incident. The cases were classified as mild and progressed to cure. **Conclusion:** In Paraíba, bee stings have increased in recent years, especially in regions with a semi-arid climate. In addition, this study provides data that may be used in the development of educational health actions to promote the prevention and control of bee stings in this region.

Keywords: bees; poisoning; toxicology; Public Health; Epidemiology.

How to cite this article: Araújo et al. Epidemiological study of bee stings in the state of Paraiba, Northeastern Brazil, from 2015 to 2019. ABCS Health Sci. 2023;48:e023224 https://doi.org/10.7322/abcshs.2021083.1816

Received: Apr 14, 2021
Revised: Oct 04, 2021
Approved: Nov 03, 2021

Corresponding author: Januse Míllia Dantas de Araújo - Universidade Federal de Campina Grande - Sitio Olho D`água da Bica s/n - Zona Rural - CEP: 58175-000 -Cuité (PB), Brazil -
E-mail: janusemillia96@gmail.com

Declaration of interest: nothing to declare

INTRODUCTION

Bees of European origin were introduced in Brazil during the colonial period. In 1956, for scientific purposes, queen bees of African origin were brought to Brazil. Accidentally, some of these bees escaped into the environment and started successive mating with the local European bees. The mating spawned hybrid bees popularly known as the Africanized bee[1]. This hybrid bee has become well-adapted to the floristic and climatic conditions of the American Continent. This enabled the conquering of a substantial portion of the territory, reaching 400 to 500 km per year[2]. They arrived in Colombia in 1980, Mexico in 1986, and in the United States of America in 1990[3,4].

In comparison to bees that originated in Europe, the Africanized bee has a more intense defensive behavior, it is more resistant to diseases and attacks by predators[3]. In addition, it has a high capacity for reproduction, adaptation, and migratory behavior[5]. Africanized bee chases the threat longer and farther, and inject a greater amount of venom compared to other bee species. It is a better honey producer than the European

bee, which encourages their breeding and management for beekeeping[3]. Because of these characteristics, the Africanized bee has been responsible for the increase in envenoming and deaths, making the bee stings a public health problem in Brazil and other countries in America[5,6].

The envenoming and deaths caused by bee stings have increased in Brazil in recent years. According to the Brazilian Ministry of Health, this condition increased from 1,440 cases in 2000 to 20,725 in 2018, totaling 159,520 cases. Deaths increased from 3 in 2000 to 58 in 2018, with a total of 466 deaths in this period[5]. The clinical manifestations induced by the bee stings depend on the sensitivity of the victim to the venom and the number of stings[6]. In the case of one or a few stings, the clinical picture can vary from local inflammation to a strong allergic reaction, which can result in anaphylactic shock. In massive bee accidents caused by multiple stings, a severe systemic toxic manifestation can also occur and often lead to death[7,8]. The massive bee envenoming and the lack of a specific antivenom represent a higher risk for public health[9,10].

There are three different clinical manifestations induced by bee stings that require treatment, namely, 1) a few stings on a non-sensitized person; 2) one or more stings on a hypersensitive person; 3) massive bee envenoming by multiple stings[5-7]. For the treatment of toxic manifestations caused by one or a few stings, it is recommended to remove the stingers and to use cold compresses and analgesics for pain relief[5,7]. In cases of massive bee envenoming, antihistamines and anti-inflammatory, and systemic corticosteroids are used to treat the extensive edema. In cases where intravascular hemolysis, rhabdomyolysis, acute tubular necrosis, and respiratory and cardiovascular collapse occur, appropriate treatment should be established as soon as possible[6,7]. The treatment of allergic reactions varies according to the severity of the manifestations exhibited by victims and they are treated in the same way as other anaphylactic reactions[6,7].

In 2018, the Northeast region was responsible for the highest number and incidence of envenoming and deaths caused by bee stings in Brazil[11]. Despite its medical importance, the epidemiological profile of the bee sting cases in the state of Paraíba is not yet conclusively determined. In addition, little is known about the characteristics of the populations most affected by this kind of injury and in which regions and municipalities it occurs most frequently. In this sense, the present study aimed to describe the epidemiological characteristics of bee stings in Paraíba, Northeastern Brazil, from 2015 to 2019.

METHODS

Study Design

This is a descriptive epidemiological study of cases of bee stings in the state of Paraíba, Brazil, from 2015 to 2019. A retrospective investigation of secondary epidemiological data was conducted, namely, year, month, sex, age group, severity, the time elapsed from the sting to medical care, and evolution of the cases. These data were collected, in June/2020, using the TABNET application, a generic tabulator developed by the Informatics Department of the Unified Health System (DATASUS), which provides information from the Unified Health System databases[12]. The options were selected, respectively, on the platform's website of "Access to Information," "Information of Health (TABNET)", "Epidemiological and Morbidity", "Notified Diseases and Illnesses - 2007 onwards (SINAN)", "Accident by Venomous Animals", being chosen the state of Paraíba. Then, the rows and columns were filled in according to the variables considered and every year of the analyzed period from 2015 to 2019. For the description of the results, simple measures of absolute and relative distribution were used. To calculate the average incidence coefficients, the arithmetic mean of the respective annual coefficients was used.

The spatial distribution of cases was determined using the ArcGIS 10.5 software (ESRI, USA) with estimates concerning the average incidence in each municipality. Through the proportion of cases, divided by the population of the State of Paraíba, we have obtained the incidence rate estimated for every 100,000 inhabitants. The spatial interpolation of the incidence of bee stings was performed using the inverse distance weighting method. For this analysis, the power value used was 2, the research area was defined with a radius of 30.15, and smoothing of 0.2 was used. No barriers were required[13]. Population and demographic information were collected, in June/2020, from the database of the Instituto Brasileiro de Geografia e Estatística (IBGE)[14].

This study was developed following the norms of Resolution 466/2012 by the National Council for Ethics in Research (CONEP), which advises that if the research involves only secondary data in the public domain, without identifying the participants, approval from the System of the Committee on Ethics in Research from CONEP is not required.

Study Area

The Paraíba is one of the states in the Northeast region of Brazil, it is between the parallels 6° 02' 12" and 8° 19' 18" S, and between the meridians 34° 45' 54" and 38° 45' 45" W. To the north, it is limited by the state of the Rio Grande do Norte; to the east, by the Atlantic Ocean; to the west, by the state of the Ceará; and to the south, by the state of the Pernambuco. The state of Paraíba consists of 223 municipalities, and occupies an area of 56 469.778 km², with a population of 3,766,528 inhabitants and demographic density[14] of about 66.7 inhabitants/km².

The climate of the Paraíba is hot climate, with elevated temperatures throughout the year, varying according to the local relief and vegetation. The capital, João Pessoa, is located in the coastal region. Paraíba has a humid tropical climate in coastal areas. The summer

is hot and humid, with temperatures [15] that can vary between 24°C and 31°C. The rainy season is irregular and it occurs frequently between April and July, with an average annual rainfall of 1,600 mm. However, in the interior portion of the state, the semi-arid climate predominates, characterized by low humidity, with temperatures between 27°C and 31°C, reaching up to 41°C in extended periods of drought. The rains are scarce and irregular, with rainfall below 700 mm per year[15,16].

RESULTS

A total of 1,151 cases of bee stings were reported in Paraíba, from 2015 to 2019, reaching an average of 230 cases per year and 19.18 cases per month. The average incidence rates per 100,000 inhabitants were 3.15; 2.73; 4.22; 8.15; 12.29 cases from 2015 to 2019, respectively. Figure 1 shows the annual and monthly temporal distribution of bee stings in Paraíba, from 2015 to 2019. There was a gradual increase in the number of cases, from 119 in 2015 to 463 in 2019. The cases were distributed in all months of the year, most frequently in the months of September (n=145; 12.6%), August (n=116; 10%), July (n=112; 9.7%), and October (n=112; 9.7%), followed by a decrease in November (n=83; 7.2%), December (n=76; 5.8%), January (n=73; 6.3%) and February (n=80; 7.0%).

Concerning the spatial distribution, the incidence rates of the cases were irregularly distributed in 37 municipalities, and the values varied between 0 and 585.16 cases/100,000 inhabitants (Figure 2). The regions of *Agreste* and *Sertão* of Paraíba presented the most significant rates. The municipalities with the highest incidence of cases per 100,000 inhabitants were: Catolé do Rocha (587.16), Santa Luzia (409.57), Piancó (314.44), Picuí (308.66), Água Branca (253.61), Juru (210.82) and Itaporanga (198.50) (Figure 2).

Table 1 shows the distribution of bee stings in Paraíba, from 2015 to 2019, according to sex, age group, the time elapsed from the accident to medical care, severity, and progression. The cases occurred more frequently in male individuals (n=712; 61.8%), aged between 20 and 39 years (n=508; 44.1%), followed by age groups between 40 and 59 years (n=231; 20.1%) and between 15 and 19 years (n=116; 10.1%). Most victims received medical care within 1 hour after the accident (n=395; 34.3%), followed by those who received medical care between 1 and 3 hours after the sting (n=266; 23.1%). Regarding the severity, the cases were classified as mild (n=881; 76.5%), moderate (n=113; 9.8%), and severe (n=10; 0.9%). The cases evolved to cure more frequently (n=917; 79.7%) and 1 case of death was reported.

DISCUSSION

The current study shows an increase in bee stings in Paraíba, from 2015 to 2019. In this period, the number of cases increased from 119 to 463, totaling 1,151 with an average of 230 cases per year. Bee stings occur every month, which may be monitored and controlled throughout the year. The spatial distribution showed that cases were reported in 31 municipalities, most frequently in central and western Paraíba. The highest incidence was reported in the northwest region, in the municipalities of Catolé do Rocha, Santa Luzia, Piancó, Picuí, Água Branca, Juru, and Itaporanga. Importantly, Marques et al.[17] reported a high incidence of bee stings in the southwestern region of the state of Rio Grande do Norte. These two regions are located in the semi-arid area of the Northeast region (*Agreste* and *Sertão*), where the hot and dry climate prevails for about 7 to 8 months. Under these conditions, bees are more active and can seek better survival conditions, in which the distance from predators and the availability of food and water are more adequate[18,19]. The greater movement of bees may contribute to the high incidence of envenoming in these regions.

The distribution of cases in the municipalities of Catolé do Rocha, Santa Luzia, and Picuí in the state of Paraíba has a spatial relationship with accidents in the southwestern municipalities of the state of Rio Grande do Norte, namely Parelhas, Acari, Riacho de Santana, Caraúbas, Cerro Corá, Pau dos Ferros and Patu. This data suggests that these regions form, in the Northeast of Brazil, an extensive risk area for this type of envenoming. A considerable

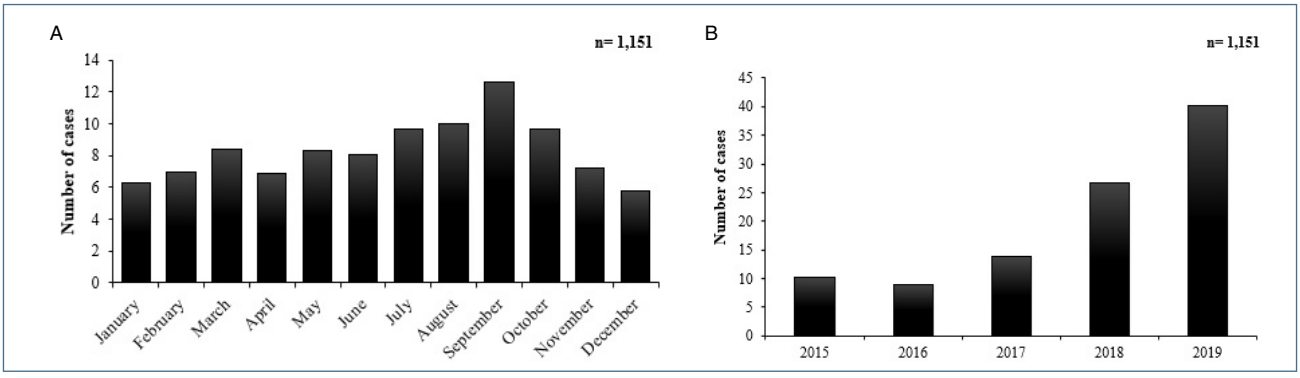
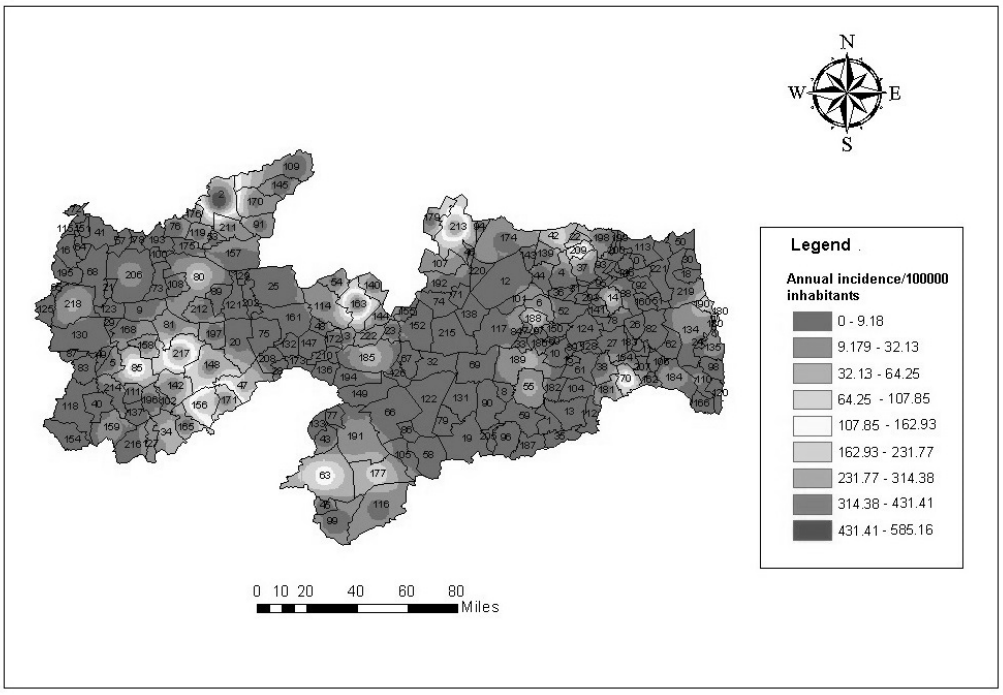


Figure 1 (A and B): Temporal distribution of the bee stings in Paraíba, Brazil, from 2015 to 2019.



0	Pedro Régis	38	Mogeiro	76	Bom Sucesso	114	São Mamede	152	Juazeirinho	190	Lucena
1	Gado Bravo	39	Serra Redonda	77	Amparo	115	Bernardino Batista	153	Borborema	191	Sumé
2	Catolé do Rocha	40	Ibiara	78	Mulungu	116	São João do Tigre	154	Santa Inês	192	Pedra Lavrada
3	Areia de Baraúnas	41	Uiraúna	79	São Domingos do Cariri	117	Pocinhos	155	Tenório	193	Santa Cruz
4	Solânea	42	Araruna	80	Pombal	118	Conceição	156	Juru	194	Livramento
5	São José de Caiana	43	Prata	81	Coremas	119	Jericó	157	Paulista	195	Santa Helena
6	Remí-gio	44	Casserengue	82	Sapé	120	Pitimbu	158	Igaracy	196	Pedra Branca
7	Areial	45	Zabelê	83	Bonito de Santa Fé	121	Condado	159	Santana de Mangueira	197	Emas
8	Caturité	46	Baraúna	84	Montadas	122	São João do Cariri	160	Cuité	198	Campo de Santana
9	São João da Lagoa Tapada	47	Imaculada	85	Itaporanga	123	Nazarezinho	161	Patos	199	Logradouro
10	Massaranduba	48	Quixaba	86	Coxixola	124	Alagoa Grande	162	Juripiranga	200	Caiçara
11	Sobrado	49	Serra Grande	87	Monte Horebe	125	Cachoeira dos Índios	163	Santa Luzia	201	Duas Estradas
12	Barra de Santa Rosa	50	Mataraca	88	Araçagi	126	Parari	164	São José dos Ramos	202	Malta
13	Aroeiras	51	Capim	89	São Bentinho	127	São José de Princesa	165	Tavares	203	Pilões
14	Guarabira	52	Areia	90	Boqueirão	128	Juarez Távora	166	Caaporã	204	Riachão do Poço
15	RiachÃ£o do Bacamarte	53	Mato Grosso	91	São Bento	129	Vista Serrana	167	Lagoa de Dentro	205	Riacho de Santo Antônio
16	Triunfo	54	Varzea	92	Itapororoca	130	São José de Piranhas	168	Aguiar	206	Sousa
17	Sertaozinho	55	Queimadas	93	Belém	131	Cabaceiras	169	Cuitegi	207	Pilar
18	Marcação	56	Serra da Raiz	94	Nova Floresta	132	São José do Bonfim	170	Brejo do Cruz	208	Mãe d'Água
19	Barra de São Miguel	57	Vieirópolis	95	Pirpirituba	133	Ouro Velho	171	Água Branca	209	Dona Inês
20	Catingueira	58	Caraúbas	96	Alcantil	134	Santa Rita	172	Passagem	210	Cacimbas
21	Marizópolis	59	Barra de Santana	97	São Sebastião de Lagoa de	135	João Pessoa	173	Teixeira	211	Riacho dos Cavalos
22	Riachão	60	Matinhas	98	Conde	136	Desterro	174	Cuité de Mamanguape	212	Cajazeirinhas
23	Assunção	61	Ingá	99	São Sebastião do Umbuzeir	137	Curral Velho	175	Lagoa	213	Picuí
24	Bayeux	62	Cruz do Espí-rito Santo	100	São Francisco	138	Olivedos	176	Brejo dos Santos	214	Diamante
25	São José de Espinharas	63	Monteiro	101	Algodão de Jandaí-ra	139	Cacimba de Dentro	177	Camalaú	215	Soledade
26	Mari	64	Poço de José de Moura	102	Nova Olinda	140	São José do Sabugi	178	Lastro	216	Manaí-ra
27	Gurinhum	65	Bom Jesus	103	Pilãezinhos	141	Alagoinha	179	Frei Martinho	217	Piancó
28	Maturéia	66	Serra Branca	104	Itatuba	142	Santana dos Garrotes	180	Cabedelo	218	Cajazeiras
29	Carrapateira	67	Santo André	105	Congo	143	Damião	181	Salgado de São Félix	219	Rio Tinto
30	Baía da Traição	68	São João do Rio do Peixe	106	São Miguel de Taipu	144	Junco do Seridó	182	Fagundes	220	Sossêgo
31	Serraria	69	Boa Vista	107	Nova Palmeira	145	São José do Brejo do Cruz	183	Caldas Brandão	221	Mamanguape
32	Gurjão	70	Itabaiana	108	São Domingos de Pombal	146	Curral de Cima	184	Pedras de Fogo	222	Salgadinho
33	Puxinanã	71	Cubati	109	Belém do Brejo do Cruz	147	Cacimba de Areia	185	Taperoá		
34	Princesa Isabel	72	Poço Dantas	110	Alhandra	148	Olho d'Água	186	Lagoa Seca		
35	Umbuzeiro	73	Aparecida	111	Boa Ventura	149	São José dos Cordeiros	187	Santa Cecí-lia		
36	Arara	74	Seridó	112	Natuba	150	Alagoa Nova	188	Esperança		
37	Bananeiras	75	Santa Teresinha	113	Jacaraú	151	Santarém	189	Campina Grande		

Figure 2: Spatial distribution of the bee stings in Paraíba, Brazil, from 2015 to 2019

Table 1: Distribution of the bee stings in Paraíba, from 2015 to 2019, according to sex, age group, the time elapsed from the sting to medical care, severity, and progression

Gender	N	%
Female	437	38.0
Male	712	61.8
Unknown	2	0.2
Total	**1,151**	**100**
Victim's Age (years)	**N**	**%**
< 1	20	1.7
1-4	56	4.9
5-9	66	5.7
10-14	66	5.7
15-19	116	10.1
20-39	508	44.1
40-59	231	20.1
60-64	24	2.1
65-69	20	1.7
70-79	33	2.9
> 80	11	10.0
Total	**1,151**	**100**
Time from sting until medical care (hours)	**N**	**%**
0-1	395	34.3
1-3	266	23.1
3-6	67	5.8
6-12	32	2.8
12-12	64	5.6
24 and +	99	8.6
Unknown	228	19.8
Total	**1,151**	**100**
Severity	**N**	**%**
Mild	881	76.5
Moderate	113	9.8
Severe	10	0.9
Unknown	147	12.8
Total	**1,151**	**100**
Progression	**N**	**%**
Cure	917	79.7
Deaths	1	0.1
Unknown	233	20.2
Total	**1,151**	**100**

number of cases was also observed in Campina Grande, this may partly be explained by the fact that this municipality has several medical reference centers that often assist individuals living in small municipalities, especially those with less than 25,000 inhabitants or that are further away from large urban centers. The findings of this study, on the spatial distribution of the incidents, may be used by public health agents of the Paraíba to develop sanitary actions at a local and/or regional level, aiming at preventively controlling envenoming and improving the care of the victims. Also, the budget may be managed with greater security, reducing and/or avoiding losses.

The difference in cases between male (62%) and female (38%) individuals shows that men are more exposed to the risk of envenoming than women. This result agrees with epidemiological studies conducted in the Northeast region, in which the percentage of men affected by bee stings has reached values similar to those of the present study[17,20]. That may be due to the work activities performed by men, namely, civil construction, transportation, agriculture, and tending to livestock[20]. In Paraíba, most honey production is concentrated in the region of the municipality of Catolé do Rocha. It has been reported that in this region beekeeping is an activity practiced mostly by men[21]. It was a reported association between sex (male and female) and the type of venomous animals in the state of the Ceará, showing that there was a higher risk of snakebites and bee stings in males than in females[9].

Regarding the victims' age, most of them were between 20 and 59 years old (64.2%), suggesting that the economically active population is the most affected by this type of incident. This study also shows a considerable proportion of cases (28.1%) involving children and adolescents (0 to 19 years old), which agrees with studies carried out in the states of Ceará[20] and Santa Catarina[22]. In the state of the Rio Grande do Norte, it was demonstrated that children and adolescents are at greater risk of progressing to a severe condition and/or death[17]. This fact may be partially explained by the greater amount of venom in the blood about the body mass, part of the body affected by the sting, the sensitivity of the victim to the venom, greater permeability of the blood-brain barrier, and the immune system still in formation[23,24]. In municipalities with the highest incidence of cases, health professionals should receive specific training for the medical care of children and adolescents.

The victims received more often medical assistance up to 3 hours after the sting (57.4%), suggesting that the population may be aware of the importance of the immediate search for medical care if they are stung by bees. Moreover, the instant manifestation of acute pain at the site of the sting is a crucial indicator of this behavior, besides the fact that the cases may have happened close to a medical care unit. The time elapsed from the sting to the medical care observed in the present study agrees with other epidemiological studies conducted in the states of Ceará[20] and Rio Grande do Norte[17]. Most cases exhibited mild severity (76.5%), while few cases were classified as moderate (9.8%) and severe (0.9%). The predominance of cases that progressed to cure (79.7%) is also in line with epidemiological studies conducted in other regions of Brazil[19,24].

Despite the notification of only one case of death, a bee sting is still a concern, as it can often be a case of a medical emergency. Since underreporting is a reality in Brazil[5], the dwindling number of moderate and severe cases may not represent the real magnitude of the incidents. The underreporting of cases involving bee stings has been reported by several studies[8,22,25]. The recording of information about bee stings can present deficiencies due to incorrect identification and categorization of these insects in both the category "Bee" and in the category "Others", used to include, among others, wasps, and ants. In addition, the medical records do not address whether the envenoming is caused by a single sting

or multiple stings. It is important to create a new category in the medical records to register the distinction between allergic reactions and toxic effects by massive bee envenoming to assess the case in more detail. The current study was based on a secondary source of epidemiological data recorded by different health professionals, thus allowing for different interpretations of medical records, affecting the veracity of the information. However, this study may improve the understanding of the epidemiological characteristics of the bee stings in Paraíba and it also may be useful to identify the conditions that increase the risk of envenoming. It also provides findings that may be used in the development of educational health actions to promote the prevention and control of bee stings in this region.

In conclusion, bee stings have increased in Paraíba, indicating that are urgently needed health actions to reduce the number of envenoming. The cases occur in all months of the year, in the regions of *Agreste* and *Sertão*, suggesting that these regions form an area of greater risk for bee stings. There is a predominance of incidents among young adult men, but the number of cases among children is high also. The progression of the cases is often favorable and the lethality rate is low. Further studies in this region are needed to investigate the circumstances in which the bee stings occur, their clinical manifestations, and the outcome of cases. Also, an investigation of the species community structure of those bees existing in the Northeast region is necessary to better understand the species involved in this type of incident.

REFERENCES

1. Keer WE, Keer E, Keer W. The history of the introduction of African bees in Brazil. South African Bee J. 1967;2(39):33-5.
2. Mistro DC, Rodrigues LAD, Ferreira Jr WC. The Africanized honey bee dispersal: a mathematical zoom. Bull Mathemat Biol. 2005;67(2):281-312. https://doi.org/10.1016/j.bulm.2004.07.006
3. Ferreira Jr RS, Almeida RAMB, Barraviera SRCS, Barraviera B. Historical perspective and human consequences of africanized bee stings in the Americas. J Toxicol Environ Health B Crit Rev. 2012;15(2):97-108. https://doi.org/10.1080/10937404.2012.645141
4. Winston ML. The biology and management of africanized honey bees. Annu Rev. Entomol. 1992;37:173-93. https://doi.org/10.1146/annurev.en.37.010192.001133
5. Medeiros CR, França FO. Acidentes por abelhas e vespas. In: Cardoso JLC, França FO, Wen FH, Málaque CMS, Haddad V. Animais Peçonhentos no Brasil: biologia, clínica e terapêutica dos acidentes. 2 ed. São Paulo: Sarvier, 2009; p. 259-67.
6. Pucca MB, Cerni FA, Oliveira IS, Jenkins TP, Argemí L, Sorensen CV, et al. Bee Updated: Current Knowledge on Bee Venom and Bee Envenoming Therapy. Front Immunol. 2019;10:2090. https://doi.org/10.3389/fimmu.2019.0209
7. Almeida RA, Olivo TE, Mendes RP, Barraviera SR, Souza LR, Martins JG, et al. Africanized honeybee stings: how to treat them. Rev Soc Bra Med Trop. 2011;44(6):755-61. https://dx.doi.org/10.1590/S0037-86822011000600020
8. Chippaux JP. Epidemiology of envenomation by terrestrial venomous animals in Brazil based on case reporting: from obvious facts to contingencies. J Venom Anim Toxins Incl Trop Dis. 2015;21(13):1-17. https://doi.org/10.1186/s40409-015-0011-1
9. Braga JRM, Souza MMC, Melo IMLA, Faria LEM, Jorge RJB. Epidemiology of accidents involving venomous animals in the State of Ceará, Brazil (2007–2019). Rev Soc Bras Med Trop. 2021;54. https://doi.org/10.1590/0037-8682-0511-2020
10. Toledo LFM, Moore DCBC, Caixeta DML, Salú MS, Farias CVB, Azevedo ZMA. Multiple bee stings, multiple organs involved: a case report. Rev Soc Bras Med Trop. 2018;51(4):560-2. https://doi.org/10.1590/0037-8682-0341-2017
11. Brasil. Ministério da Saúde. Secretaria de Saúde. Acidentes por abelha. Available from: https://www.gov.br/saude/pt-br/assuntos/saude-de-a-a-z/a/acidentes-ofidicos/acidentes-por-animais-peconhentos-o-que-fazer-e-como-evitar
12. Brasil. Ministério da Saúde. Banco de dados do Sistema Único de Saúde-DATASUS. Available from: https://datasus.saude.gov.br/informacoes-de-saude-tabnet/
13. Mitas L, Mitasova H. Spatial interpolation. In: Longley PA, Goodchild MF, Maguire DJ, Rhind DW. Geographical information systems: principles, techniques, management, and applications. 2rd ed. United States: Wiley, 1999; p. 481-92.
14. Instituto Brasileiro de Geografia e Estatística (IBGE). Panorama: Paraíba. Available from: https://cidades.ibge.gov.br/brasil/pb/panorama
15. Silva ASA, Menezes RSC, Telesca L, Stosic B, Stosic T. Fisher Shannon analysis of drought/wetness episodes along a rainfall gradient in Northeast Brazil. Int J Climatol. 2020;41(1). https://doi.org/10.1002/joc.6834
16. Nascimento IRS, Borges PF, Rodrigues ENS, Souza FMS, Cartaxo PHA, Araújo LS, et al. Análise da Teoria da Entropia utilizando dados pluviométricos no Estado da Paraíba. Rev Cient Rural. 2019;21(2):1-15. https://doi.org/10.30945/rcr-v21i2.2746
17. Marques MRV, Araújo KAM, Tavares AV, Vieira AA, Leite RS. Epidemiology of envenomation by Africanized honeybees in the state of Rio Grande do Norte, Northeastern Brazil. Rev Bras Epidemiol. 2020;23:E.200005. https://doi.org/10.1590/1980-549720200005
18. Pereira AM, Chaud-Netto J, Bueno OC, Arruda VM. Relationship among ***Apis melifera L.*** stings, swarming and climate conditions in the city of Rio Claro, SP, Brazil. J Ven Animals Toxins Includ Tropical Dis. 2010;16(4):647-53. https://doi.org/10.1590/S1678-91992010000400016
19. Mello MHSH, Silva EA, Natal D. Africanized bees in a metropolitan area of Brazil: shelters and climatic influences. Rev Saude Publica. 2003;37(2):237-41. https://doi.org/10.1590/s0034-89102003000200012

20. Sousa GS, Alves JE, Ximenes Neto FRG, Braga PET. Epidemiologia e distribuição espacial de acidentes por abelhas no estado do Ceará, 2003 a 2011. SaBios Rev Saude Biol. 2015;10(3):75-86.

21. Silva DP, Silva CAL, Pinto MSC, Silva KB, Silva RA, Maracajá PB, et al. Diagnosis socioeconomic, environmental and productive of the activity of the bee in the municipalities of the microregion Catolé of the Rocha - PB. Rev Verde Agroecol Desenvolv Sustentável. 2014;9(3):213-22.

22. Oliveira SK, Trevisol DJ, Parma GC, Ferreira Júnior RS, Barbosa AN, Barraviera B, et al. Honey bee envenoming in Santa Catarina, Brazil, 2007 through 2017: An observational, retrospective cohort study. Rev Soc Bra Med Trop. 2019;52:e20180418. http://dx.doi.org/10.1590/0037-8682-0418-2018

23. Betten DP, Richardson WH, Tong TC, Clark RF. Massive honey bee envenomation-induced rhabdomyolysis in an adolescent. Pediatrics. 2006;117(1):231-5. https://doi.org/10.1542/peds.2005-1075

24. Akolly DAE, Guedenon KM, Tsolenyanu E, Bessi LK, Gnamey DK, Atakouma Y. Massive Envenomation by Bees Sting in a Child in Togo. Open J Pediatr. 2016;6(3):232-6. http://dx.doi.org/10.4236/ojped.2016.63032

25. Diniz AGQ, Belmino JFB, Araújo KAM, Vieira AT, Leite RS. Epidemiology of honeybee sting cases in the state of Ceará, Northeastern Brazil. Rev Inst Med Trop São Paulo. 2016;58(40):1-5. https://doi.org/10.1590/S1678-9946201658040