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EPIDEMIOLOGICAL PROFILE OF THE BEE STINGS IN PIAUÍ, NORTHEASTERN BRAZIL, FROM 2011 TO 2020

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Resumo

No Brasil, a região Nordeste tem registrado a maior incidência de casos e óbitos por picada de abelha. Contudo, as circunstâncias em que os acidentes ocorrem e a sua distribuição espacial ainda são pouco conhecidas. Objetiva-se determinar o perfil epidemiológico do acidente por picada de abelha no estado do Piauí, de 2011 a 2020. Estudo epidemiológico realizado por meio de uma pesquisa de dados disponíveis no Sistema de Informação de Agravos de Notificação do Ministério da Saúde. Foram notificados 6.800 casos distribuídos em 148 municípios do Piauí. Os acidentes foram registrados em todos os meses dos anos investigados, sobretudo, nas regiões do centro-sul, centro-norte, sudeste e sudoeste piauiense. Os casos ocorreram principalmente em áreas urbanas, afetando com maior frequência homens adultos e crianças. As regiões do corpo mais atingidas foram a cabeça e os membros superiores. A maioria dos agravos recebeu cuidado médico até 3 horas após o incidente, manifestou severidade leve e evoluiu para cura. O crescimento dos casos de picada de abelha aponta um emergente problema sanitário ambiental no Piauí, indicando que ações sanitárias são urgentemente necessárias para diminuir a sua incidência nesta região.

Palavras-chave: abelhas, envenenamento, picada de abelha, saúde pública

Abstract

In Brazil, the Northeast region has recorded the highest incidence of cases and deaths caused by bee stings. However, the circumstances under which these incidents occur and their spatial distribution remain poorly understood. This study aims to determine the epidemiological profile of bee sting incidents in the state of Piauí from 2011 to 2020. It is an epidemiological study based on data obtained from the Notifiable Diseases Information System of the Brazilian Ministry of Health. There were 6,800 bee stings distributed in 148 municipalities of Piauí. The cases were recorded every month of the years investigated, especially in the center-

south, center-north, southeast, and southwest regions of the state. They occurred mainly in urban areas, mostly affecting adult men and children. The anatomical regions of the body most affected by stings were the head and upper limbs. Most of the injuries received medical care up to three hours after the accident, expressed mild severity, and progressed to healing. The growth of bee sting cases should be considered an emerging environmental sanitary problem in the state of Piauí. In this way, sanitary actions are urgently necessary to reduce their incidence in this region.

Keywords: bees, envenoming, bee sting, public health.

1 Introduction

The bees of European origin, *Apis mellifera mellifera*, *Apis mellifera caucasic*, *Apis mellifera liguestic*, and *Apis mellifera carnical*, were introduced in Brazil during the colonial period. However, these species produce small amounts of honey and present difficulties in adapting to tropical environmental conditions. In 1956, for scientific studies with the purpose of improving beekeeping, queen bees of African origin (*Apis mellifera scutellata*) were brought to Brazil. Accidentally, some of them escaped to the environment, triggering consecutive mating with the European bees, conceiving a hybrid known as Africanized bee (Ferreira *et al*., 2012).

This hybrid bee has adapted to the climatic conditions, flora, and fauna of the Americas. In the 1960s, they arrived in Paraguay, Bolivia, Uruguay, and Argentina. In 1977, their appearance was registered in Venezuela, Colombia, and Ecuador. In 1985, they reached Mexico and, in 1990, the United States of America. The Africanized bee has a high reproductive, adaptive, and migratory capacity, in addition to exhibiting intense defensive behavior (Ferreira *et al*., 2012). Such attributes and anthropogenic environmental changes, in urban and rural areas, probably contributed to increase the cases and deaths caused by bee stings in Brazil and other American countries (Araújo *et al*., 2022; Chippaux, 2015; de Oliveira *et al*., 2019; Kono *et al*., 2021).

Clinical manifestations induced by bee stings can be classified into toxic and allergic reactions. Local toxic manifestations result from one or a few stings, which often cause severe pain, mild or moderate edema, and erythema. Systemic envenoming results from multiple stings, approximately 100 simultaneous ones. The most frequent symptoms are itching, flushing, heat, hypotension, tachycardia, headache, nausea and/or vomiting, abdominal

cramps, and bronchospasm. In more severe cases, direct damage to the cardiovascular, muscular, nervous, hematological, respiratory, and renal systems may occur, which may increase the risk of death due to the release of cytokines and multiple organ failure. Allergic reactions are IgE dependent and classified as type I hypersensitivity reactions. Local allergic reactions cause edema and itching that persist for a few days. Eventually, they may progress to a systemic reaction, resulting in generalized hives, bronchospasm, hypotension, urinary incontinence, glottis edema, cyanosis, loss of consciousness, and anaphylactic shock (Medeiros; França, 2009; Almeida *et al*., 2011).

Envenoming and deaths by bee stings have increased in all regions of Brazil (de Oliveira *et al*., 2019; Costa *et al*., 2018; Marques *et al*., 2020). Between 2010 and 2018, 115,833 cases and 328 deaths were reported. In 2018, the Northeast region recorded the highest incidence of cases and deaths from it in the country (BRASIL, 2018). Few studies have been conducted to determine the characteristics of this type of injury, mainly in the Northeast region of the country. Consequently, there is little regional and/or local epidemiological information on the most affected populations and in which circumstances, regions, and/or municipalities bee stings occur more frequently. Thus, the present study aims to determine the epidemiological profile of bee stings in the state of Piauí, Northeastern Brazil, from 2011 to 2020.

2 Methodology

2.1 Study design

This study is a descriptive epidemiological investigation of bee stings in the state of Piauí, Northeastern Brazil, from 2011 to 2020. A retrospective survey of secondary epidemiological data was conducted, using the variables month, year, sex, age group, occurrence zone, anatomical site of the sting, the time elapsed from the sting to receiving medical care, local and systemic symptoms, severity, and outcome of cases. The results of the descriptive analysis were described in figures (graphs) of absolute and relative frequency distribution. Then, the number of cases recorded per municipality was observed using a thematic map with a distribution of values by the Quantile method (Dickey; Fuller, 1979). Epidemiological information was collected from the Notifiable

Diseases Information System database of the Ministry of Health (BRASIL, 2023). Population and demographic data were collected from the Brazilian Institute of Geography and Statistics database (IBGE, 2023).

This study was developed following the norms of Resolution 466/2012 of the National Council for Ethics in Research (CONEP), which state that research involving only secondary data in the public domain, without identifying participants, does not require approval by the Committee of Ethics in Research of the CONEP System.

2.2 Study area

Piauí is the third largest state in Northeast Brazil, occupying an area of 251,755.481 km², with a population of 3,289,290 inhabitants and a demographic density of 12.40 inhabitants/km². The distribution of its population is irregular; there is a large population in the north and center-east of the state, while in the center-south and south, the demographic density is low. The population is distributed in 224 municipalities, with approximately 65.8% of individuals residing in urban areas and 34.2% in rural areas (IBGE, 2023).

Its territory is covered by coastal vegetation, mangroves, *caatinga*, *cerrado*, and coconut forest. It is located between two transition zones: the semi-arid Northeast and the humid Amazon. Thus, Piauí has two climate types: the hot and humid tropical climates, influenced by the Amazonian environment, and the semi-arid one, with characteristics of the northeastern *sertão*. The west and southwest regions are under the influence of a hot and humid tropical climate. Their average temperature can vary between 18°C and 30°C and the annual precipitation can vary between 1000mm and 1800mm. This climate type has two well-defined seasons, the rainy one, between December and May, and the dry one, between June and November (de Medeiros, 2020). In the east and southeast regions, which correspond to about 62% of the territory of the state, the climate is semi-arid. In these regions, rainfall rates are low, ranging from 500mm to 800mm. The rains occur more frequently between the months of December and March but are irregular throughout the year. There are long periods of drought, and the average temperature is high, ranging from 23°C to 40°C (de Medeiros, 2020; Modesto dos Passos, 2020).

3 Results and Discussion

Figure 1A shows that 6,800 bee stings were reported in the state of Piauí from 2011 to 2020. In 2011, 66 cases were recorded, and from 2012 on there was an increase, mainly in 2017 (n=1150), 2018 (n=1464), 2019 (n=1338), and 2020 (n=786).

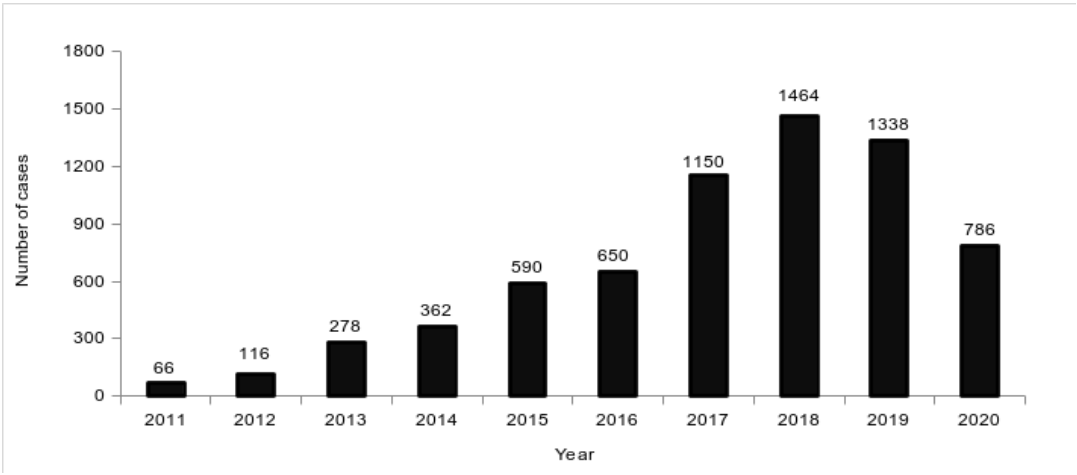

Figure 1A: Distribution by year of the bee stings in Piauí, Brazil, from 2011 to 2020

Source: Research data, 2023

The growth of the number of bee sting cases in the state of Piauí revealed an emerging neglected environmental public health problem in the Northeast region of Brazil. The increase in cases in other regions of the country has also been reported (Araújo *et al*., 2022; Chippaux, 2015; de Oliveira *et al*., 2019; Kono *et al*., 2021; Costa *et al*., 2018; Marques *et al*., 2020; BRASIL, 2018). This data may be partially explained by the improvement of the system for recording epidemiological and clinical information on envenoming caused by venomous animals, possibly due to the decentralization of health surveillance actions (Kono *et al*., 2021; Sousa *et al*., 2015).

Bee stings occurred in all months (Figure 1B), with a monthly average of 567 cases. The proportion of cases was slightly higher in May (n=734), June (n=804), July (n=663), and August (n=711).

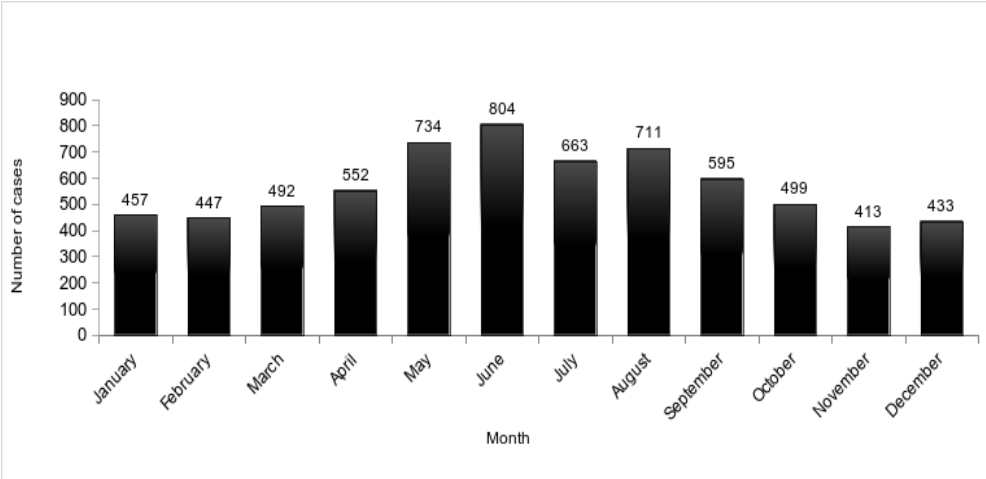

Figure 1B: Distribution by month of the bee stings in Piauí, Brazil, from 2011 to 2020

Source: Research data, 2023

The incidents were recorded during all months of the years investigated, with a slight increase between May and August. In Piauí, the greatest rainfall occurs from December to April (de Medeiros, 2020). After this period, there is a large supply of water and food, mainly due to the flowering of herbaceous and shrubby plants (Modesto dos Passos, 2020). Under these conditions, bees are more active and may seek better survival conditions, such as more distance from predators and better availability of food and water (Bodlah *et al*., 2024). This movement may favor their contact with humans, increasing the number of attacks (Oliveira Orsi *et al*., 2024). However, further studies are needed to investigate the relationship between climatic and floristic factors and the incidence of cases in this region.

The incidents were reported in 148 municipalities, mainly in Picos (n=1550; 22.8%), followed by Teresina (n=1383; 20.4%), Piripiri (n=497; 7.3%), Floriano (n=318; 4.7%), Bom Jesus (n=207; 3.1%), Sussuapara (n=178; 2.6%), Campo Alegre (n=175; 2.6%), Oeiras (n=162; 2.4%), and Itaueira (n=144; 2.1%) (Figure 2).

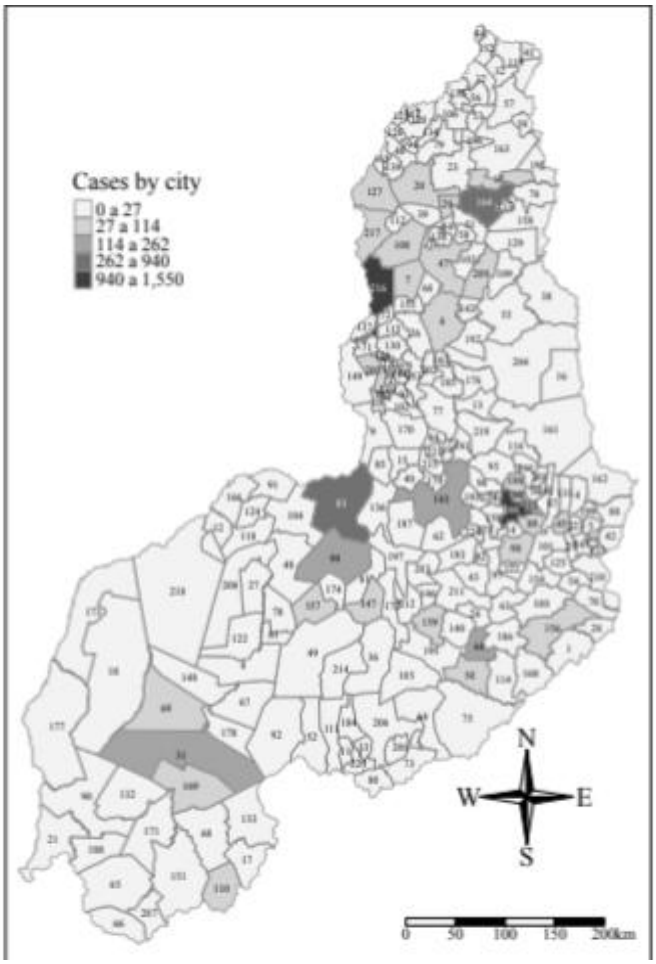

Figure 2: Spatial distribution of the bee stings in Piauí, Brazil, from 2011 to 2020

Source: Research data, 2023

nº	Município	nº	Município	nº	Município	nº	Município
1	Acauã	57	Cocal	113	Lagoa de São Francisco	169	Redenção do Gurguéia
2	Agricolândia	58	Cocal de Telha	114	Lagoa do Barro do Piauí	170	Regeneração
3	Água Branca	59	Cocal dos Alves	115	Lagoa do Piauí	171	Riacho Frio
4	Alagoinha do Piauí	60	Coivaras	116	Lagoa do Sítio	172	Ribeira do Piauí
5	Alegrete do Piauí	61	Colônia do Gurguéia	117	Lagoinha do Piauí	173	Ribeiro Gonçalves
6	Alto Longá	62	Colônia do Piauí	118	Landri Sales	174	Rio Grande do Piauí
7	Altos	63	Conceição do Canindé	119	Luís Correia	175	Santa Cruz do Piauí
8	Alvorada do Gurguéia	64	Coronel José Dias	120	Luzilândia	176	Santa Cruz dos Milagres

9	Amarante	65	Corrente	121	Madeiro	177	Santa Filomena
10	Angical do Piauí	66	Cristalândia do Piauí	122	Manoel Emídio	178	Santa Luz
11	Anísio de Abreu	67	Cristino Castro	123	Marcolândia	179	Santa Rosa do Piauí
12	Antônio Almeida	68	Curimatá	124	Marcos Parente	180	Santana do Piauí
13	Aroazes	69	Currais	125	Massapê do Piauí	181	Santo Antônio de Lisboa
14	Aroeiras do Itaim	70	Curral Novo do Piauí	126	Matias Olímpio	182	Santo Antônio dos Milagres
15	Arraial	71	Curralinhos	127	Miguel Alves	183	Santo Inácio do Piauí
16	Assunção do Piauí	72	Demerval Lobão	128	Miguel Leão	184	São Braz do Piauí
17	Avelino Lopes	73	Dirceu Arcoverde	129	Milton Brandão	185	São Félix do Piauí
18	Baixa Grande do Ribeiro	74	Dom Expedito Lopes	130	Monsenhor Gil	186	São Francisco de Assis do Piauí
19	Barra D'Alcântara	75	Dom Inocêncio	131	Monsenhor Hipólito	187	São Francisco do Piauí
20	Barras	76	Domingos Mourão	132	Monte Alegre do Piauí	188	São Gonçalo do Gurguéia
21	Barreiras do Piauí	77	Elesbão Veloso	133	Morro Cabeça no Tempo	189	São Gonçalo do Piauí
22	Barro Duro	78	Eliseu Martins	134	Morro do Chapéu do Piauí	190	São João da Canabrava
23	Batalha	79	Esperantina	135	Murici dos Portelas	191	São João da Fronteira
24	Bela Vista do Piauí	80	Fartura do Piauí	136	Nazaré do Piauí	192	São João da Serra
25	Belém do Piauí	81	Flores do Piauí	137	Nazária	193	São João da Varjota
26	Beneditinos	82	Floresta do Piauí	138	Nossa Senhora de Nazaré	194	São João do Arraial
27	Bertolínia	83	Floriano	139	Nossa Senhora dos Remédios	195	São João do Piauí
28	Betânia do Piauí	84	Francinópolis	140	Nova Santa Rita	196	São José do Divino
29	Boa Hora	85	Francisco Ayres	141	Novo Oriente do Piauí	197	São José do Peixe
30	Bocaina	86	Francisco Macedo	142	Novo Santo Antônio	198	São José do Piauí
31	Bom Jesus	87	Francisco Santos	143	Oeiras	199	São Julião
32	Bom Princípio do Piauí	88	Fronteiras	144	Olho D'Água do Piauí	200	São Lourenço do Piauí

33	Bonfim do Piauí	89	Geminiano	145	Padre Marcos	201	São Luis do Piauí
34	Boqueirão do Piauí	90	Gilbués	146	Paes Landim	202	São Miguel da Baixa Grande
35	Brasileira	91	Guadalupe	147	Pajeú do Piauí	203	São Miguel do Fidalgo
36	Brejo do Piauí	92	Guaribas	148	Palmeira do Piauí	204	São Miguel do Tapuio
37	Buriti dos Lopes	93	Hugo Napoleão	149	Palmeirais	205	São Pedro do Piauí
38	Buriti dos Montes	94	Ilha Grande	150	Paquetá	206	São Raimundo Nonato
39	Cabeceiras do Piauí	95	Inhuma	151	Parnaguá	207	Sebastião Barros
40	Cajazeiras do Piauí	96	Ipiranga do Piauí	152	Parnaíba	208	Sebastião Leal
41	Cajueiro da Praia	97	Isaías Coelho	153	Passagem Franca do Piauí	209	Sigefredo Pacheco
42	Caldeirão Grande do Piauí	98	Itainópolis	154	Patos do Piauí	210	Simões
43	Campinas do Piauí	99	Itaueira	155	Pau D'Arco do Piauí	211	Simplício Mendes
44	Campo Alegre do Fidalgo	100	Jacobina do Piauí	156	Paulistana	212	Socorro do Piauí
45	Campo Grande do Piauí	101	Jaicós	157	Pavussu	213	Sussuapara
46	Campo Largo do Piauí	102	Jardim do Mulato	158	Pedro II	214	Tamboril do Piauí
47	Campo Maior	103	Jatobá do Piauí	159	Pedro Laurentino	215	Tanque do Piauí
48	Canavieira	104	Jerumenha	160	Picos	216	Teresina
49	Canto do Buriti	105	João Costa	161	Pimenteiras	217	União
50	Capitão Gervásio Oliveira	106	Joaquim Pires	162	Pio IX	218	Uruçuí
51	Capitão de Campos	107	Joca Marques	163	Piracuruca	219	Valença do Piauí
52	Caracol	108	José de Freitas	164	Piripiri	220	Várzea Branca
53	Caraúbas do Piauí	109	Juazeiro do Piauí	165	Porto	221	Várzea Grande
54	Caridade do Piauí	110	Júlio Borges	166	Porto Alegre do Piauí	222	Vera Mendes
55	Castelo do Piauí	111	Jurema	167	Prata do Piauí	223	Vila Nova do Piauí
56	Caxingó	112	Lagoa Alegre	168	Queimada Nova	224	Wall Ferraz

The record of cases in 148 municipalities shows that bee stings are irregularly distributed in the state, and were more frequent in the south-central,

north-central, southeast, and southwest regions, where there is the highest demographic density in Piauí. The high number of cases reported in Picos and Teresina may be because both have several reference medical centers that often care for individuals residing in small municipalities, especially those distant from large urban centers. In addition, the region around of Picos is one of the largest honey producers in the country, with approximately one thousand rural producers working in apiaries (Oliveira, 2014), which may also explain the increase in cases. These results suggest that the central-north, southeast, and southwest regions of Piauí represent an area with a risk of bee stings. Information on the spatial and temporal distribution of cases may be used by managers and public health agents in the state of Piauí to conduct educational and health actions at the local and/or regional level, monitor the cases, and improve care with the victims. Moreover, the public budget can be managed with greater precision, reducing and/or avoiding losses.

The distribution of cases according to sex, age group, area of occurrence, the time elapsed between the sting and receiving medical care, anatomical region of the sting, local and systemic symptoms, severity, and outcome is shown in Table 1.

Table 1: Distribution of the bee sting cases in the Piauí, Brazil, from 2011 to 2020, according to the gender, victims age, occurrence zone, time from sting until medical care, anatomic region of the sting, severity and outcome

Variables	(n)	%
Gender		
Female	2660	39.12
Male	4140	60.88
Total	6800	100
Victims age (Years)		
0-9	1307	19.62
09-18	689	10.35
18-28	1541	23.14
28-38	1328	19.94
38-48	829	12.45
48-58	501	7.52

58-68	247	3.71
68+	218	3.27
Total	6660	100
Occurrence zone		
Urban	3869	59.47
Rural	2592	39.84
Periurban	45	0.69
Total	6506	100
Time from sting until medical care		
0-1h	2445	45.04
1-3h	1821	30.57
3-6h	476	7.99
6-12h	164	2.75
12-24h	367	6.16
>24h	684	11.48
Total	5957	100
Anatomic site of the sting		
Head	2620	42.85
Arm	895	14.80
Hand	956	15.63
Trunk	695	11.37
Leg	423	10.12
Foot	526	8.6
Total	6115	100
Severity		
Mild	5797	89.39
Moderate	654	10.88
Severe	34	0.52
Total	6485	100
Outcome		
Cure	6322	99.75
Death	16	0.25
Total	6338	100

Source: Research data, 2023

The cases involved men (n=4140; 60.88%) and women (n=2660; 39.12%), mainly individuals aged between 18 and 28 years (n=1541; 23.14%) and 0 to 9

years old (n=1307; 19.62%). The incidents happened in urban (n=3869; 59.47%) and rural areas (n=2592; 39.84%). Most individuals received medical care within 1 hour after the sting (n=2445; 41.04%), followed by 1 to 3 hours (n=1821; 30.57%).

Most frequently, the stings affected the head (n=2620; 42.85%), hand (n=956; 15.63%), arm (n=895; 14.80%), trunk (n=695; 11.37%), and leg (n=423; 10.12%). Local clinical manifestations were reported in 6498 cases and systemic ones in 751 cases. Regarding severity, injuries were classified as mild (n=5797; 89.39%), moderate (n=654; 10.08%), and severe (n=34; 0.52%). Most bee stings progressed to cure (n=6322; 98.18%) and 16 cases to death, resulting in a lethality rate of 0.002% (Table 1).

The difference in the cases between males (60.88%) and females (39.12%) indicates that the first are more exposed to stings than the latter. The context of the incident may be related to the work activities conducted predominantly by men, namely, transport, civil construction, agriculture, livestock, and, mainly, beekeeping. Regarding the age group, adult individuals (18 to 38 years old) were the most affected, showing that the largest number of cases is among the working age population (Marques *et al*., 2020).

The significant number of incidents with children from 0 to 9 years old (19.62%) arouses concern due to their not having a real perception of the danger that bees may represent and the typically increased curiosity in this age group. In addition, the caricatured representation of bees in animations for children as docile and friendly insects may contribute to a greater number of cases involving them (Schwebel; Wells; Johnston, 2015). Another cause for concern is their low body mass, which can withstand a smaller number of stings. Injuries caused by one or a few stings, devoid of anaphylactic shock or systemic toxic reactions, are often not reported. In such cases, victims do not seek medical care, as the sting of a bee may usually cause only local reactions of transient pain and edema (Almeida *et al*., 2011).

On the other hand, when this same situation occurs with babies and children (0 to 9 years), parents usually seek medical care, resulting in a medical record (Chippaux, 2015; Kono *et al*., 2021). Therefore, underreporting of bee

stings is a reality (Chippaux, 2015; de Araújo et al., 2023), especially in mild cases involving adults (Kono *et al*., 2021).

The higher frequency of bee stings in urban areas may be due to their high number of inhabitants and the ability of bees to adapt to anthropogenic environmental changes (Chippaux, 2015; Kono *et al*., 2021). Also, social and environmental changes in rural areas reduce the quality and availability of habitats for bees. Consequently, urban areas often become a refuge and/or shelter for them, as well as a place with a large source of food and water (de Araújo *et al*., 2023). Further studies are needed to investigate whether bee stings are associated with wild beehives in forests or with honey producing ones, in rural or even urban colonies.

Medical care was performed in 75.61% of cases up to 3 hours after the sting, suggesting that the population is aware of the importance of rapidly seeking medical care. In addition, the instant manifestation of pain in the sting site can also be the trigger for the rapid search for medical care. The most affected anatomical region of the body was the head (42.85%), followed by the hand (15.63%), arm (14.80%), trunk (11.37%), and leg (10.12%). Bees, because they are winged insects, preferably pick the upper regions of the body. The upper ends, arm, and hand are naturally used to ward them off in situations of attack and are, therefore, also stung.

Despite the favorable prognosis and the low rate of lethality, 16 cases progressed to death. Even in a small number, deaths must always be considered relevant. Bee stings require medical care, as they can often be a medical emergency, and there is no specific serum for their treatment (Cavalcante *et al*., 2024). Since most cases expressed mild severity and progressed to cure, there is evidence that they may have been caused by one or multiple stings, although the notification file does not include a space for reporting this number. In addition, there is no discrimination between the severity caused by toxic envenoming and the one resulting from allergic reactions.

The manifestation of local symptoms occurred in 6498 cases and systemic ones in 751 cases. The most frequent local clinical manifestations were pain

(n=5826; 89.65%), edema (n=5592; 86.05%), pruritus (n=429; 6.60%), paresthesia (n=151; 2.32%) and hyperemia (n=130; 2.0%). The most frequent systemic manifestations were vagal (n=319; 42.47%), neurological (n=141; 18.77%), and respiratory changes (n=123; 16.37%), and fever (n=68; 9 .0%) (Table 2).

Table 2: Distribution of bee sting cases in Piauí, Brazil, from 2011 to 2020, according to local and systemic clinical manifestations

Clinical manifestations	
Local	**(n)**
Pain	5826
Edema	5595
Itch	429
Paresthesia	151
Hyperemia	130
Ecchymosis	129
Erythema	88
Redness	75
Exanthema	30
Total	6498
Systemic	**(n)**
Vagal	319
Neurological	142
Respiratory	123
Fever	68
Renal	17
Hemolytic	14
Hemorrhagic	11
Total	751

Source: Research data, 2023

Local clinical manifestations appeared in 97.04% of cases, with greater pain, edema, and itching. Systemic symptoms were present in 11.57% of cases, with a predominance of vagal, neurological, and respiratory manifestations. These findings are similar to those reported by other authors (Araújo *et al*., 2022; de Oliveira *et al*., 2019; Costa *et al*., 2018; Marques *et al*., 2020).

4 Conclusion

The epidemiological profile of bee stings in Piauí is similar to other regions of northeastern Brazil. Cases occurred during all months of the year, especially in the center-south, center-north, southeast, and southwest regions of the state. The high number of incidents and the occurrence of deaths revealed the importance of conducting preventive health educational actions to control the cases and improve the medical care for the victims. The results of this study may be useful to identify the regions and higher risk factors for bee stings in the state of the Piauí.

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