

Short Communication

Honey bee envenoming in Santa Catarina, Brazil, 2007 through 2017: an observational, retrospective cohort study

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Abstract

Introduction: We evaluated the epidemiological and clinical profile of reported cases of bee sting incidents in Santa Catarina, Brazil. **Methods:** This retrospective cohort study included all reported cases of bee sting incidents among the population of Santa Catarina from 2007 to 2017. **Results:** In total, 8,912 cases were reported, corresponding to an overall rate of 12.3/100,000 population. The mean age was 29,8 years with 60.2% men. The lethality rate was 0.2%. **Conclusions:** Santa Catarina has a high incidence rate of bee stings, which is higher than the national average. The data presented in this study may be underestimated.

Keywords: Africanized honeybee. Santa Catarina. Brazil. Envenoming.

Incidents caused by venomous animals are a global public health issue¹. In Brazil, 224,590 incidents (439 deaths) occurred in 2017, according to the Notifiable Diseases Information System (SINAN)². It is estimated that 15,000 incidents (140 deaths) are caused by Africanized honey bees (*Apis mellifera*) per year².

Between 2000 and 2017, there was an exponential increase in the number of honey bee sting envenomings in Brazil, estimated at 138,743 cases (414 deaths) during that period, which corresponds to a lethality rate of 0.3%. Part of this increase may be due to the mandatory notification system implemented as of 2010³.

Honey bee stings present distinct clinical manifestations, depending on the individual's sensitivity to venom and on the number of stings. Subjects who are affected by few stings and

those who are not venom-sensitized commonly develop only topical clinical manifestations. Usually, these subjects do not seek medical care. In sensitized subjects, where a single honey bee sting is capable of triggering a severe hypersensitivity reaction, immediate medical intervention is required. These severe hypersensitivity cases may evolve and cause glottic edema, bronchospasm, and anaphylactic shock. The occurrence of massive attack by Africanized honey bees is not a rare phenomenon, and consequent clinical manifestations are directly related to the number of stings. The most serious cases are observed in children, in adults over 60 years of age, and when more than 500 stings occur. Medical care is vital for adequate treatment, often requiring admission to intensive care units⁴.

Africanized honey bee sting incidents are a public health issue in the Americas because of the high defensiveness of the hybrid Africanized *Apis mellifera*⁵ and the lack of a specific antivenom for the treatment⁶. As of the year 2000, the Center for the Study of Venoms and Venomous Animals of São Paulo State University (CEVAP-UNESP), in a partnership with the Vital Brazil Institute, started to develop a specific antivenom to

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address this issue. Currently, this new antivenom is in the final stage of phase I/II clinical trial at the National Clinical Trial Network (RNPC) Centers, including Botucatu in São Paulo State, and Tubarão in Santa Catarina, Brazil⁶. Preliminary results have shown the antivenom is safe and has promising efficacy.

To estimate the number of participants in clinical trial phase III, it is necessary to build the temporal series of the disease intended to be evaluated. In this context, one of the major challenges in proposing a clinical trial phase III to assess the new antivenom is the lack of knowledge about the real epidemiology of the Africanized honey bee sting incidents across the Brazilian states. In order to contribute to the solution of this problem, we sought to evaluate the occurrence of bee sting incidents between 2007 and 2017 in Santa Catarina State, Brazil. Considering the severity of these incidents and the absence of previous studies evaluating the temporal trend in Santa Catarina State, Brazil, the aim of this study was to evaluate the epidemiological and clinical profile of the reported cases of honey bee stings in the region from 2007 to 2017.

This observational, retrospective cohort study was carried out from 2007 through 2017 on subjects living in Santa Catarina, Brazil, verified by the health authorities as honey bee sting cases.

The study protocol was approved by the Research Ethics Committee of the University of Southern Santa Catarina (Register No. 2,350,299) on October 26, 2017. We asked the 20th Regional Health Management to allow us access to their database of honey bee sting cases reported in all 295 municipalities grouped in 9 macroregions of the Santa Catarina State and recorded in the SINAN. For the purpose of estimating annual incidence, we used the total population of Santa Catarina per year during the study period, as provided by the Brazilian Institute of Geography and Statistics (IBGE) and population estimates by the Department of Information Technology of the Unified Health System (DATASUS).

Socio-demographic data (gender, age, race/ethnicity, education, gestation, and work-related cases) and data about honey bee sting incidents (notification date, municipality of occurrence, zone, date of first symptoms, time elapsed between sting and medical care, and bee sting site). We also evaluated the topical and systemic clinical symptoms and clinical evolution of the case.

Descriptive epidemiology was used for data presentation. Quantitative variables were expressed as measures of central tendency and dispersion, whereas qualitative variables were expressed in proportions. In order to calculate the honey bee sting envenoming rate, we took the total number of cases within the study period and the sum of the population in each year of observation, using a constant of 100,000 people. Lethality rate was calculated using the number of deaths and the total number of honey bee sting incidents, expressed as a percentage. The linear regression model was used to evaluate the temporal trend of the bee sting incidents during the study period. The significance level was set at 0.05.

The Quantum GIS-QGIS software was used for mapping the locations of the bee sting incidents. Microsoft Excel v. 2016 was used to create tables displaying the total number of cases per year and their distribution per municipality.

Shaped maps provided by the Brazilian cartographic system were used for the cartographic data of the municipalities and regional health centers.

We analyzed 8,912 cases of honey bee sting incidents in Santa Catarina State reported between 2007 and 2017, which corresponds to an annual rate of 12.3 incidents per 100,000 population. The mean age was 29.8 (SD 19.4) years, median 27 years, and range from 0 to 96 years. **Table 1** shows the distribution of cases according to socio-demographic, environmental, and clinical characteristics.

Out of the total cases, 46 (0.5%) pregnant women were stung by honey bees, and 1,713 (19.2%) incidents were work-related cases, mainly agriculture and livestock farming activities.

Among the topical manifestations sorted as "other", hyperemia was reported in 827 cases, pruritus in 334, redness in 234, and 223 other symptoms such as abscess, blister, allergy, fever, and pain. The surveyed subjects also reported other systemic manifestations, such as allergy with anaphylaxis (57 cases), respiratory alterations (84 cases), headache, dizziness, and nausea and vomiting.

Figure 1 shows the annual distribution of honey bee sting incidents in Santa Catarina State. In the present study, there was an upward trend of honey bee sting incidents (13.1 percentage points per year; 95% confidence interval: 8.3-34.4), even though the effect was not statistically significant (p -value = 0.20).

Of the total reported cases, 15 deaths were caused by the honey bee stings, and one was due to other causes not reported. Considering the total number of bee sting incidents, the lethality rate was 0.2%.

Figure 2 provides the geographic distribution of the incidence rate of honey bee stings reported in Santa Catarina from 2007 to 2017 per 100,000 population. A variation in the geographical concentration was observed, depending on the study year.

A lack of knowledge about the real epidemiology of bee sting incidents in Brazil impairs problem solving. This study revealed an elevated incidence of bee stings in the Santa Catarina State, Brazil, with an annual rate of 12.3 incidents per 100,000 population. The Southeast Region of Brazil leads in absolute numbers, followed by the South Region. However, the incidence rate is 8.1 per 100,000 population in the South Region and 6.1 in the Southeast Region³. Therefore, the rate found in this study is higher than that of the South and Southeast Regions of Brazil.

Young male subjects were the most affected in Santa Catarina State. Studies on the epidemiological profile of honey bee sting incidents in the states of Paraíba and Ceará during similar time periods showed the same profile⁷⁻⁹. The results of this study are also similar to those observed with venomous animal incidents in general, which indicates that male subjects are more exposed to this kind of incident, possibly because they are more likely to be involved in activities related to agriculture and the construction industry¹⁰.

Most of the reported incidents occurred in urban areas, which corroborates the findings by Diniz et al.⁸ and Linard et al.⁹. The explanation for such occurrence may be based on the fact that

TABLE 1: Socio-demographic, environmental characteristics and clinical events of the 8,912 bee sting incidents reported between 2007 and 2017. Santa Catarina, Brazil.

Characteristics	n	%
Gender		
Male	5,363	60.2
Female	3,549	39.8
Age (years)		
0-19	3,093	34.7
20-29	1,805	20.3
30-39	1,236	13.9
40-49	1,177	13.2
50-59	867	9.7
≥60	734	8.2
Race/Ethnicity		
White	8,206	92.1
Brown	533	6.0
Unknown	173	1.9
Education		
Illiterate	54	0.6
Elementary school	4,070	45.7
High school	2,053	23.0
College	517	5.8
Not applicable	1,048	11.8
Unknown	1,170	13.1
Region in which the incident occurred		
Rural area	3,940	44.2
Urban area	4,731	53.1
Peri-urban	124	1.4
Unknown	117	1.3
Season in which the incident occurred		
Summer	4,063	45.6
Fall	2,117	23.8
Spring	2,020	22.7
Winter	712	8.0
Body site affected		
Head	3,531	39.6
Upper limbs	3,030	34.0
Lower limbs	1,113	12.5
Trunk	1,080	12.1
Unknown	158	1.8
Time elapsed between incident and medical care (hours)		
0 -1	3,139	35.2
1 -3	2,064	23.2
3 -6	812	9.1
6 -12	327	3.6
12 -24	809	9.1
>24	1,208	13.6
Unknown	553	6.2
Topical manifestations*		
Pain	8,110	91.0
Edema	7,747	86.9
Ecchymosis	632	7.1
Necrosis	35	0.4
Other	1,618	18.2
Systemic manifestations (n=594)**		
Neuroparalytic	136	1.5
Vagal alterations	260	2.9
Myelitic/hemolytic manifestations	24	0.3
Renal impairment	21	0.2
Other	405	4.5
Outcome		
Cure	8,691	97.5
Death	16	0.2
Unknown	205	2.3

*Some patients presented more than one local manifestation. **Not all patients had systemic manifestations.

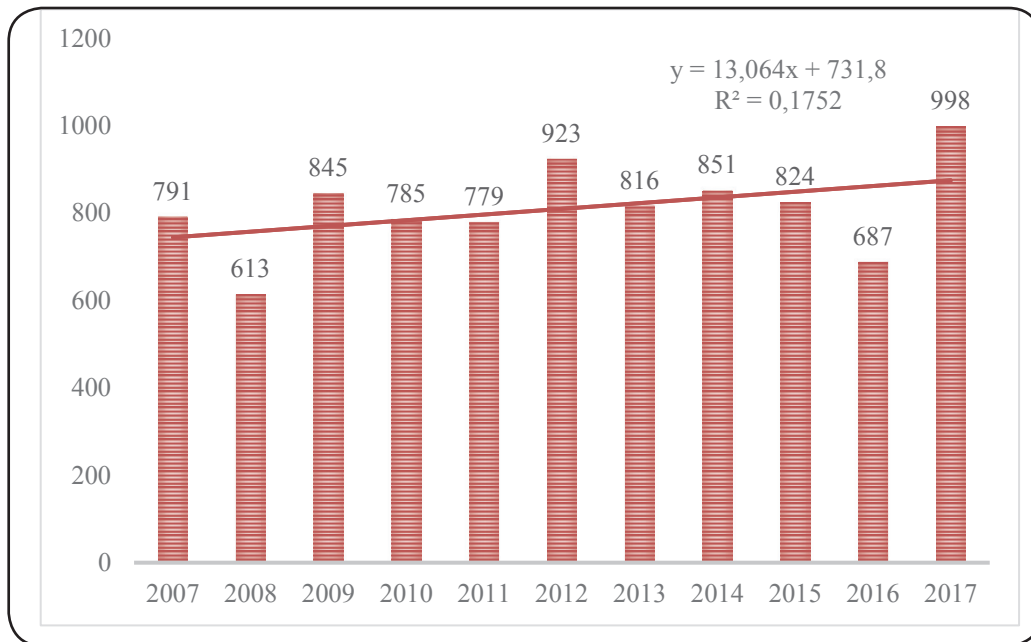


FIGURE 1: Linear regression analysis of the 8,912 bee sting incidents between 2007 and 2017. Santa Catarina, Brazil.

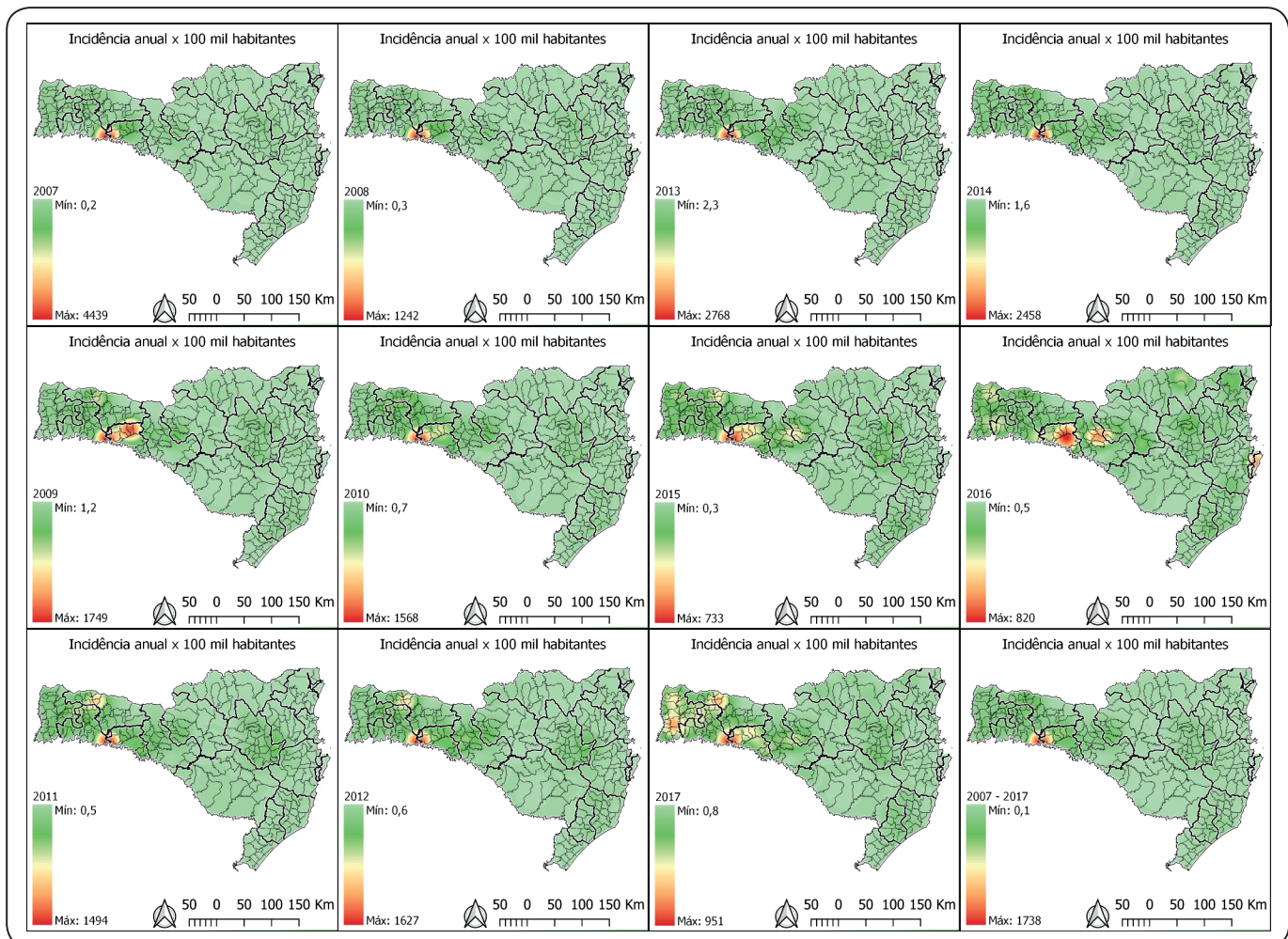


FIGURE 2: Geographical distribution of reported cases of bee stings by incidence rate between 2007 and 2017. Santa Catarina, Brazil.

urban areas provide numerous sites for honey bee hives¹¹. The high number of bee sting incidents in urban areas may be related to anthropomorphic changes such as the expansion of cities and, as a consequence, population decline in rural areas. In this sense, the state of Santa Catarina has had high urban growth since the mid-twentieth century, which supports this hypothesis.

The current study showed that most subjects were stung in the head, followed by the upper limbs, lower limbs, and trunk. These findings are similar to those observed by Diniz et al.⁸ and Linard et al.⁹. Moreti and Marchini¹² have evaluated the flight altitude of the Africanized honey bee hives and concluded that the maximum flight altitude reached was 1.62 meters. This corresponds approximately to the height of the head or upper limbs of the average Brazilian population.

Regarding the time elapsed between sting and medical care, the majority of patients were attended to in less than 3 hours. Thus, one could speculate that the population of the state of Santa Catarina is well informed about the importance of early medical care for this type of incident^{4,8,9}. This behavior has certainly contributed to the high frequency of favorable outcomes.

The lethality rate was lower than the national average, and among the cases described, the majority were elderly subjects over 60 years of age (data not shown), which is an age group usually affected by other comorbidities as well. Deaths from honey bee stings among people aged 50 years and over have also been described in Mexico but were always caused by massive attack¹³. The fact that the notification form does not record the number of stings, as it is a single form for all kinds of incidents with venomous animals, prevented us from confirming if the lethality rate was higher among those with the highest amount of venom inoculated. In this context, it is impossible to know whether death was caused by intoxication, as in the case of massive attack, or was due to anaphylaxis. However, the greater number of stings was directly related to higher morbidity, severity, and need for hospitalization^{14,15}. It should be noted that late complications that evolved to death were not recorded to be a result of honey bee sting incidents. Because of these cases, lethality rates may be underestimated.

A detailed analysis of the context in Santa Catarina State revealed that the largest number of cases occurred in the western part of the state. In those areas, the economic base is agriculture and cattle raising, even though only 19.2% of the bee sting incidents were related to work.

In closing this discussion, we need to analyze the content of the compulsory notification form. The study presented several limitations because of poor completion, missing information, and items that did not cover specific bee sting incidents. The form had no space to either fill in the number of stings or inform the cause of death, whether it was because of a hypersensitivity reaction or bee venom poisoning. The number of bee sting cases may have been under-reported, since many people do not seek health care services. In spite of these limitations, the current study will contribute to a better understanding of bee sting incidents in Santa Catarina State.

Overall, the state of Santa Catarina, located in southern Brazil, had a high incidence rate of bee stings, which was higher

than the national average. The cases were concentrated in the mid-western and far-western regions of the state. They occurred mainly in urban areas, affecting economically active people, especially men, and the head was the most affected site. The data on honey bee sting incidents presented in this study may be underestimated, given that many cases are not reported because affected people did not seek medical care or health professionals failed to report all cases. No antivenoms are currently available for the treatment of Africanized honey bee stings.

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Conflict of Interest: The authors declare no conflict of interest in carrying out this study.

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