Rev Soc Bras Med Trop 51(1):80-84, January-February, 2018
doi: 10.1590/0037-8682-0109-2017

Short Communication

Hymenoptera stings in Brazil: a neglected health threat in Amazonas State

***Allyson Guimarães Costa*[1],[2], *Bárbara Aparecida Chaves*[1],[2], *Felipe Leão Gomes Murta*[1],[2], *Jacqueline Almeida Gonçalves Sachett*[1],[2], *Vanderson Souza Sampaio*[1],[2],[3], *Vanessa Costa Silva*[1] and *Wuelton Marcelo Monteiro*[2],[3]**

[1]. Instituto de Pesquisa Clínica Carlos Borborema, Fundação de Medicina Tropical Dr. Heitor Vieira Dourado, Manaus, AM, Brasil.
[2]. Programa de Pós-Graduação em Medicina Tropical, Universidade do Estado do Amazonas, Manaus, AM, Brasil.
[3]. Fundação de Vigilância em Saúde, Manaus, AM, Brasil.

Abstract

Introduction: Hymenoptera injuries are commonly caused by stinging insects. In Amazonas state, Brazil, there is no information regarding distribution, profile, and systemic manifestations associated with Hymenoptera injuries. **Methods:** This study aimed to identify risk factors for systemic manifestation using the Brazilian Notifiable Diseases Surveillance System (2007 to 2015). **Results:** Half of Hymenoptera injuries were caused by bee stings. Hymenoptera injuries were concentrated in Manaus, and 13.36% of cases displayed systemic signs. Delayed medical assistance (4 to 12 hours) presented four times more risk for systemic manifestations. **Conclusions:** Simple clinical observations and history of injury are critical information for prognostic improvement.

Keywords: Hymenoptera sting. Bee sting. Wasp sting. Ant sting. Systemic manifestation.

Stings by insects in the order Hymenoptera are common worldwide, caused mainly by ants, bees, and wasps[1,2]. The venom released during these injuries is an important weapon against other insects and predators; however, in humans, it can cause both local, and systemic alterations, associated mainly with the deposit of the venom inoculum in the skin (bees), multiple stings (ants and wasps), or even concentration of venom (ants and bees)[3,4].

Hymenoptera venom contains potentially allergenic proteins (e.g. melittin, phospholipase A1 and A2, hyaluronidase and acid phosphatase) capable of inducing toxic or vasoactive responses[5]. The major local and systemic manifestations observed after the injuries include pain, pruritus, swelling, erythema, vomiting, diarrhea, muscle weakness, respiratory depression, and seizures[6].

In Brazil, accidents involving Hymenoptera are mainly caused by the genera *Solenopsis* and *Paraponera* (ants), *Apis* (bees), and *Polistes* and *Mischocyttarus* (wasps)[1,4,7]. The total number of accidents due to this order remains unknown, mainly due to the fact that there is no compulsory notification of cases, with the exception of bee stings, with a mean of 9,926 cases per year in the period from 2007 to 2015[4].

In the Brazilian Amazon region, the reporting of cases involving venomous animals is probably much lower than the actual number of cases, mainly due to the difficulty in traversing the riverine topography, and the indigenous populations arriving at the health centers[8]. Thus, this study aimed to analyze the profile of stings by insect in the order Hymenoptera (ants, bees, and wasps), reported in the state of Amazonas, and the spatial distribution thereof. Furthermore, risk factors associated with the systemic manifestations were assessed, improving knowledge about the health surveillance aspects of patients from the Brazilian Amazon.

The State of Amazonas is located in the Western Brazilian Amazon, comprising an area of 1,570,946.8km^2, with 62 municipalities. The estimated population of the state was 3,807,921 inhabitants in 2010, with 74.2% living in urban zones, and 25.8% in rural areas. For the analysis, all registers of bee stings as well as ant and wasp injuries (Hymenoptera) were considered. Data were retrieved from the Brazilian Notifiable Diseases Surveillance System [Sistema de Informação de Agravos de Notificação (SINAN)] from January 1, 2007 to December 31, 2015, based on data report forms used in the investigation, and follow-up of cases. All duplicates were removed and only variables with up to 70% of completeness were used in the regression models.

Corresponding author: Wuelton Marcelo Monteiro.
e-mail: wueltonmm@gmail.com
Received 31 March 2017
Accepted 12 September 2017

Systemic manifestation, comprising blurred vision or dizziness, vomiting or diarrhea, myalgia, renal and unspecified manifestations, were defined as outcomes. Independent variables included insect type, patient sex, age, level of schooling, area of occurrence (rural or urban), work-related injury, anatomical region of the injury, and time elapsed between the bite and medical assistance.

In order to identify risk factors for systemic manifestation following Hymenoptera injuries, a transverse study was carried out, wherein patients with systemic manifestations were classified as cases, while the remaining were classified as controls.

Logistic regression analysis was performed to calculate the Odds Ratio (OR) with its respective 95% confidence interval (CI). Variables with a significance level of $p<0.2$ in the univariate model were included in the multivariable analysis. For the final model, statistical significance was set as a $p<0.05$. Goodness-of-fit for the logistic regression model was determined by Hosmer-Lemeshow testing. Statistical analyses were performed using STATA v. 13(StataCorp LLC, College Station, TX, USA) and maps were generated using ESRI ArcMap v. 10.4.1 (ESRI, Redlands, CA, USA).

From 2007 to 2015, 423 Hymenoptera injuries were registered in the Amazon state, half of which were caused by bee stings (50.12%). Hymenoptera registers prevail in the region of Manaus and surroundings (**Figure 1**). Municipalities with the highest number of cases were in Manaus (75 [17.73%]), Rio Preto da Eva (67 [15.83%]), Alvarães (61 [14.42%]), Uarini (49 [11.58%]), Borba (41 [9.69%]), Santa Isabel do Rio Negro (30 [7.09%]), and Tefé (27 [6.38%]). For ant injuries, the most incidents were in the Rio Negro region: Santa Isabel do Rio Negro (27 [20.76%]), Uarini (25 [19.23%]), Alvarães (23 [17.69%]), Borba (22 [16.92%]), and Barcelos (11 [8.46%]). Bee stings, the more incidents were Uarini (68 [32.07%]), Barcelos (39 [18.39%]), Alvarães (25 [11.79%]), Jutaí (18 [8,49%]), and Tefé (17 [8.01%]). Regarding wasp stings, Uarini (23 [28.39%]), Barcelos (18 [22.22%]), Alvarães (13 [16.04%]), Jutaí (7 [8.64%]) and Santa Isabel do Rio Negro (6 [7.40%]) were the most prevalent municipalities.

Records consisted mainly of men (62.17%), aged from 0 to 10 years (31.44%), with a low education level (17.02%) (**Table 1**).

Most of the Hymenoptera injury records were from urban areas (56.5%) and almost 20% of registered cases were work related accidents. Three hundred and ninety-six of the total indicated anatomical regions included injury of the upper limbs (31.68%), head (30.02%) and lower limbs (24.59%). The time elapsed from sting to medical assistance was under 3 hours (75.41%).

In general, all of the registered cases, 58 (13.36%) reported systemic signs and symptoms: blurred vision or dizziness (18 [31.03%]), vomiting or diarrhea (17 [29.31%]), myalgia (8

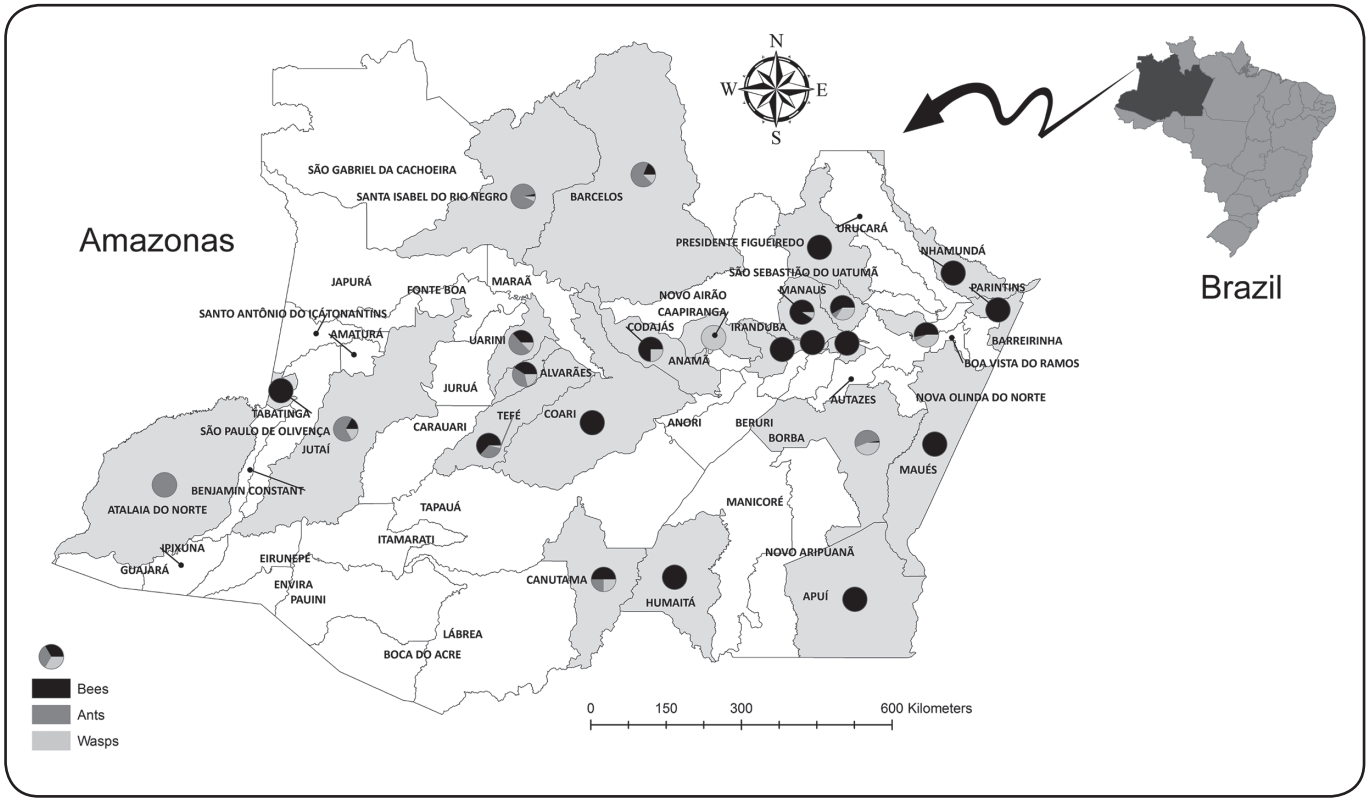

FIGURE 1: The distribution of the average spatial rate of Hymenoptera stings in Amazonas State, Brazil, from 2007, to 2015.

TABLE 1: Characteristics of the 423 Hymenoptera injuries reported in the Amazonas State, from 2007, to 2015.

Characteristics (Completeness)	Number	%
Hymenoptera (n=423; 100%)		
Bees	212	50.12
Wasps	81	19.15
Ants	130	30.73
Sex (n=423; 100%)		
Male	263	62.17
Female	160	37.83
Age group in years (n=423; 100%)		
<=10	133	31.44
10–20	64	15.13
20–30	69	16.31
30–40	51	12.06
40–50	43	10.17
50–60	33	7.80
>60	30	7.09
Schooling in years (n=213; 50.35%)		
Illiterate	33	7.80
1–4	72	17.02
5–8	62	14.66
>8	46	10.87
Ignored	210	49.65
Area of occurrence (n=413; 97.64%)		
Urban	239	56.50
Rural	174	41.14
Ignored	10	2.36
Work related accident (N=404; 95.51%)		
No	323	76.36
Yes	81	19.15
Ignored	19	4.49
Anatomical region of the injury (n=396; 93.62%)		
Lower limbs	104	24.59
Upper limbs	134	31.68
Body	31	7.33
Head	127	30.02
Ignored	27	6.38
Time elapsed from sting to medical assistance in hours (n=392; 92.67%)		
0–3	319	75.41
4–6	28	6.62
7–12	9	2.13
13–24	18	4.26
>24	18	4.26
Ignored	31	7.33

TABLE 2: Factors associated with systemic manifestations from Hymenoptera injuries in the Amazonas State, Brazil, from 2007, to 2015.

Variables	Systemic manifestations		Crude OR (CI 95%)	p-value	Adjusted OR (CI 95%)	p-value
	Yes (%)	No (%)				
Hymenoptera						
Wasp	6 (10.34)	75 (20.55)	1	1	-	-
Bee	36 (62.07)	176 (48.22)	2.556 (1.033–6.323)	**0.042**	3.170 (1.134–8.856)	**0.028**
Ant	16 (27.59)	114 (31.23)	1.754 (0.656–4.686)	0.262	4.085 (1.219–13.687)	**0.022**
Sex						
Male	36 (62.07)	227 (62.19)	1	1	-	-
Female	22 (37.93)	138 (37.81)	1.005 (0.567–1.779)	0.986	-	-
Age group in years						
<=10	17 (29.31)	116 (31.78)	1	1	-	-
10-20	7 (12.07)	57 (15.62)	0.837 (0.328–2.135)	0.711	1.208 (0.414–3.529)	0.728
20-30	7 (12.07)	62 (16.99)	0.770 (0.303–1.957)	0.584	0.506 (0.168–1.524)	0.226
30-40	5 (8.62)	46 (12.60)	0.741 (0.258–2.127)	0.578	1.086 (0.335–3.519)	0.889
40-50	7 (12.07)	36 (9.86)	1.326 (0.509–3.452)	0.562	1.127 (0.341–3.717)	0.844
50-60	7 (12.07)	26 (7.12)	1.837 (0.691–4.882)	0.223	1.531 (0.473–4.950)	0.477
>60	8 (13.79)	22 (6.03)	2.481 (0.953–6.454)	0.062	1.462 (0.477–4.485)	0.506
Schooling in years						
Illiterate	4 (6.90)	29 (7.95)	1	1	-	-
1-4	11 (18.97	61 (16.71)	1.307 (0.383–4.458)	0.669	-	-
5-8	10 (17.24)	52 (14.25)	1.394 (0.401–4.843)	0.601	-	-
>8	5 (8.62)	41 (11.23)	0.884 (0.218–3.578)	0.863	-	-
Area of occurrence						
Urban	26 (44.83)	213 (58.36)	1	1	-	-
Rural	31 (53.45)	143 (39.18)	1.031 (0.832–1.278)	0.777	-	-
Work related injury						
No	42 (72.41)	281 (76.99)	1	1	-	-
Yes	15 (25.86)	66 (18.08)	1.520 (0.795–2.905)	0.205	1.403 (0.688–2.861)	0.352
Anatomical region of the injury						
Lower limbs	9 (15.52)	95 (26.03)	1	1	-	-
Upper limbs	19 (32.76)	115 (31.51)	1.743 (0.754–4.033)	0.194	2.496 (0.982–6.339)	0.054
Body	6 (10.34)	25 (6.85)	2.533 (0.824–7.787)	0.105	3.402 (0.816–14.171)	0.093
Head	23 (39.66)	104 (28.49)	2.334 (1.028–5.296)	**0.043**	3.236 (1.067–9.809)	**0.038**
Time elapsed from sting to medical assistance in hours						
0–3	36 (62.07)	283 (77.53)	1	1	-	-
4–6	9 (15.52)	19 (5.21)	3.723 (1.566–8.849)	**0.003**	4.026 (1.618–10.016)	**0.003**
7–12	4 (6.90)	5 (1.37)	6.288 (1.614–24.496)	**0.008**	7.885 (1.716–36.229)	**0.008**
13–24	2 (3.45)	16 (4.38)	0.982 (0.217–4.449)	0.982	1.156 (0.245–5.459)	0.854
>24	4 (6.90)	14 (3.84)	2.246 (0.701–7.193)	0.173	1.824 (0.464–7.164)	0.389

CI: confidence interval; **OR:** odds ratio.

[13.77%]), renal (3 [5.17%]) and unspecified manifestations (12 [20.69%]).

Bee stings, ant accidents, head injuries, and time elapsed from sting to medical assistance between 4 and 12 hours, were independently associated with systemic manifestations. Bee stings and ant injuries are associated with a three-, to four-fold risk of systemic manifestation, respectively (OR=3.170; p value=0.028; OR=4.085; p value=0.022). Head injuries are associated to a three-fold risk for the outcome (OR=3.236; p value=0.038). Delays in medical assistance between 4 and 12 hours presented four times more risk for systemic manifestations (OR=4.026; p value=0.003), while 7–12 hours of delay resulted in an eight-fold increase in risk (OR=7.885; p value=0.008; **Table 2**).

Accidents involving Hymenoptera are usually mild and moderate cases. However, this neglected public health issue sometimes can lead to severe cases and even death, since people are not aware about the risks of adverse reactions[9,10]. Age distribution of Hymenoptera records in Amazonas state differed from that described in previous studies. Results showed that registers comprise mainly children aged 0–10 years (31.57%). Records from young men aged 10–20, and 20–30 years were 15.13% and 16.315, respectively (**Table 1**)[11,12]. This finding probably reflects indigenous rituals such as those from Sateré-Mawé ethnicity, in which pre-teens, as a coming-of-age ritual, must put their hands inside a glove containing bullet ants belonging to the genera Paraponera and Dinoponera ("*Tucandeira*'s ritual"), known to cause severe pain[13]. This is reinforced by the fact that many of ant-accident records refer to indigenous ethnicity (41 [31.78%]) and that the majority of registers refer to upper limbs as anatomical region of injury (134 [31.68%])[14].

Time elapsed from sting to medical assistance was less than 3 hours in majority of records (319 [75.41%]) as described in other studies[11,12]. This may occur because most cases come from urban areas, where transportation to health care is faster. The most frequent systemic clinical manifestations were vagal (17 [29.31%]) and neurological (18 [31.03%]) signs, which was corroborated by other studies[11,12]. Here we showed for the first time that bee stings, head injuries, and time to medical assistance could be applied as good predictors for systemic manifestations among reported cases of Hymenoptera injury in Amazonas state.

This could be useful as a clinical tool for risk classification. Although local pain and edema are the most common symptoms, clinical manifestations as anaphylaxis, vasculitis, nephrosis, neurites, encephalitis, serum sickness, urticaria, joint pain, and fever can also be present[6,12]. Since these systemic manifestations can lead to death, especially by allergenic mechanisms, health surveillance systems must be aware of these clinical features[15]. Once several cases are mild and progress to cure, systemic manifestations and deaths are poorly registered. Despite that, we showed that simple clinical observations as well as the history of injury are critical pieces of information that can be used to improve knowledge regarding progression of Hymenoptera-related injury.

Acknowledgments

We would like to thank the Fundação de Vigilância em Saúde do Amazonas (FVS-AM) for providing the data for this study. We also thank Fundação de Medicina Tropical Dr. Heitor Vieira Dourado (FMT-HVD) and Programa de Pós-Graduação em Medicina Tropical da Universidade do Estado do Amazonas for the support provided to enable carrying out this research.

Conflict Of Interest

The authors declare that there are no conflicts of interest.

REFERENCES

1. Ferreira Jr RS, Almeida RAMB, Barraviera SRCS, Barraviera B. Historical Perspective and Human Consequences of Africanized Bee Stings in the Americas. J Toxicol Environ Heal Part B. 2012 Feb;15(2):97–108.
2. Santos L, Pieroni M, Menegasso A, Pinto J, Palma M. A new scenario of bioprospecting of Hymenoptera venoms through proteomic approach. J Venom Anim Toxins Incl Trop Dis. 2011;17(4):364–77.
3. de Graaf DC, Aerts M, Danneels E, Devreese B. Bee, wasp and ant venomics pave the way for a component-resolved diagnosis of sting allergy. J Proteomics. 2009;72(2):145–54.
4. Barbosa AN, Boyer L, Chippaux J-P, Medolago NB, Caramori CA, Paixão AG, et al. A clinical trial protocol to treat massive Africanized honeybee (Apis mellifera) attack with a new apilic antivenom. J Venom Anim Toxins Incl Trop Dis. 2017 Dec;23(1):14.
5. Przybilla B, Ruëff F. Insect stings: clinical features and management. Dtsch Arztebl Int. 2012;109(13):238–48.
6. Fitzgerald KT, Flood AA. Hymenoptera Stings. Clin Tech Small Anim Pract. 2006 Nov;21(4):194–204.
7. de Medeiros CR. Himenópteros de Importância Médica. In: Cardoso JLC, França FOS, Wen FH, Malaque CMS, Haddad-Jr V. Animais Peçonhentos do Brasil: Biologia, Clínica e Terapêutica dos Acidentes. 2th Ed. São Paulo(SP): Sarvier, 2009, p. 253-258.
8. Sampaio VS, Gomes AA, Silva IM, Sachett J, Ferreira LCL, Oliveira S, et al. Low Health System Performance, Indigenous Status and Antivenom Underdosage Correlate with Spider Envenoming Severity in the Remote Brazilian Amazon. PLoS One. 2016;11(5):e0156386.
9. Ennik F. Deaths from bites and stings of venomous animals. West J Med. 1980 Dec;133(6):463–8.
10. du Toit-Prinsloo L, Morris NK, Meyer P, Saayman G. Deaths from bee stings: a report of three cases from Pretoria, South Africa. Forensic Sci Med Pathol. 2016;12(1):81–5.
11. Diniz AGQ, Belmino JFB, Araújo KAM de, Vieira AT, Leite R de S. Epidemiology of Honeybee Sting Cases in the State of Ceará, Northeastern Brazil. Rev Inst Med Trop Sao Paulo. 2016;58(40):1–5.
12. Linard AT, Barros R, Sousa J, Leite R. Epidemiology of bee stings in Campina Grande, Paraíba state, Northeastern Brazil. J Venom Anim Toxins Incl Trop Dis. 2014;20(1):13.
13. Haddad Junior V, Amorim PCH de, Haddad Junior WT, Cardoso JLC. Venomous and poisonous arthropods: identification, clinical manifestations of envenomation, and treatments used in human injuries. Rev Soc Bras Med Trop. 2015;48(6):650–7.
14. Botelho JB, Wiegel VA. The Sateré-Mawé community of Y'Apyrehyt: ritual and health on the urban outskirts of Manaus. História, Ciências, Saúde – Manguinhos. 2011;18(3):723–44.
15. Kanchan T, Atreya A, Shekhawat RS. Fatal anaphylaxis from hymenoptera stings. Med Leg J. 2016;84(4):212–4.