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CLINICAL RESEARCH



Clinico-epidemiology of arthropod stings and bites in primary hospitals of North Western province of Sri Lanka

Senanayake A. M. Kularatne^a , Seyed Shahmy^b , Shantha S. Rathnayake^b and Andrew H. Dawson^{b,c} 

^aFaculty of Medicine, University of Peradeniya, Peradeniya, Sri Lanka; ^bSouth Asian Clinical Toxicology Research Collaboration, University of Peradeniya, Peradeniya, Sri Lanka; ^cCentral Clinical School, University of Sydney, Sydney, Australia

ABSTRACT

Objective: Arthropod stinging and bites are common environmental hazards in Sri Lanka. However, their medical importance has not been fully evaluated yet. This study aims to study the burden, epidemiology, and outcome of stings and bites in primary hospitals in the Kurunegala district in North Western Province (NWP) of Sri Lanka.

Methodology: The study was conducted one year from 25th May 2013 to 25th May 2014. Details of all stings and bites admissions and their outcomes were retrospectively extracted from hospital records in all 44 primary hospitals in the district.

Results: There were 623 stings and bites with population incidence of 38/100,000 (95% CI 27–52). There were no deaths. Median age was 38 years (IQR: 19–53 years), and 351 (56%) were males. Most of stings and bites (75%) occurred in the daytime. Median time to hospital arrival was 55 minutes (IQR: 30 min to 2 h). The offending arthropods had been identified in 557 (89%) cases, of them, 357 (57%) were Hymenoptera (hornet and bees), 99 centipedes, 61 spiders and 40 scorpions. Local pain occurred in 346 (56%) cases – centipede 69 (70%), Scorpion 24 (60%), spider 36 (59%), Hymenoptera 187 (52%) and unidentified 30 (45%). Hymenoptera stings and spider bites occurred between 06 am to 12 noon, and scorpion stings and centipede bites mostly occurred between 06 pm to 12 midnight. Mild, moderate to severe anaphylaxis reactions occurred in 173 (28%) patients including 110 Hymenoptera stings – mild 39, moderate 62 and severe 9. From primary hospitals, 53(9%) cases had been transferred to tertiary care units for further management. Of them, 41 cases were Hymenoptera stings and 24 (58%) of them had mild, moderate to severe anaphylaxis. In the entire group, 27% severe cases received adrenaline.

Conclusions: The primary hospitals in NW province of Sri Lanka manage large numbers of arthropod stings and bites. These include Hymenoptera (hornet and bee), centipedes, spiders, and scorpions. Pain, swellings and anaphylactic reactions were the most common adverse effects.

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Introduction

Nearly 11,500 species of identified arthropods contribute to Sri Lanka's rich biodiversity [1–3]. Among those, some arthropods of the Class Insecta (Order Hymenoptera), Class Arachnida (especially spiders and scorpions) and Class Chilopoda (centipedes) stings or bites are potentially harmful to humans.

Published experience of arthropod stings has been confined to case reports from tertiary care hospitals of Sri Lanka [4–9]. However, tertiary hospital studies are unlikely to represent the true burden of stings and bites as most patients present to primary care hospitals and are unlikely to require transfer.

This lack of epidemiological information has implications for primary prevention, health resource planning, and education. Sri Lanka has a well-developed network of government hospitals which provide treatment at no cost to the patients. It is estimated that most of the patients are within 30 minutes

from a primary hospital [10]. The North Western Province (NWP) of Sri Lanka includes the land area of both dry and intermediate zones representing best geography to study arthropod stings and bites. Therefore, aims of this study are to assess the burden and pattern of arthropod stings and bites and to audit the management of them in the primary hospitals of Kurunegala district of NWP.

Materials and methods

Study designs and patient enrolment

In this retrospective study, we studied hospital records of patients with arthropod stings and bites who presented to the 44 primary hospitals in Kurunegala district. However, the Teaching hospital Kurunegala, the tertiary care hospital in the district was not included. The study period included one year from 25th May 2013 to 25th May 2014.

Table 1. General descriptions of the cohort.

Descriptions, n (%)	Hymenoptera ^a n = 357	Centipede n = 99	Spider n = 61	Scorpion n = 40	Unidentified Insects n = 66 ^b	Entire group total = 623
Gender n = 623						
Male	219	41	34	19	38	351 (56)
Female	138	58	27	21	28	272 (44)
Age-year n = 623						
Median	40	38	40	30.5	24.5	38
Range (min–max)	1–84	1–78	4–75	1–73	1–74	1–84
IQR	23–54	16–52	23–55	16.5–46.25	8–41	19–53
Time of bite n = 287						
00.00–06.00 h	2 (1)	3 (8)	3 (10)	1 (5)	3 (12)	12 (4)
06.00–12.00 h	89 (50)	8 (22)	13 (45)	4 (21)	9 (38)	123 (43)
12.00–18.00 h	73 (41)	8 (22)	10 (34)	2 (10)	6 (25)	99 (34)
18.00–24.00 h	14 (8)	18 (49)	3 (10)	12 (63)	6 (25)	53 (18)
Site of bite n = 282						
Head	49 (44)	3 (4)	–	–	8 (23)	60 (21)
Trunk	3 (3)	5 (7)	–	–	3 (9)	11 (4)
Upper limb	15 (14)	13 (18)	7 (18)	3 (12)	10 (29)	48 (17)
Lower limb	12 (11)	50 (69)	32 (82)	23 (88)	12 (34)	129 (46)
Multiple sites	31 (28)	1 (1)	–	–	2 (6)	34 (12)

^aHymenoptera include giant Asian honey bee (*Apis dorsata*) and hornet (*Vespa affinis*).

^bIn 66 cases, the name offending arthropods was not documented.

Procedures

The data extracted from the patients' hospital records were transcribed into data extraction forms and entered into a database in Microsoft Access by trained research assistants. The main variables extracted were demographic information, type of stingers and biters, clinical signs and symptoms and treatment. Two other researchers reviewed the hospitals' records and the database for the accuracy of data entry.

Identifications of stingers and biters, clinical assessment and treatments

The stinging insects had been identified based on the description of patients and witnesses, using clinical signs and symptoms [11,12]. Extracted clinical data included epidemiological and demographic details, clinical manifestations such as transient pain, itching, swelling, and anaphylaxis. Details of therapy for anaphylaxis were recorded.

The severity of anaphylaxis is graded by an expert clinician analyzing the clinical records according to published literature [2,8,13]. The severity was graded as mild, moderate and severe using the Brown grading system [13]. Clinical manifestations limited to skin and subcutaneous tissues (erythema, urticaria, periorbital oedema etc.) were considered as mild. Anaphylaxis with features suggestive of gastrointestinal, moderate respiratory or cardiovascular involvement (systolic blood pressure drop down to 90 mmHg, dyspnoea, stridor, wheezing, nausea, vomiting, dizziness, throat tightness, etc.) was graded as moderate. Systolic blood pressure dropping below 90 mmHg at any stage, central cyanosis, SpO₂ = <92% at any stage, confusion, loss of consciousness, urinary or fecal incontinence were considered as features of severe anaphylaxis.

Data management and statistical analysis

Data were entered into a database in Microsoft Access by trained research assistants. The database was independently cross-checked with the original data sources for accuracy and completeness by two other researchers. Data analysis was performed in the R programming language version 3.2.5.

All the individual level variables including the signs and symptoms of envenoming and the incidence of stingers were considered for descriptive analysis. All patient data analyzed were anonymized.

Ethics statement

The Ethical Review Committee, Faculty of Medicine, University of Peradeniya, Sri Lanka approved the study of envenoming in Primary Hospitals in North Western Province (NWP). As the study was an audit done retrospectively on generated data in multiple primary hospitals of in NWP where individual patient consent was not required by the IRB.

Results

There were 623 admissions of stings and bites with population incidence of 38 per 100,000 population (95% CI: 27–52). Median age was 38 years (IQR: 19–53 year), and 351 (56%) were males. In the entire group, most of the stings and the bites (75%) occurred in the daytime between 6 am to 6 pm. Median time to hospital arrival was 55 min (IQR: 30min to 2h). The offending stingers and biters were documented in hospital records for 557 (89%) cases, of them, 357 (57%) were Hymenoptera, 99 centipedes, 61 spiders and 40 scorpions (Table 1). Of the entire group, on admission median systolic BP was 120 mmHg (IQR: 110–130 mmHg) and the

Table 2: Descriptions of the clinical manifestations.

Descriptions, <i>n</i> (%)	Local manifestations (At the site of bite)				Anaphylactic reactions			Total anaphylaxis	Total manifestations ^a
	Admission	Pain	Swelling	Total local manifestations ^a	Mild ^b	Moderate ^c	Severe ^d		
Centipede	99	69 (70)	35 (35)	77 (78)	3	22	1	26 (26)	98 (99)
Hymenoptera	357	187 (52)	78 (22)	215 (60)	39	62	9	110 (31)	272 (76)
Scorpion	40	24 (60)	18 (45)	29 (72)	0	6	-	6 (15)	32 (80)
Spider	61	36 (59)	16 (26)	40 (66)	2	2	-	4 (6)	42 (69)
Unidentified insect stings**	66	30 (45)	28 (42)	42 (64)	13	13	1	27 (41)	54 (82)
Total	623	346	175	403	57	105	11	173	498 ^a

LOC: loss of consciousness; SBP: systolic blood pressure.

^aThe total number of clinical manifestations occurred either as sole manifestation or in combination with others.

Brown Grading.

^bMild (skin and subcutaneous tissues only) – Generalized erythema, urticaria, periorbital edema or angioedema.

^cModerate (features suggesting respiratory, cardiovascular or gastrointestinal involvement) – Dyspnea, stridor, wheeze, nausea, vomiting, dizziness (presyncope), diaphoresis, chest or throat tightness or abdominal pain.

^dSevere (hypoxia, hypotension or neurologic compromise) – Cyanosis or SpO₂ ≤ 92% at any stage, hypotension (SBP <90 mm Hg in adults), confusion, collapse, LOC or incontinence.

Table 3: Audit of medications given- anaphylaxis versus nonanaphylaxis groups.

	IV hydrocort-isonone	Prednisolone	IM Adrenaline	Chlorpheniramine oral &/IV	Promethazine
Centipede					
Anaphylaxis (26)	4	7	1	12	2
Non-Anaphylaxis (73)	10	22	0	39	8
Hymenoptera					
Anaphylaxis (110)	82	84	10	98	45
Non- Anaphylaxis (247)	159	170	3	191	80
Scorpion					
Anaphylaxis (6)	1	1	0	3	2
Non- Anaphylaxis (34)	1	6	0	19	5
Spider					
Anaphylaxis (4)	0	1	0	1	0
Non- Anaphylaxis (57)	10	22	0	26	2
Unidentified insect Stings					
Anaphylaxis (27)	15	22	1	23	6
Non Anaphylaxis (39)	11	14	0	18	4
Total	293	349	15	430	154

diastolic BP was 80 mmHg (IQR: 70–80 mmHg) and pulse rate was 80 beats/min (IQR: 78–86 beats/min).

Local pain and swelling occurred in 346 (55%) and 175 (28%) patients, respectively. The occurrence of pain respective to the stings and bites were centipede 69(70%), spider 36(59%) and Hymenoptera 187(52%), Scorpion 24 (60%) and unidentified insect bite 30(45%). Of them, 281 (81%) cases received paracetamol or NSAIDs such as diclofenac sodium and ibuprofen either as a sole or in combination with others as a treatment for local pain.

Demographics and epidemiological data

Most of the hymenopteran stings (*n* = 89, 50%) and spider bites (*n* = 13, 45%) occurred between 06 am to 12 noon and scorpion stings and centipede bites mostly occurred between 06 pm to 12 midnight, respectively. The majority of Hymenoptera stings were in the head area (49%) of the victims (Table 1).

Clinical manifestations

The sign and symptoms of envenoming were documented in 498 cases (80%) including unidentified insect bites. Documentation was present in 76% Hymenoptera, 69% spiders, 80% scorpions and 99% centipede's bites.

Local manifestations were detected in 403 cases (65%) and anaphylaxis occurred in 173 cases (28%). Of the 173 anaphylaxis group, 57 (33%) were mild, 105 (61%) were moderate and 11 (6%) were severe. In the entire group, 125 cases were dry bites of mild cases without any recorded complications of signs and symptoms.

These clinical manifestations occurred either as a sole manifestation or in combination with others. The clinical manifestations produced by different categories are summarized in Table 2.

Treatment and hospital outcomes

In the entire group, 173 (28%) patients developed mild, moderate to severe anaphylaxis. The medications given were; IV hydrocortisone 293(38.4%), IM adrenaline 15 (2.4%), oral prednisolone 349 (56%), IV chlorpheniramine 430 (69%) and IV promethazine 154 (24.7%). The highest rate of anaphylaxis appeared to be documented in the Hymenoptera group, in addition, there were high rates of treatment in the group not identified as having anaphylaxis (Table 3).

There were no deaths in the cohort. Of the entire group, 53 (8%) cases were transferred to a tertiary care unit for further management (Table 4). Of them, 41 cases were Hymenoptera stings and 24 (58%) of them had mild, moderate to severe anaphylaxis.

Table 4. Hospital outcome.

Type of stings	Transfers to tertiary care	Discharged from hospital	Self-discharge from hospitals	Total
Centipede	7	68	24	99
Hymenoptera	41	223	93	357
Scorpion	1	29	10	40
Spider	2	36	23	61
Unidentified insect stings	2	38	26	66
Total	53	394	176	623

*Heterometrus swammerdami* (Family Scorpionidae)

Photograph by Sanjeewa Jayarathne

Figure 1. Picture of a black scorpion, one of the main species of black scorpion responsible for stings in the study region. *Heterometrus swammerdami* (Family: Scorpionidae) Figure credit: Mr. Sanjeewa Jayarathne.

Discussion

We found a substantial number of arthropod stings and bites presenting to primary hospitals in Kurunegala district of Sri Lanka. As 92% of patients stayed in primary hospitals, the calculated population incidence and health burden of these stings and bites is more accurate than data derived from tertiary hospital. Extrapolation of this primary data to other rural provinces is likely to provide a more accurate assessment of the national burden of stings and bites and help inform the allocation of health resources to the hospitals.

During the same period, 2186 snakebites [10] and 2627 poisonings were reported from the same hospitals.

In Sri Lanka 18 species of scorpion are known [14], the commonly encountered species is the black scorpion (*Heterometrus* species) (Figure 1) and none of these species caused fatal stings. However, in recent past, fatal envenoming of Indian red scorpion (*Hottentotta tamulus*) occurred in Jaffna peninsula of Sri Lanka and believe that the species were moved to peninsula while transporting the goods for Indian peacekeeping forces between 1987 and 1990 [7,9].

Spiders (Araneae) are an enormous group, comprising ubiquitous arthropod predators found in many environments. It is estimated that little over 400 species of spiders are found in Sri Lanka [15] (Figure 2). Most of their envenoming does not cause fatalities despite high morbidity due to muscle spasms [16].

Centipedes are usually nocturnal arthropod predators, which are distributed widely, especially in warm, temperate and tropical regions [17,18]. There are total of 24 species of centipedes has been recorded from Sri Lanka [19] (Figure 3). The bite of large centipedes can cause some pain and

*Poecilotheria fasciata* (Family Theraphosidae)

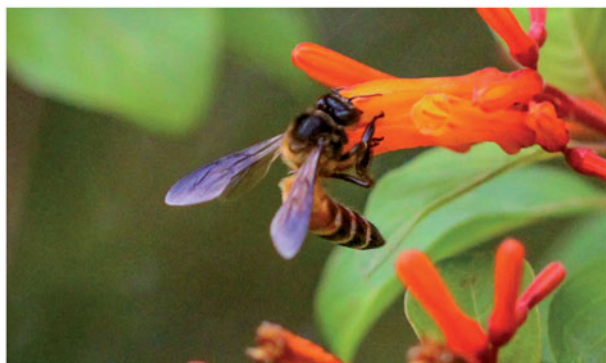
Photograph by Sanjeewa Jayarathne

Figure 2. Picture of a "tarantulas" spider one of the spider species found in Sri Lanka. The creature was captured near a temple premises in the study district. *Poecilotheria fasciata* (Family: Theraphosidae) Figure credit: Mr. Sanjeewa Jayarathne.Order: Scolopendromorpha
Family: Scolopendridae**Figure 3.** Picture of a centipede. The creature was captured at the backyard of the house during the night time. Order: Scolopendromorpha, Family: Scolopendridae.

discomfort in humans, although there are no authenticated cases of human fatalities from centipede bites. Common effects included intense local pain, erythema, induration, and necrosis, as well as mild constitutional symptoms [18,20,21].

Giant Asian honeybee (Figure 4) and Hornets (Figure 5) belong to Hymenoptera group, as these are not easily distinguished by victims [22], all were pooled as Hymenoptera. Hymenoptera and spider bites were more common during the daytime. Centipede and scorpions are easily identifiable, the majority of their bites occurred at night. Clinically, pain and swelling at the site of sting or bite were the common manifestations. The most serious complication requiring specific treatment was anaphylaxis. This occurred in one-third of patients with Hymenoptera stings and one-fourth of centipede bites and was rare with other identified arthropods. Severe anaphylaxis was seen in 11 patients, of them, nine patients recovered and two were lost to follow up following the transfer.

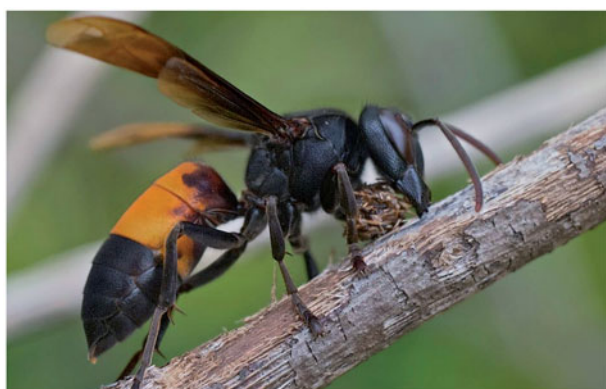
Hymenoptera was the most commonly identified bite and are the main cause of insect-related anaphylaxis. There are three families of Hymenoptera of clinical importance: the



Apis dorsata (Family Apidae)

Photograph by Sanjeeva Jayathne

Figure 4. Picture of a giant Asian honey bee. One of the main species of Asian honey bee responsible for the stings in Sri Lanka. *Apis dorsata* (Family: Apidae) Figure credit: Mr. Sanjeeva Jayarathne.



Vespa affinis (Family Vespidae)

Photo credit: <https://www.flickr.com/photos/23271361@N06/2869878090>

Figure 5. Picture of a Hornet A main species of Hornet responsible for wasp stings in Sri Lanka. *Vespa affinis* (Family: Vespidae) Figure credit: <https://www.flickr.com/photos/23271361@N06/2869878090>.

bees (honeybees, bumblebees), vespids (yellow jackets, hornets, wasps) and stinging ants (genus *Solenopsis* and others) [23]. Of these, Rock honeybee or Giant Asian honeybee (*Apis dorsata*) (Figure 4) and hornet (*Vespa affinis*) are widely distributed throughout Oceanic Asia including Sri Lanka [24,25]. Fatalities due to stings particularly from the Hymenoptera group have been reported in Sri Lanka [4–6,8,26].

The venom of the Hymenoptera contains mainly biogenic amines and also some enzymes and toxins [27]. Most patients with large local reactions patients have detectable venom-specific IgE [28]. Cutaneous symptoms are most common overall, affecting 80%; they are the sole manifestation in 15% of adults but in more than 60% of affected children [29]. Almost 50% of reactions in both children and adults included respiratory complaints. Symptoms and signs of hypotension were uncommon in children but occurred in over 60% of adults, with half experiencing loss of consciousness [23,30].

Management of anaphylaxis is important, but this study suggests an inconsistent approach in managing mild, moderate or severe anaphylaxis. Only, three of the 11 cases with severe anaphylaxis received adrenaline suggesting under treatment.

Antihistamines followed by steroids were most commonly prescribed in patients diagnosed with anaphylaxis but also in

a large number of patients without anaphylaxis. The recommended treatment for anaphylaxis caused by insect sting is not different from anaphylaxis due to other causes [31]. Being the first contact doctor, medical professionals in primary hospitals pay a pivotal role in managing anaphylaxis. Given the importance of primary hospitals in managing arthropod bites this observed variation in anaphylaxis management suggests that clinical guidelines and education are needed.

Implications

In particular, the low rate of adrenaline use in severe anaphylaxis is of concern as this is the most likely cause of potential deaths. We found that patients were treated empirically with commonly used medications for allergy and anaphylaxis. Therefore, development of management guidelines and medical education are needed in future. Furthermore, these findings will be of interest to basic scientists to create many research questions and to explore the arthropod fauna in Sri Lanka.

Limitations

This study was based on a retrospective extraction of data from hospital records. While hospital staff was encouraged to systematically record details of bites and stings, there was variation in the quality of record keeping. While demographic information such as age and gender is well recorded, it is possible that there would have been underreporting of symptoms and signs of envenoming and anaphylaxis especially if they were mild. However, this has little impact on the observation of the reported treatment of anaphylaxis. Community members who have been bitten but had mild symptoms were probably less likely to present to the hospital so a hospital-based survey will underestimate the community incidence of insect bites. However, the burden of insect bites is more likely to be represented by hospital presentations. Identification of arthropod species was based on the description of the patient, apart from Hymenoptera, other three arthropods are terrestrial and have distinct morphology that makes them easy to identify. We may have missed some patients by not having THK but this would have had little impact on the district epidemiology because of the low referral rates from the primary hospital.

Conclusions

The primary hospitals in NW province of Sri Lanka manage a large number of stings caused by the diverse group of creatures. Of them, Hymenoptera (hornet and bee) is leading and results in significant anaphylaxis.

We recognized arthropod stings and bites are medically important in Sri Lanka, but there is a variation in treatment and suboptimal management of bites and anaphylaxis. Therefore, treatment guidelines should be developed and disseminated.

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Disclosure statement

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ORCID

Senanayake A. M. Kularatne  <https://orcid.org/0000-0002-3396-4952>

Sayed Shahmy  <https://orcid.org/0000-0002-2339-1572>

Andrew H. Dawson  <https://orcid.org/0000-0002-8047-397X>

References

- [1] Wikipedia Wildlife of Sri Lanka-Faunal Diversity of Sri Lanka, Number of described species of fauna in Sri Lanka; Available from: https://en.wikipedia.org/wiki/Wildlife_of_Sri_Lanka
- [2] Kularatne SAM. Snakes and Envenoming in Sri Lanka – A Handbook on Management of Snakebite; Sri Lanka: A.M.P Print Shop (Pvt) Ltd,Gampola; 2013.
- [3] Kularatne S, Senanayake N. Venomous snake bites, scorpions, and spiders. *Handb Clin Neurol*. 2014;120:987–1001.
- [4] Kularatne K, Kannangare T, Jayasena A, et al. Fatal acute pulmonary oedema and acute renal failure following multiple wasp/hornet (*Vespa affinis*) stings in Sri Lanka: two case reports. *J Med Case Rep*. 2014;8:188.
- [5] Ralapanawa DMPUK, Kularatne SAM. A case of Kounis syndrome after a hornet sting and literature review. *BMC Res Notes*. 2014;7:867.
- [6] Kularatne S, Gawarammana I, De Silva P. Severe multi-organ dysfunction following multiple wasp (*Vespa affinis*) stings. *Ceylon Med J*. 2011;48:146.
- [7] Kularatne SA, Dinamithra NP, Sivansuthan S, et al. Clinico-epidemiology of stings and envenoming of Hottentotta tamulus (Scorpiones: Buthidae), the Indian red scorpion from Jaffna Peninsula in northern Sri Lanka. *Toxicon*. 2015;93:85–89.
- [8] Kularatne SA, Raveendran S, Edirisinghe J, et al. First reported case of fatal stinging by the large carpenter bee *Xylocopa tranquebarica*. *Wilderness Environ Med*. 2016;27:262–265.
- [9] Ranawana KB, Dinamithra NP, Sivansuthan S, et al. First report on Hottentotta tamulus (Scorpiones: Buthidae) from Sri Lanka, and its medical importance. *Euscorpius*. 2015;2013:1–8.
- [10] Shahmy S, Kularatne SA, Rathnayake SS, et al. A prospective cohort study of the effectiveness of the primary hospital management of all snakebites in Kurunegala district of Sri Lanka. *PLoS Negl Trop Dis*. 2017;11:e0005847.
- [11] Przybilla B, Ruëff F. Insect stings: clinical features and management. *Dtsch Arztebl Int*. 2012;109:238.
- [12] Xie C, Xu S, Ding F, et al. Clinical features of severe wasp sting patients with dominantly toxic reaction: analysis of 1091 cases. *PLoS One*. 2013;8:e83164.
- [13] Brown SG. Clinical features and severity grading of anaphylaxis. *J Allergy Clin Immunol*. 2004;114:371–376.
- [14] Kovařík F, Lowe G, Ranawana KB, et al. (2016) Scorpions of Sri Lanka (Scorpiones: Buthidae, Chaerilidae, Scorpionidae) with description of four new species of the genera Charmus Karsch, 1879 and Reddyanus Vachon, 1972, stat. n. *Euscorpius* 2016: 1–133.
- [15] Wijesinghe DP. (1987) The present status of spider taxonomy in Sri Lanka. In: Proceedings of the workshop on “Present Status of Faunal Taxonomy in Sri Lanka” SLAftAoS, 7–19pp., editor. Sri Lanka: Sri Lanka Association for the Advancement of Science.
- [16] Ahmed MRJ, Morsch VM, et al. (2009) Snake venom phospholipase A2 enzymes, Hand book of Venom and Toxins of Reptiles: Taylor and Francis. 207–220 p.
- [17] Bush SP, King BO, Norris RL, et al. Centipede envenomation. *Wilderness Environ Med*. 2001;12:93–99.
- [18] Vazirianzadeh B, Rahmani AH, Moravvej SA. Two cases of chilopoda (centipede) biting in human from Ahwaz, Iran. *Pakistan Journal of Medical Sciences* 2007;23:956.
- [19] Duminda SB, Dissanayake LDTSW. An annotated checklist of centipedes (Myriapoda: Chilopoda) of Sri Lanka. *Int J Environ Biodiversity*. 2016;7:71–77.
- [20] Norris RL. (1999) Centipede envenomations. *eMedicine Journal* 3.
- [21] Serinken M, Erdur B, Sener S, et al. A case of mortal necrotizing fasciitis of the Trunk resulting from a centipede (*Scolopendra moritans* Bite. *Internet J Emerg Med*. 2005;2.
- [22] Swain J. How do bee and wasp stings differ? (2010) [cited 2010 May 17]; Available from: http://archive.boston.com/business/articles/2010/05/17/how_do_bee_and_wasp_stings_differ/
- [23] Golden DB. Insect sting allergy and venom immunotherapy: a model and a mystery. *J Allergy Clin Immunol*. 2005;115:439–447.
- [24] Hepburn HR, Hepburn C. Bibliography of the giant honeybees, *Apis dorsata* Fabricius (1793) and *Apis laboriosa* F. Smith (1871). *Apidologie*. 2007;38:219–220.
- [25] Itioka T, Inoue T, Kiang H, et al. Six-year population fluctuation of the giant honey bee *Apis dorsata* (Hymenoptera: Apidae) in a tropical lowland dipterocarp forest in Sarawak. *Annals of the Entomol Soc Am*. 2001;94:545–549.
- [26] Budagoda B, Kodikara K, Kularatne W, et al. Giant Asian honeybee or Bambara stings causing myocardial infarction, bowel gangrene and fatal anaphylaxis in Sri Lanka: a case series. *Asian Pacific J Trop Med*. 2010;3:586–588.
- [27] Schmidt JO. Toxinology of venoms from the honeybee genus *Apis*. *Toxicon*. 1995;33:917–927.
- [28] Green A, Reisman R, Arbesman C. Clinical and immunologic studies of patients with large local reactions following insect stings. *J Allergy Clin Immunol*. 1980;66:186–189.
- [29] Schuberth KC, Lichtenstein LM, Kagey-Sobotka A, et al. An epidemiologic study of insect allergy in children. I. Characteristics of the disease. *J Pediatr*. 1982;100:546–551.
- [30] Lockey RF, Turkeltaub PC, Baird-Warren IA, et al. The Hymenoptera venom study I, 1979–1982: demographics and history-sting data. *J Allergy Clin Immunol*. 1988;82:370–381.
- [31] Lieberman P, Kemp SF, Oppenheimer J, et al. The diagnosis and management of anaphylaxis: an updated practice parameter. *J Allergy Clin Immunol*. 2005;115:S483–S523.