

Asian Pacific Journal of Tropical Biomedicine

journal homepage: www.apjtb.com



Document heading doi: 10.12980/APJTB.4.2014C1323 © 2014 by the Asian Pacific Journal of Tropical Biomedicine. All rights reserved.

Scorpion fauna and epidemiological aspects of scorpionism in southeastern Iran

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PEER REVIEW

Peer reviewer

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Comments

New and updated information about scorpionism and scorpion fauna in an endemic region is valuable. These results are fundamental and more studies are needed to determine more species composition and their ecology as well as the correlation between scorpions' species and the patients' clinical signs and symptoms.

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ABSTRACT

Objective: To identify the scorpion fauna and classify the epidemiological aspects of scorpionism in an endemic region, Southeast Iran.

Methods: Scorpionism data were collected from health centers and hospitals in Sistan–Baluchestan Province during 2010–2011. Specimens were collected at night, using UV light, between May and October 2012.

Results: In total, 246 scorpions were collected from two families (Buthidae and Scorpionidae). Five species including *Odontobuthus odonturus*, *Hottentotta (Buthotus) jayakari*, *Compsobuthus matthiesseni*, *Scorpio maurus* and *Orthochirus scrobiculosus* are reported for the first time from this area. *Androctonus crassicauda* was the dominant species. In total, 3638 scorpion sting cases were recorded by health system, the majority of which were females. Stings mostly occurred in July and the age group of 15–24 years presented the highest frequency. Scorpionism decreased during 2011 compared with that in 2010 (68.2%).

Conclusions: Based on the results, scorpionism is a serious health problem in this area and increasing knowledge of residents regarding the prevention methods of scorpion stings is recommended. Additional research on the scorpion fauna, their ecological and molecular variety in this part of the country is needed as well as the correlation between scorpions' species and the clinical signs and symptoms.

KEYWORDS

Scorpion fauna, Scorpionism, Epidemiology, Iran

1. Introduction

Scorpions are medically important arthropods of the class Arachnida that commonly found in hot, dry environments^[1,2]. They are generally nocturnal and emerge after sunset, taking cover during the day under rocks, in crevices, or within burrows^[3]. Scorpions are of various lengths ranging from 13 to 220 mm and their morphologic

structures are easily identifiable^[4].

Although they are not a reservoir of disease agents, some have venomous stings^[4]. Of over 1500 species known, approximately 30 have medical importance. The lethality of scorpion venom neurotoxins is greater than that of snake venom and their LD₅₀ is lower than that of cyanide. The mortality of scorpion stings varies with species. Based on the scientific literature, 48 valid species belonging to four

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Foundation Project: Supported by Tehran University of Medical Sciences (Grant No.

91–03–27–18800).

Article history:

Received 24 Jan 2014

Received in revised form 3 Feb, 2nd revised form 13 Feb, 3rd revised form 22 Feb 2014

Accepted 18 Mar 2014

Available online 5 Apr 2014

families and 16 genera have been detected in the eastern Mediterranean region. In the Middle East, venomous scorpion species include *Androctonus crassicauda* (*A. crassicauda*), *Mesobuthus tamulus*, *Mesobuthus eupeus* (*M. eupeus*), *Parabuthus liosoma*, *Buthus occipitanus*, and *Leiurus quinquestriatus*[2], and there may be more[5]. At least 51 species of scorpions have been identified in Iran, belonging to 18 genera and four families, Buthidae, Scorpionidae, Hemiscorpiidae, and Diplocentridae[6], of which approximately 10 species have been incriminated in human envenomation. This is more than any other country in the Middle Eastern region[7]. Excluding *Hemiscorpius lepturus* (Hemiscorpiidae), the most medically important scorpion in Iran[3], all venomous scorpion species belong to the large family Buthidae[2].

Scorpion sting is a widespread health problem in various parts of the world, particularly in tropical and subtropical countries[8–10]. It is an important cause of mortality; primarily in children[9]. The true incidence of scorpion stings is unclear because some cases do not request medical services. However, at least 1 million scorpion stings are estimated to occur annually in the world[1], leading to more than 3 250 deaths[4]. Approximately 40 000–50 000 cases of scorpion sting were recorded annually in Iran[11], with about 19 deaths each year[6].

The Kuzestan province has the highest incidence of scorpionism in Iran, followed by Sistan–Baluchestan, Hormozgan, Bushehr, and Ilam provinces[7].

Sistan–Baluchestan is the largest province of Iran and is located in the southeast, where the risk of scorpion stings is high[7]. The scorpions' fauna and the epidemiology of their stings in this province have been poorly investigated. This study aimed to describe the scorpion fauna and classify scorpionism with respect to its epidemiology in this region with one of the highest incidences in Iran.

2. Material and methods

2.1. Study area

The Sistan–Baluchestan province (also named Sistan and Baluchistan or Sistan va Baluchestan) is the largest province in Iran and is located in the southeast of the country, having a common border of 1 265 km with the southeastern neighboring countries, Pakistan and Afghanistan. The province is bordered from the south by the Gulf of Oman and the Indian Ocean. It has an area of 181 785 km² and a population of approximately 2 400 000. It consists of two parts: Sistan in the north, adjoining Afghanistan, and Baluchestan in the south, adjoining Pakistan and the Gulf of Oman[12].

Our study was conducted in Baluchestan in the Zahedan, Khash, Iranshahr, Saravan, Sarbaz, Nikshahr, and Chabahar districts (Figure 1). These districts have a subtropical climate, and some tropical diseases such as malaria occur

in the southern districts[12,13].

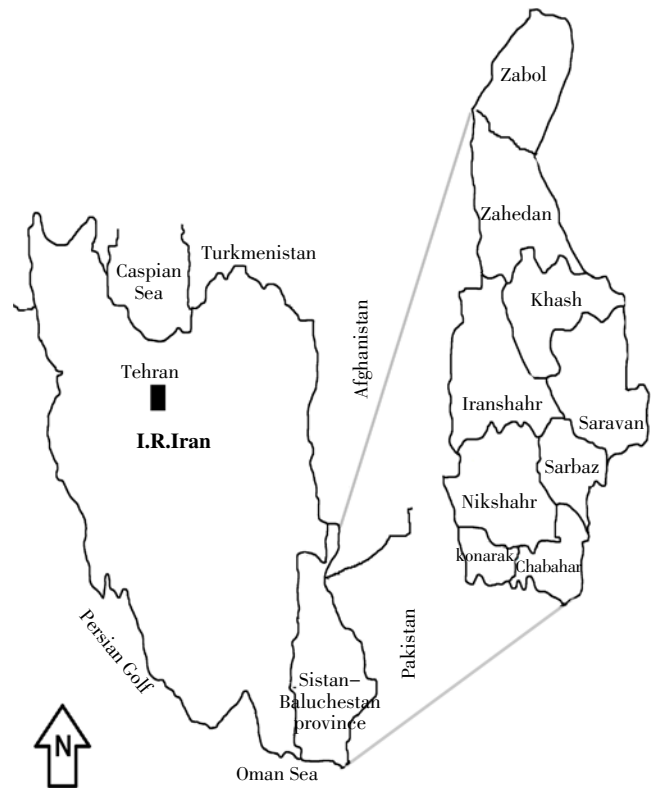


Figure 1. Map of Sistan–Baluchestan province, southeastern Iran[13].

2.2. Scorpion collection & identification

Specimens were collected at night using UV light. They were stored in 70% ethanol and morphological studies were conducted under a stereomicroscope using diagnostic keys. This cross-sectional study was performed during May–October, 2012 when scorpion stings were at a peak (Figure 2).



Figure 2. Scorpions collected at night using UV light.

2.3. Scorpionism data collection

The scorpionism data was obtained from case history folders in 4 hospitals and 197 rural/urban health centers during 2010 and 2011. The clinical data of each patient including sex, age, residence, site of bite, history of scorpion sting, antivenom injection method, antivenom shock, and final outcome of patients have been recorded in a questionnaire that formerly prepared by Iranian Center for Disease Control (CDC). The questionnaires have been registered by physicians who treat the patients based on

the national immunization guidelines (protocol). These data were analyzed by SPSS–15 software.

3. Results

3.1. Scorpion fauna

In total, 246 specimens were captured including 156 (63.4%) female and 90 (36.6%) male. Nine species from two families (Buthidae and Scorpionidae) were identified. *A. crassicauda* (29.3%) was the dominant species, followed by *Odontobuthus odonturus* (*O. odonturus*) (18.3%) and *Odontobuthus doriae* (*O. doriae*) (15.8%) at a relatively lower population size. The scorpion species identified are listed in Table 1.

Table 1

The scorpion species identified in this study.

Family	Species	No. of captured	Percentage
Buthidae C. L. Koch, 1837	<i>A. crassicauda</i>	72	29.3%
	<i>O. odonturus</i>	45	18.3%
	<i>O. doriae</i>	39	15.8%
	<i>C. matthiesseni</i>	9	3.7%
	<i>M. eupeus</i>	9	3.7%
	<i>O. scrobiculosus</i>	21	8.5%
	<i>Hottentotta (Buthotus) saulcyi</i>	15	6.1%
	<i>Hottentotta (Buthotus) jayakari</i>	3	1.2%
Scorpionidae Latreille, 1802	<i>S. maurus</i>	33	13.4%

3.2. Epidemiological data

In total 3638 scorpionism cases were recorded during 2010 and 2011, the majority are (51.6%) female and the others are 48.4% male. The age group of 15–24 years had the highest frequency of scorpionism at 693 (19.1%) and the age group of >65 years had the lowest frequency at 100 (2.8%) (Table 2). The occurrence of scorpion stings in rural areas (2682, 73.7%) was much higher than that in urban areas (956, 26.3%). Scorpion sting cases were more frequently reported at the end of spring (June) and at the beginning of summer (July), but the fewest occurrences were reported in January and February (Figure 3).

Table 2

Epidemiological characteristics of patients stung by scorpions, southeastern Iran, 2010–2011

Age	Male		Female		Total	
	2010	2011	2010	2011	n	%
0–4	102	53	101	47	303	8.3
5–9	158	48	145	40	391	10.7
10–14	195	41	211	59	506	13.9
15–24	241	81	271	100	693	19.1
25–34	229	72	241	105	647	17.8
35–44	183	43	166	56	448	12.3
45–54	130	21	129	55	335	9.2
55–64	99	7	85	24	215	5.9
>65	43	13	32	12	100	2.8
Total	1380	379	1381	498	3638	

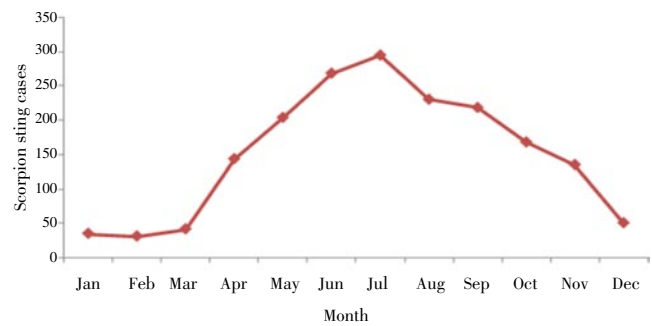


Figure 3. Average monthly scorpion sting cases, southeastern Iran, 2010–2011.

The highest prevalence of scorpion stings occurred on hands (1541, 42.3%) and feet (1432, 39.4%) (Table 3).

The number of patients treated with antivenom was 3223 (88.6%). It was a polyvalent scorpion antivenom prepared from horse and produced in Razi Vaccine & Serum Research Institute in Iran. In total, 5366 antivenom vials were consumed, corresponding to 166 vials/100 affected cases. Most patients (1540, 42.3%) were treated 6 h after the sting, and most of these were injected with intramuscular antivenom (1664, 51.6%), all of them recovering. There were no reports of shock due to antivenom injection. The sting cases not treated with antivenom were 415 (11.4%) (Table 4). Mortality caused by scorpion sting during the study period was not reported. The number of patients who had previously been stung was 178 (4.9%). There was no death due to scorpion sting during the study.

Table 3

Scorpion sting site among the studied cases, southeastern Iran, 2010–2011

Sting site	No. of Patients		Total [n (%)]	
	2010	2011		
Head and trunk	529	136	665	18.3
Hand	1227	314	1541	42.3
Leg	1005	427	1432	39.4

Table 4

Characteristics of scorpion antivenom, southeastern Iran, 2010–2011.

Characters	Male (n)		Female (n)		Total	
	2010	2011	2010	2011	n	%
Time of anti venom injection after stung	<6	654	105	683	98	1540 42.3
	6–12	454	38	467	62	1021 28.1
	>12	175	152	155	180	662 18.2
Total	1283	295	1305	340	3223	88.6
Without anti venom injection		97	84	76	158	415 11.4
Using number of anti venom vial		2259	394	2254	459	5366
Injection method of anti venom	Muscular	592	234	564	274	1664 51.6
	venous	691	61	741	66	1559 48.4

4. Discussion

In the present study, nine scorpion species were identified. According to the latest reports, two species, *O. odonturus* and *Hottentotta (Buthotus) jayakari* are reported for the first time from southeast Iran (Sistan–Baluchestan province)[6]. Based on a recent report describing the distribution of collected scorpions in the past five decades in Iran, it appears that besides two aforementioned

species *Compsobuthus matthiesseni* (*C. matthiesseni*), and *Scorpio maurus* (*S. maurus*) are reported for the first time from the Sistan–Baluchestan province. Also *Orthochirus scrobiculosus* (*O. scrobiculosus*) had been collected from the northern part of the province (Sistan), but had not previously been reported from the southern part (Baluchestan)[5]. Other literature review confirm this report too[14–16]. We accordingly propose that further studies should be performed on the scorpion species and their geographical distribution in this part of the country. Although *O. odonturus*, *Hottentotta* (*Buthotus*) *jayakari* and *S. maurus* are not known as venomous scorpions, *C. matthiesseni* and *O. scrobiculosus* belong to poisonous species[4,5,17].

Iran, with approximately 10 venomous species, has the greatest number among Middle Eastern countries[7]. *A. crassicauda*, which is known as a venomous and dangerous scorpion, was dominant species in our study. It has a wide distribution in Azerbaijan, Iraq, Syria, Jordan and Saudi Arabia, as well as being widely distributed in Iran[4,14,15,18]. *M. eupeus*, *O. doriae*, *S. maurus*, *Hottentotta* species and some *Compsobuthus* species may be noted as other species geographically widespread in Iran[6]. But the distribution of *O. odonturus* is narrower[5,6].

M. eupeus has been collected from China, Central Asia, Armenia, Georgia, Iraq, Turkey, Afghanistan and Pakistan[6,11]. *O. scrobiculosus* extends from central Asia throughout Iran and Iraq to Jordan and Sinai. *Hottentotta* (*Buthotus*) *sauleyi* has distributed over the Middle East from Syria and Turkey to Iraq, Iran and Afghanistan. Also *C. matthiesseni* is found in Syria, Turkey and Iraq[6].

In the present study, scorpionism decreased during 2011 compared with that in 2010 (68.2%) in the Sistan–Baluchestan province. The reasons for this reduction are unclear and require further investigation. Perhaps increasing public awareness regarding scorpion sting prevention, extensive distribution of free longlasting impregnated bed nets for malarial prevention, and improvement of amenities, such as electricity, in rural areas that allow resting indoors at nights, are among the reasons for this decline. In Africa the use of bed nets impregnated with pesticides for malaria vector control also led to a reduction in scorpionism[19].

According to the literature, most scorpion stings occur in the hot months, particularly in summer[2,4,20]. Our results agreed, showing that many scorpion stings occurred during the hot months of May–September, with a peak in July.

Although in some studies scorpionism was more frequent in males[1,8,21], in this research the gender distribution of sting cases was different. A similar result has been reported from the west of Iran and Turkey[4,20,22].

In the current study, hands, followed by legs, were more frequently stung than other parts of the body. Other investigations showed similarly that extremities including hand, arm, leg, thigh, and foot were more affected[1,4], a result postulated to be due to socio–economic structure[4].

In our study the 15–24 age group was most affected by scorpion stings. Similar results have been reported for the same age group (15–29) in Turkey as well as in Iran[1,4,22].

In the current study some of patients did not receive antivenom. The similar result has stated in annual report of the Iranian scorpionism which showed that 12.1% of patients didn't receive any antivenom during 2009[1]. Some researchers have expressed the unusual distribution of venomous scorpions and insufficient access to medical treatment could be the primary reasons for failure of scorpionism treatment[9].

Finally, based on the results, scorpionism is a serious health problem in southeastern Iran and increasing knowledge of residents regarding the prevention methods of scorpion stings is recommended. We also conclude that additional research on the scorpion fauna and their morphological, ecological and molecular variety in this region is needed as well as the correlation between scorpions' species and the clinical signs and symptoms.

Conflict of interest statement

We declare that we have no conflict of interest.

Acknowledgements

The great appreciation goes to Dr. M Divband from Centre for Disease Control & Prevention and Dr. M Salehi from Research Center for Infectious Diseases and Tropical Medicine, Zahedan University of Medical Sciences. Special thanks to Mr. E Taraz and Mr. E Shahiroudi from Sarbaz and Konarak Health Centers for their help during the field work. This study was financially supported by Tehran University of Medical Sciences with the grant number 91–03–27–18800.

Comments

Background

Southeastern of Iran with subtropical climate is an endemic foci of scorpionism. Also this area is relatively undiscovered in terms of scorpion species composition. This research presents new formal data about the scorpion fauna and scorpionism status in this important region.

Research frontiers

This research focuses on scorpion species composition as well as scorpion stings. Also the clinical data of each patient including sex, age, residence, site of bite, history of scorpion sting, antivenom injection method, antivenom shock, and final outcome of patients have been recorded.

Related reports

Several studies have been done about the scorpion species in the world and Iran but it seems that there is not enough investigation on the scorpion species in southeast of the country. Also scorpionism investigations should be considered.

Innovations and breakthroughs

Apart from updated information about the scorpion species, this is the first formal report about the scorpionism in southeastern of Iran.

Applications

Data presented in the current research indicate the scorpionism status as well as the antivenom therapy that can be used for improvement of the quality of health service system. Also the identification of new species is very interesting and can be applied in the future investigations.

Peer review

New and updated information about scorpionism and scorpion fauna in an endemic region is valuable. These results are fundamental and more studies are needed to determine more species composition and their ecology as well as the correlation between scorpions' species and the patients' clinical signs and symptoms.

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