

Original Article

Epidemiological Characterizations, New Localities, and a Checklist of the Known Scorpions in the Kurdistan Region, Northern Iraq

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Abstract

Background: Annually, thousands of scorpion stings and rare mortalities are recorded in the Kurdistan Region of Iraq. In the present study, we prepared a checklist for the geographical distribution of scorpion fauna composition, new localities data, and scorpion sting profile for the years 2019–2020 in the region.

Methods: Random field surveys for scorpion collection were carried out in 22 localities in the Kurdistan Region from June 2020 to October 2021. Clinical data related to scorpion stings in 2019 and 2020 were obtained from the medical records of public health offices in the region.

Results: In this survey, 166 specimens were collected. They were composed of seven scorpion species belonging to three families including: Buthidae, Hemiscorpiidae, and Scorpionidae. The collected species were *Androctonus crassicauda*, *Compsobuthus matthiesseni*, *Hottentotta saulcyi*, *Mesobuthus mesopotamicus*, *Orthochirus fomichevi*, *Hemiscorpius lepturus*, and *Scorpio kruglovi*. Moreover, three scorpion species comprising *Buthacus tadmorensis*, *Hottentotta mesopotamicus*, and *Calchas anlasi* were recorded in the previous study conducted in the Kurdistan region. In 2019–2020, 3726 scorpion stings were reported, with a peak in the summer season. Most of the patients were 15–49 years old. In the current study, medically significant scorpion species have been identified.

Conclusion: The outcome of the present work will increase the awareness of the Kurdish community regarding the distribution of dangerous scorpion species and consequently reduce their stings.

Keywords: Scorpion; Scorpion sting; Distribution; Scorpionism; Iraq

Introduction

The Kurdistan Region is located in northern Iraq and has a population of around six million people. The total area of the region is approximately 40,643km². The region covers Erbil, Duhok, and Sulaymaniyah provinces. It is located at 36°04'59"N; 44°37'47"E. The region has borders with three countries that have higher scorpion diversity than Iraq (19 species) (1). Iran, in the west, has the highest scorpion species diversity (78 species, 2 subspecies) as compared to the other neighbouring countries (2), followed by Turkey in the north with 41 species and 3 subspecies (3); then Saudi Arabia

in the east with 26 species (4) and Syria with 21 species (5).

Scorpion stings are unpleasant but rarely endanger life. Children and older adults are at the highest risk for severe complications. Among the 2710 species of known scorpions (6), only about 50 of them develop venom toxic enough to be lethal to humans (7). Each year, more than one million scorpion stings occur. Deaths from these stings are a major public health concern in tropical countries where access to medical care is limited (8).

According to recent publications, 4162 scor-

pion stings were recorded in primary health care centres in the Kurdistan Region in 2017 and 2018 (9). Based on the envenomation epidemiological data of the neighbour countries, *Androctonus crassicauda* (Olivier, 1807), *Androctonus bicolor* (Ehrenberg, 1828) and *Hemiscorpius lepturus* (Peters, 1861) are considered the most dangerous scorpions among the known species in Iraq and they are responsible for the most death cases related to scorpion stings (10–11).

Knowledge of scorpion stings and diversity in Iraq generally, and the Kurdistan Region in particular is extremely poor. According to recent studies on the scorpion fauna of the Kurdistan Region of Iraq, *Compsobuthus matthiesseni* (Birula, 1905), *H. lepturus*, *Hemiscorpius saulcyi* (Simon, 1880), *Orthochirus fomichevi* (Kovařík, Yağmur, Fet and Hussen, 2019), and *Scorpio kruglovi* (Birula, 1910) were listed in Sulaymaniyha Province. In Duhok Province, *A. crassicauda*, *C. matthiesseni*, *Hottentotta mesopotamicus* (Lourenço and Qi, 2007), *H. saulcyi*, *O. fomichevi* and *S. kruglovi* were listed. While in Erbil Province, *A. crassicauda*, *Buthacus tadmorensis* (Simon, 1892), *C. matthiesseni*, *Calchas anlasi* (Yağmur, Soleglad, Fet and Kovařík, 2013), *H. saulcyi*, *H. lepturus*, *M. mesopotamicus*, *O. fomichevi* and *S. kruglovi* were listed (1, 11, 12).

The aim of this paper is to investigate scorpion stings in 2019–2020 and explain the current geographical distribution of different scorpion species from the Kurdistan Region. The outcomes of the present work will increase the awareness level of the Kurdish community regarding the scorpion's type and consequently reduce their stings.

Materials and Methods

Epidemiological data

The clinical data relating to the scorpion stings present in this study were obtained from the medical records of primary public health offices of the Kurdistan Region. Statistical da-

ta of scorpion envenomation of 2019 and 2020 were checked. The relevant information for each scorpion sting case such as gender, age, and the geographical region of scorpion sting were recorded. Excel software is used to analysis data statically and organize it in detailed tables and graphs.

Study area

This cross-sectional study for scorpion species collection was conducted in the Kurdistan Region administrative of Iraq. Sulaymaniyah is located at latitude 35°33'26"N, 45°26'08"E at elevation of 882m on the board of Iran. Duhok is located at latitude 36°52'N, 43°0'E at elevation of 565m on the board of Turkey and Syria. Erbil is located at latitude 36° 11'28.0068"N, 44°0'33.0012"E at elevation of 390m on the board of Iran and Turkey. The geographical features of three provinces are roughly identical and consist of two areas: mountains and plains. They have semi-arid climate weather with very warm dry summers and cool wet winters. The Kurdistan area provinces are separated into 32 districts to better understand the geographical distribution of each scorpion species. Twenty-two sites were randomly selected for this study survey (Fig. 3).

Scorpion survey

A random field survey for scorpion collection was carried out in twenty-two stations in rural and urban areas of the three provinces of Kurdistan during the period of June 2020 to October 2021. Sampling at night was done by using a black ultraviolet light (UV) to detect scorpions above ground, while during sunny days the ground was examined by searching under stones, rocks, and tree barks. All the collected scorpion specimens were placed in 80% ethyl alcohol and kept at the Zoology Laboratory at the University of Zakho. All species were identified based on the descriptions and taxonomic keys published by Levy and Amitai (13) and Kovařík (14).

Review of the Scorpion fauna of Kurdistan

In this section, we reviewed all the data in previous studies related to the identified localities of scorpions in Kurdistan. Then we build a district-based checklist for the geographical distribution of each scorpion species recorded in Kurdistan.

Results

Epidemiological data

A total of 3726 scorpion sting cases were dealt with by the public hospitals in three provinces of the Kurdistan Region, Iraq during the 2-year period from January 2019 until December 2020. According to the recorded evidence on scorpion stings, the highest numbers of cases were reported in 2019 and the lowest in 2020 (Table 1).

The scorpion sting victims were mostly between the ages of 15 and 49, accounting for 42.8% of all cases, followed by 30.1% of those between the ages of 4 and 14 (Table 1). Those over 50 and less than 4 accounted for 13.4% and 13.7% of the cases, respectively.

Summer was the most common season for scorpion stings (51.9%), with autumn being the next most common season (32.2%). In contrast, scorpion stings were reported at a very

low rate of 12.2% and 3.7% in the spring and winter, respectively (Fig. 1). The number of male and female scorpion sting victims was 2079 (55.8%) and 1647 (44.2%), respectively. Table 2 summarizes the monthly occurrence of scorpion sting cases by gender.

Scorpion fauna composition

Out of all the 166 specimens collected in different sites of this survey, the Buthidae family involves five species: *A. crassicauda*, *C. matthiesseni*, *H. saulcyi*, *M. mesopotamicus* and *O. fomichevi*, while Scorpionidae and Hemiscorpiidae each have a single species: *S. kruglovi* and *H. lepturus*, respectively (Table 3, Fig. 2).

Among all the collected samples, 102 (61.4%) were male and 64 (38.6%) females. The most abundant species were *H. saulcyi* 93 (56.0%), *S. kruglovi* 46 (27.7%) and *A. crassicauda* 15 (9.0%), which were collected from various sites in this survey. The lowest frequency was from *C. matthiesseni* 4 (2.4%), *M. mesopotamicus* 3 (1.8%), *H. lepturus* 3 (1.8%) and *O. fomichevi* 2 (1.2%) (Fig. 2). *Orthochirus fomichevi* was collected only from Zakho District in Duhok Province, while *C. matthiesseni*, *M. phillipsii* were collected only from Erbil Province.

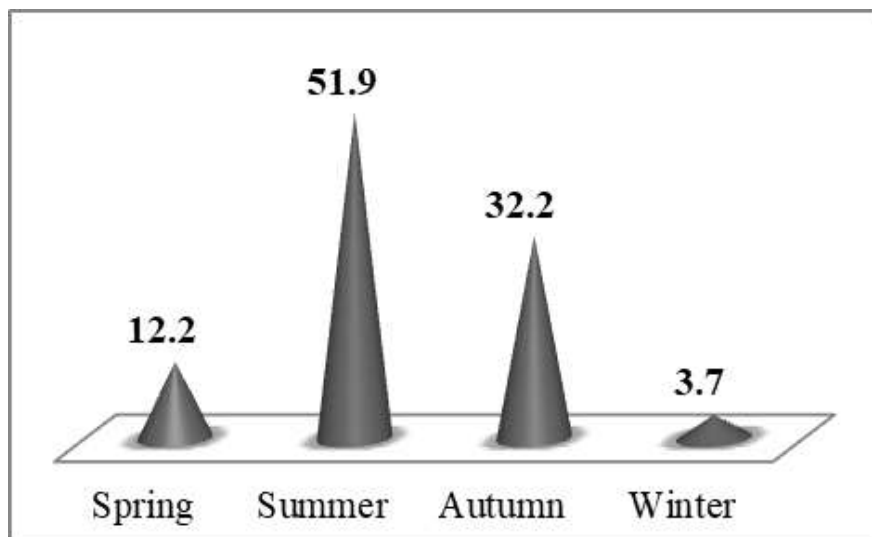


Fig. 1. Seasonal average rate of scorpion stings in three cities north of Iraq during 2019–2020

Table 1. Age distribution for scorpion stings in Erbil, Duhok and Sulaymaniyah Provinces during 2019–2020

Year	City	Age (Years)				Total
		1–4	5–14	15–49	50 over	
2019	Erbil	98	201	150	98	1990
	Duhok	129	399	593	164	
	Sulaimaniyah	9	23	97	29	
	Average	236	623	840	291	
2020	Erbil	102	128	124	87	1736
	Duhok	155	316	412	105	
	Sulaimaniyah	16	57	219	15	
	Average	273	501	755	207	
Total (%)		509 (13.6)	1124 (30.2)	1595 (42.8)	498 (13.4)	3726 (100)

Table 2. Monthly gender-based scorpion sting cases recorded in the Kurdistan Region provinces from 2019 to 2020

Month	2019	2020	Male	Female	Total	%
January	9	13	11	11	22	0.6
February	12	4	7	9	16	0.4
March	10	25	17	18	35	0.9
April	42	68	70	40	110	3
May	146	166	158	154	312	8.4
June	320	349	403	266	669	18
July	316	196	314	198	512	13.7
August	388	319	341	366	707	19
September	221	312	286	247	533	14.3
October	283	170	257	196	453	12.1
November	181	78	155	104	259	7
December	62	36	60	38	98	2.6
Total (%)	1990 (53.4)	1736 (46.6)	2079 (55.8)	1647 (44.2)	3726	100

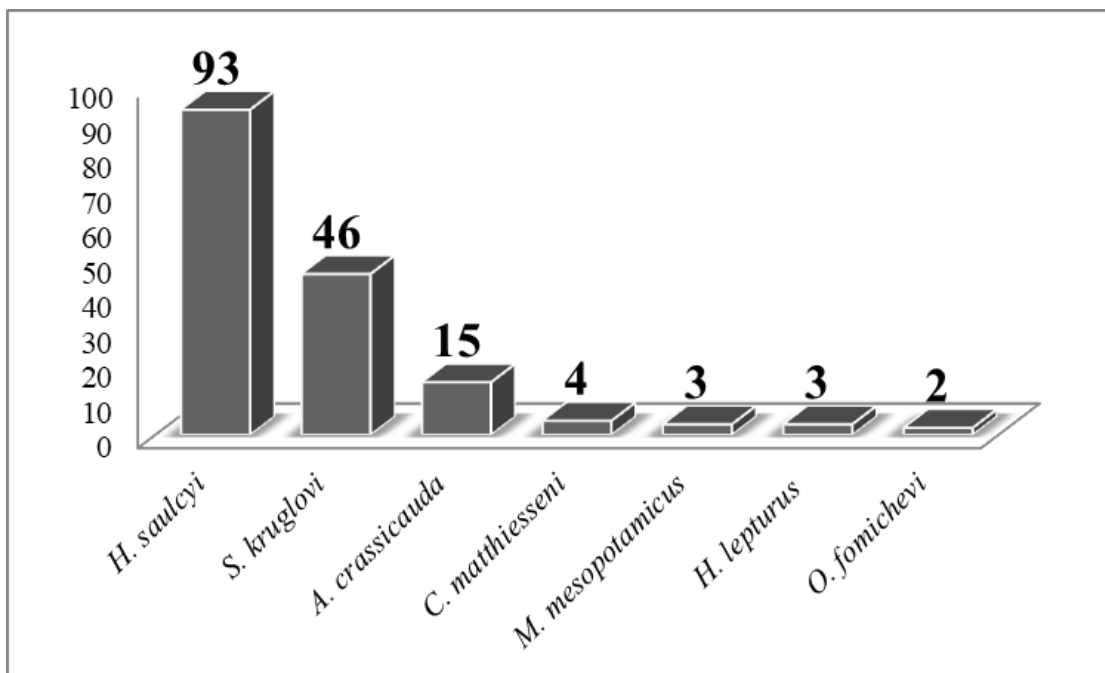


Fig. 2. Scorpion species composition collected in this survey in Kurdistan Region, 2020–2021

Table 3. Species of scorpions collected in different survey sites in Kurdistan Region provinces 2020–2021

Collection site (District)	Topography	Altitude (m)	Latitude and Longitude	Scorpion species (N.)	Total collected
Sulaymaniyah Province					
Qaladze (Pishdar)	Plain	882	36° 10' 51.2" N 45° 7' 26.9" E	<i>H. saulcyi</i> (10) <i>S. kruglovi</i> (15) <i>A. crassicauda</i> (3)	28
Kele Border (Pishdar)	Mountain	849	36.18 66 N 45.3243 E	<i>S. kruglovi</i> (12) <i>A. crassicauda</i> (1)	13
Bawze (Pishdar)	Mountain	1138	36.0878 N 45.3133 E	<i>H. saulcyi</i> (16) <i>S. kruglovi</i> (1) <i>A. crassicauda</i> (1)	18
Swne (Pishdar)	Mountain	890	36° 14' 53.2" N 45° 7' 34.6" E	<i>H. saulcyi</i> (3)	3
Makok mountain (Ranya)	Mountain	882	36° 17' 29.2" N 44° 47' 29.3" E	<i>H. saulcyi</i> (3)	3
Chaqizh lower (Sulaymaniyah)	Plain	912	35.626307°N 45.199277°E	<i>H. lepturus</i> (3) <i>A. crassicauda</i> (1) <i>C. matthiesseni</i> (1) <i>H. saulcyi</i> (3) <i>O. fomichevi</i> (1)	9
Duhok Province					
Telkabar (Zakho)	Plain	487	37°16'28"N 42°71'78"E	<i>H. saulcyi</i> (25) <i>A. crassicauda</i> (1) <i>C. matthiesseni</i> (1)	27
Sheransh (Zakho)	Mountain	1439	37°13'48"N 42°50'40"E	<i>H. saulcyi</i> (5)	5
Betas (Zakho)	Mountain	678	37° 3' 39" N 42° 44' 7" E	<i>H. saulcyi</i> (4) <i>O. fomichevi</i> (1)	5
Demka (Zakho)	Mountain	873	37° 13' 10" N 43° 4' 36" E	<i>H. saulcyi</i> (7)	7
Bani nan (Bardarash)	Plain	298	36° 30' 12.2" N 43° 35' 14" E	<i>A. crassicauda</i> (2)	2
Erbil Province					
Efraz (Khabat)	Plain	291	36°21'51.37"N 43°48'24.84" E	<i>A. crassicauda</i> (2)	2
Rawanduz (Rawanduz)	Mountain	658	36°35'28.79"N 44°23'32.99" E	<i>S. kruglovi</i> (10)	10
Choman (Choman)	Mountain	2407	36°38'14.67"N 44°53'21.52"E	<i>H. saulcyi</i> (3)	3
Pirdawd (Erbil)	Plain	360	36.024650 N 43.927116 E	<i>H. saulcyi</i> (2) <i>M. mesopotamicus</i> (3)	5
Ankawa (Erbil)	Plain	413	36° 13' 42.1" N 43° 59' 43.2" E	<i>H. saulcyi</i> (2)	2
Rezan (Mergasur)	Mountain	882	44.1294069" N 36.8551834" E	<i>H. saulcyi</i> (2)	2
Harir (Shaqlawā)	Mountain	699	44.3467706 " N 36.552188 " E	<i>H. saulcyi</i> (3) <i>A. crassicauda</i> (2) <i>S. kruglovi</i> (8)	13
Qushtapa (Erbil)	Plain	390	36° 00' 2.0639" N 44° 01' 57.077" E	<i>H. saulcyi</i> (4) <i>A. crassicauda</i> (2)	6
Bestana (Erbil)	Plain	646	36° 2' 45.6" N 44° 11' 57.2" E	<i>C. matthiesseni</i> (1)	1
Koysinjaq (Koysinjaq)	Plain	594	36°4'30.33"N 44°37'11.77"E	<i>C. matthiesseni</i> (1)	1
Dashty Hawler (Dashti Hawler)	Plain	419	36° 9' 11.5" N 44° 6' 0.3" E	<i>H. saulcyi</i> (1)	1
Total					166

Table 4. Comparison of scorpion species distribution in previous and current study in Kurdistan Region provinces (Duhok, Erbil and Sulaymaniyah) in Iraq divided into 32 districts: Duhok (1- Zakho, 3- Duhok, 4- Amedi, 5- Shikhan, 6- Akre, 7- Bardarash), Erbil (8- Mergasur, 9- Soran 10- Choman, 11- Rawanduz, 12- Shaqlawa, 13- Khabat, 14- Erbil, 15- Dashti Hawler, 16- Koysnjaq, 17- Makhmur), Sulaymaniyah (18- Ranya, 19- Pishdar, 25- Sulaymaniyah, 26- Said Sadiq, 29- Halabja,). Green indicates report only in this study, Blue indicates report in only previous studies and Red indicates report in both current and previous stud studies

Scorpion Family-Species	District per Province in Kurdistan Region of Iraq																																													
	Duhok							Erbil							Sulaymaniyah																															
	1	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	25	26	29	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	25	26	29			
Buthidae																																														
<i>A. crassicauda</i>	Red	Blue			Blue	Red	Red				Green	Red	Red	Blue	Blue			Green	Red		Blue																					Blue				
<i>B. tadmorensis</i>					Blue		Blue				Blue		Blue		Red	Blue				Red																										
<i>C. matthiesseni</i>	Green																																													
<i>H. mesopotamicus</i>	Blue																																													
<i>H. salucyi</i>	Red			Blue	Blue		Red		Green		Red	Green	Red	Blue	Blue	Blue	Green	Red	Blue	Blue	Blue																									
<i>M. mesopotamicus</i>																																														
<i>O. fomichevi</i>	Red				Blue		Blue				Blue		Blue	Blue	Blue																															
Hemiscorpiidae																																														
<i>H. lepturus</i>																Blue																														
Iuridae																																														
<i>C. anlasi</i>								Blue																																						
Scorpionidae																																														
<i>S. kruglovi</i>	Blue		Blue	Blue																																										
Species number per district	6	1	1	2	4	1	6	1	1	1	6	2	5	4	8	2	1	3	6	3	2																									

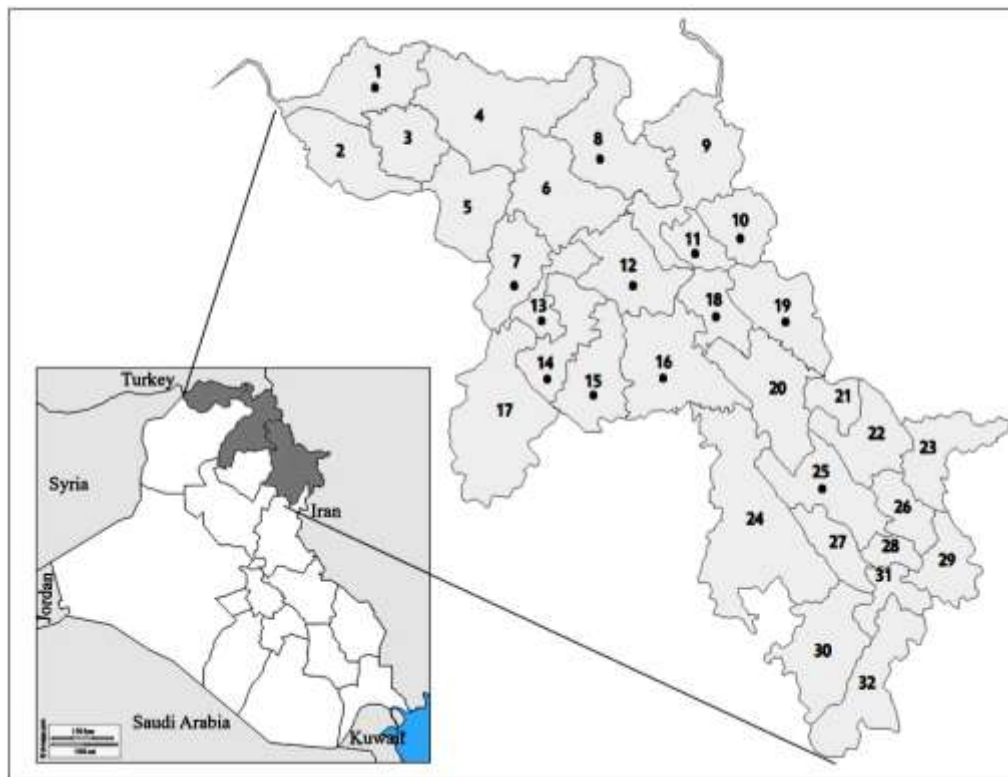


Fig. 3. Kurdistan Region provinces divided into 32 districts **Duhok** (1- Zakho, 2- Sumel, 3- Duhok, 4- Amedi, 5- Shikhan, 6- Akre, 7- Bardarash), **Erbil** (8- Mergasur, 9- Soran 10- Choman, 11- Rowanduz, 12- Shaqlawa, 13- Khabat, 14- Erbil, 15- Dashti Hawler, 16- Koysnjaq, 17- Makhmur), **Sulaymaniyah** (18- Ranya, 19- Pishdar, 20- Dukan, 21- Mawat 22- Sharbazher, 23- Penjwin, 24- Chamchamal, 25- Sulaymaniyah, 26- Said Sadiq, 27- Qaradagh, 28- Sharazur, 29- Halabja, 30- Kalar, 31- Darbandikhan, 32- Khanaqin). The study sites surveyed represented by black dots

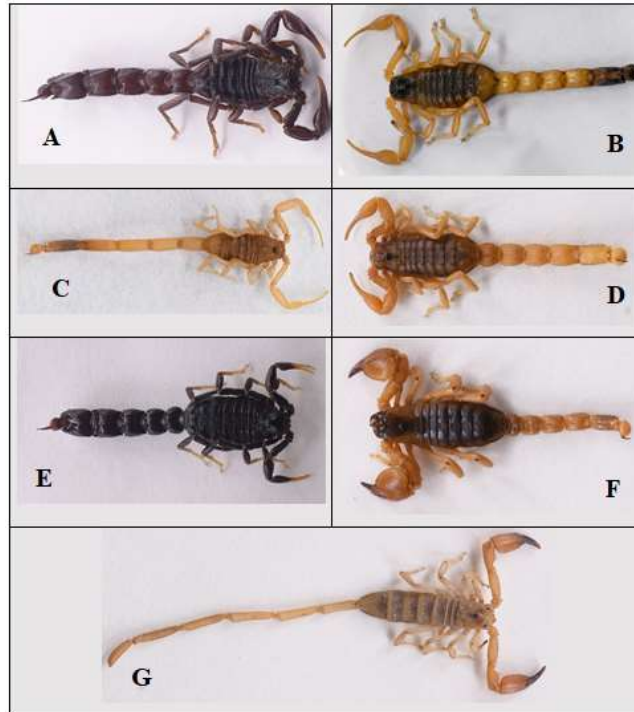


Fig. 4. General overview of scorpion species collected in this study in the Kurdistan Region of Iraq **A.** *Androctonus crassicauda*; **B.** *Hottentotta saulcyi*; **C.** *Compsobuthus matthiesseni*; **D.** *Mesobuthus mesopotamicus*; **E.** *Orthochirus fomichevi*; **F.** *Scorpio maurus*; **G.** *Hemiscorpius lepturus* (Photos by Authors)



Fig. 5. The distribution map of the known scorpion species in 22 out of 32 districts of the Kurdistan Region of Iraq: **Duhok** (1- Zakho, 2- Sumel, 3- Duhok, 4- Amedi, 5- Shikhan, 6- Akre, 7- Bardarash), **Erbil** (8- Mergasur, 9- Soran 10- Choman, 11- Rawanduz, 12- Shaqlawa, 13- Khabat, 14- Erbil, 15- Dashti Hawler, 16- Koysnjaq, 17- Makhmur), **Sulaymaniyah** (18- Ranya, 19- Pishdar, 20- Dukan, 21- Mawat 22- Sharbazher, 23- Penjwin, 24- Chamchamal, 25- Sulaymaniyah, 26- Said Sadiq, 27- Qaradagh, 28- Sharazur, 29- Halabja, 30- Kalar, 31- Darbandikhan, 32- Khanaqin)

Discussion

The current checklist study showed that the Kurdistan region had 10 scorpion species belonging to nine genera and four families: Buthidae, Hemiscorpidae, Iuridae and Scorpionidae. This diversity in the region's scorpion fauna indicates scorpions' preferred living habits and climate. Seven species (Fig. 4) of the 10 known in Kurdistan were collected in the current survey and three scorpion species were previously recorded in Kurdistan but not in this study: *B. tadmorensis*, *H. mesopotamicus*, and *C. anlasi* (12, 15–16). The Buthidae family had the highest frequency of seven species, with a single species for each of the other families. The highest number of scorpion species in this checklist was reported from Erbil province, with 9 species, followed by 6 different species in each of Duhok and Sulaymaniyah provinces. When compared to a recently published checklist of Iraq scorpions, the species richness and diversity rose by four scorpion species in each of Erbil and Sulaymaniyah, and one scorpion species in Duhok (1, 12). So, following Baghdad Province, which had 10 species, Erbil Province has the second greatest number of scorpion species variety in Iraq, followed by Diyala Province with 7 species, while the scorpion numbers recorded in the other fifteen provinces range from 0 to 6 species (1).

The geographical distribution checklist of scorpion species identified in the Kurdistan Region is shown in table 4 and figure 5 based on the 32 districts of the Kurdistan Region. The most abundant species, in terms of both species and distribution, was *H. sauley*, which was found in sixteen distinct districts across Kurdistan's three provinces. It was collected for the first time in four districts (two in Erbil and two in Sulaymaniyah), and it had previously been reported in 12 districts (11–12). In the Iraq scorpion checklist, Kachel and his colleagues (1) reported *H. sauley* in seven provinces of Iraq from three different geographical

regions of the country (MR= Mountainous and highland region (17), UR= Undulated and hilly region, DR= Desert region).

Androctonus crassicauda, one of Iraq's most dangerous scorpion species, was the second most widely distributed species in Kurdistan and the first in Iraq. The distribution of *A. crassicauda* in Kurdistan has been documented in thirteen districts, two of which are new. *Androctonus* species can adapt to a wide range of environmental conditions (18). According to the most recent Iraq scorpion checklist (1), *A. crassicauda* has been found in 14 provinces across the country, in all four geographical conditions (MR, UR, DR, AR= alluvial region). Several incidences of mortality from this species' stings have been documented in Iran's southern provinces of Hormozgan and Khuzestan (19–20).

Orthochirus fomichevi and *C. matthiesseni* have been found in 8 and 7 districts, respectively, in Kurdistan's three provinces. *Compsobothus matthiesseni* has been found in three different geographical conditions in Iraq (MR, UR, AR regions), while *O. fomichevi* has only been found in the MR region (1). Other Buthidae species' distribution were restricted to specific provinces. *M. mesopotamicus* and *B. tadmorensis* were only found in Erbil Province districts (12), while *H. mesopotamicus* was only recorded previously in Duhok province's Zakho District (15). In Iraq, the distribution of *Razianus zarudnyi* was also limited to the province of Baghdad (21).

The Hemiscorpidae family was the second to be detected in the Kurdistan Region. The only species of this family found in Kurdistan was *H. lepturus*, which was found in three districts: one in Erbil and two in Sulaymaniyah Province. *Hemiscorpis lepturus* is the most dangerous scorpion species, its envenomation causing severe complications and the main cause of death in Khuzestan Province in Iran (22–24). The key feature for identifying

this species was its small, thin stings. People's and health-care workers' lack of knowledge about this scorpion species can be hazardous to residents in their area (18).

Other non-medically important scorpion families found in Kurdistan are the Iuridae and Scorpionidae, each of which has one species, *C. anlasi* and *S. kruglovi*, respectively. Because both species' venoms are weak, they must rely on their powerful chelicerae to capture prey. *Calchas anlasi*'s distribution is limited to Turkey, with a solitary occurrence in the Kurdistan District of Soran, it requires further verification in Iraq (16). While *S. kruglovi* has a greater geographic range, it has been reported in all of Iraq's neighbouring countries except Turkey (25). In Iraq, it has been reported from six provinces from all four geographical conditions (1, 26). In the current study, *S. kruglovi* was shown to be the second most common and third most distributed in 13 districts across Kurdistan's three provinces.

The current study's epidemiological data in the Kurdistan Region revealed that the number of scorpion stings was lower in the year 2020 than in 2019. The current study's findings over a two-year period are slightly lower than earlier studies conducted in Kurdistan (9), which might be due to Covid-19's restriction laws or people's fear of visiting hospitals to receive sting treatment.

According to the data, men (55.8%) are more likely than women to be stung (44.2%). This conclusion is consistent with findings from India (27) and Argentina (28). In contrast, prior research in Iran (18, 29) found that the number of female patients presenting with scorpion stings was higher than the number of male patients. Overall, scorpion sting epidemiology is related to the victim's gender, study year, and study area. However, cultural factors such as gender disparities in behaviour may be considered.

Our findings revealed that in Kurdistan, annual epidemiological determinants of scorpion stings follow a similar trend. In the summer, the highest rate of scorpion sting cases was re-

ported. The current study's findings are consistent with those of prior research conducted in Iraq's Kurdistan (7, 10) and Iran (30, 31). According to this data, scorpion stings are most common during the hotter months of the year (May to September). As the temperature rises, scorpion activity rises, and their contact with humans increases the number of stings (32).

According to our findings, scorpion stings were most common in people aged 15 to 49 years old, followed by the age group of 4 to 14 years. This finding is consistent with findings from a previous study in the Kurdistan Region (9, 12). This age group has been identified as being at high risk in related studies, which could be due to outdoor work and activity outside the home. According to an Iranian study, scorpion stings occur most frequently among young people aged 15 to 24 years old (33). Likewise, scorpion stings are more common in people aged 20 to 29 in in the northeast region of Brazil (34).

Conclusion

According to the latest research, Scorpionism is a severe health problem in Iraq's Kurdistan Region, impacting people of all ages and genders, as well as many stung patients. However, because Kurdish society and public health agencies are unaware of the problem and potentially deadly scorpion species, more information on scorpion diversity and sting prevention techniques should be provided.

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Conflict of interest statement

The authors declare not to have conflicts of interest.

Ethical considerations

Not applicable.

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