Scorpion Fauna and Scorpionism in Zakho Province of Northern Iraq

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Abstract: Information regarding scorpion diversity and their envenoming within Iraq in general, and the Northern Iraq in particular, is limited. The number and distribution of scorpion sting cases and some details of the scorpion fauna of Zakho province were reported for the first time in this study. Overall, 2675 scorpion sting cases were reported between 2008 and 2017 consisting of 1362 male victims (51%) and 1313 female (49%). The highest percentage of victims was between 15 and 49 years old and accounted for 59% of the overall incidence. The highest incidence of scorpion sting cases occurred in the summer, particularly in July when 537 cases were reported. In total, 85 scorpions belonging to two families (Scorpionidae and Buthidae) were captured in the present study. Of the collected samples, Scorpio maurus 47 (55%) was the most abundant followed by Hottentotta saulcyi 28 (33%), and Androctonus crassicauda 10 (12%).

Keywords: Scorpion diversity, Scorpio maurus, Hottentotta saulcyi, Androctonus crassicauda.

Kuzeý Irák Zakho Ili Akrep Faunası ve Skorpionizmi

Öz: Irak genelinde ve Kuzeý Irak özellikle akrep çeşitliği ve akrep zehiri ile ilgili bilgiler sınırlıdır. Akrep sokması vakalarının dağılımı ve sayısı ile ilgili bilgiler ayrıca Zakho bölgesinde akrep faunası ile ilgili bazı ayrıntılar ilk kez bu çalışmada değerlendirilmiştir. Genel olarak, 2008-2017 yılları arasında kurbanların 1362’si erkek (%51) ve 1313’ü kadın (%49) olmak üzere 2675 akrep sokması vakası bildirilmiştir. Kurbanların en yüksek oranını 15 ile 49 yaşları arasında olduğu ve genel insidansın % 59’u oluşturduğu tespit edildimiştir. En yüksek akrep sokması vakaları yaz aylarında, özellikle de 537 vakânın rapor edildiği Temmuz ayında meydana gelmiştir. Toplamda, iki aileye (Scorpionidae ve Buthidae) ait 85 akrep tespit edilmiştir. Toplanılan örneklerden en çok Scorpio maurus 47 (%55)’a rastlanmış olup, bunu Hottentotta saulcyi 28 (%33) ve Androctonus crassicauda 10 (%12) izlenmiştir.

Anahtar kelimeler: Akrep çeşitliliği, Scorpio maurus, Hottentotta saulcyi, Androctonus crassicauda.

1. Introduction

The scorpion sting is considered a major public health problem in undeveloped countries in tropical and semi-tropical regions (Özkan, Çiftçi, & Karaer, 2011). The venoms of 30 scorpion species among 2432 known are considered potentially hazardous to humans (Prendini, & Wheeler, 2005; Rein, 2017). These hazardous venoms contain many peptides that are neurotoxic (Hossein, Farhad, Abbas, & Amir, 2012). They have the ability to paralyze or kill. Other peptides with capacities to damage cells or modulate signal transduction are also present (Ernesto, & Lourival, 2015). Each year, large numbers of scorpion stings are recorded, particularly in Mexico, Colombia, and Iran with approximately 1.2 million stings reported resulting in 3250 deaths (Kavous, Ali, Amir, Amin, & Farzad, 2017; Bawaskar, & Bawaskar, 2012). Scorpion envenoming has the most severe effects on children, resulting in neurological, respiratory, and cardiac abnormalities, sometimes resulting in fatalities (Altunkaynak, Ertekin, & Alp, 2002; Boşnak et al., 2009).

Epidemiological studies on scorpion sting and diversity have been conducted in several countries in the Middle East such as Turkey (Özkan, Adıgüzel, YakşıTir, Cesaretti, Orman, & Karaer, 2006), Saudi Arabia (Jarrar, & Al-Rawaily, 2008), and Iran (Dehghani, & Fathi, 2012). Recent unofficial reports from Iraqi Ministry of Health indicate many cases of scorpion envenoming, which vary according to region, climate, and environmental conditions. Few studies have addressed scorpion diversity and the precise numbers of cases. In this survey, we reported the diversity of scorpion species in the city of Zakho with the aim of improving our knowledge of which species cause human envenoming. We also assessed the number of cases. This work may ultimately lead to an increase in the local awareness of scorpion species present, thereby reducing the incidence of scorpion stings. It also paves the way for future studies on venom components in order to better understand their actions and to discover treatments.

The scorpion fauna of Zakho has not been searched in detail. Only Hottentotta mesopotamicus record was given by Lourenço and Qi (2007). Besides Orthochirus fonichevi and Scorpio maurus kruglov, records were given from neighboring province Dohuk by Kovarik, Yaqmur, Fet and Hussen (2019) and Pringle (1960), respectively.

2. Material and Methods

The study area, Zakho, is a mountain city in the Northern region of Iraq which has borders with Turkey and Syria. Zakho is located at 37°30’N, 43°00’E (Fig. 1). In the first part of this study, we present data relating to the scorpion stings obtained from the medical records of Zakho patients from various health centers collected in Shabanke central hospitals in the city of Zakho during the 10-year period from 2008 to 2017.

In the second part of the study, we examine the
diversity of scorpion species collected from four different rural and urban regions around Zakho province (Betase, Tawke, Sehela, & Dashtamere) during the period from April to November 2018. On sunny days, scorpions can be found hidden under solid objects (wood, stone, and bricks). At night, a UV light source can be used to locate scorpions above ground (Zeina, 2016). Collected specimens were transferred to the Zoology Laboratory at the University of Zakho and individuals were maintained in small ventilated plastic boxes. Identifications were based on procedure described by Levy and Amitai (1980) and Kovarik (2007).

Figure 1. Maps showing the outline of (A) Iraq, (B) Duhok state, and (C) Zakho province.

3. Results

3.1. Epidemiological data

A total of 2675 scorpion sting cases were dealt with by the Shabanke central hospitals of Zakho city during the 10-year period of the study from 2008-2017 (Fig. 2). This central hospital collects data of all scorpion stings cases in Zakho city. The highest numbers of cases were reported in 2017 and the lowest in 2008.

Scorpion stings were higher in summer (49% of all cases) with the next higher seasonal incidence in autumn (33%). The number and percentage of male and female patients stung by scorpions were 1362 (51%) and 1313 (49%), respectively. The monthly incidence of scorpion sting cases by genders are summarized in Table 1.

Most of the scorpion sting victims were between ages of 15 and 49, accounting for 59% of all cases (Table 2). Those over 50 and less than 1 made up 9% and 1% of the cases, respectively.

Table 3. Classification of scorpions collected in the city of Zakho.

| Phylum       | Subphylum | Class       | Order      | Family (1) | Family (2) | Color | Number collected | % total collected |
|--------------|-----------|-------------|------------|------------|------------|-------|------------------|-------------------|
| Arthropod    | Chelicerata| Arachnida   | Scorpiones | Scorpionida | Buthidae   | Yellow| 47               | 55                |
|             |           |             |            | Scorpio     | Genus      |       |                  |                   |
|              |           |             |            | maurus      | Hottentotta | Yellow| 28               | 33                |
|              |           |             |            |             | saulcyi    |       |                  |                   |
|              |           |             |            |             | Androctonus | Yellow|                 |                   |
|              |           |             |            |             | crassicauda|       |                  |                   |
Scorpio maurus (Linnaeus, 1758) (Fig. 3A)

Comments: Scorpio maurus has yellowish brown appearance with dark brown color in mesosoma and is considered non-hazardous to humans. Among the collected samples, S. maurus is accounted for 47 (55%) scorpions and was the most frequently recorded species due to their preference to inhabit at high altitude regions ranging between 900m to 1200m (Salah Eddine, Youcef, & Haroun, 2012).

Distribution: Taxonomically, 19 subspecies of S. maurus have been accepted. They are distributed widely in two continents: Asia (Iraq, Iran, Kuwait, Israel, Jordan, Qatar, Lebanon, Turkey, Saudi Arabia, Syria, Yemen) and Africa (Morocco, Egypt (Sinai), Senegal, Tunisia, Algeria, Congo, Egypt (Sinai), Libya, Mauritania) (Dimitris, Iasmi, & Dimitris et al., 2008). The triangular sternum together with the presence of accessory spines on telson is the main prominent characteristic of this family (Zuhair, & El-Oran, 2009).

Androctonus crassicauda (Olivier, 1807) (Fig. 3C)

Comments: Androctonus crassicauda is black in color and has a wide, thickly segmented tail. In this survey, only 10 individuals of this species were captured. A. crassicauda generally prefers low altitude localities and has been collected previously in the middle and southern part of Iraq (Zeina, & Sabah, 2016). This species inhabits under cemetery stones, inside sand and soil in plain (Mulood et al., 2017). However, in this study, it was found in a higher place at altitude range from 600m to 900m, Zakho city, northern part of Iraq. It is one of the widely distributed species in Iraq.

Distribution: A. crassicauda is distributed in countries such as Azerbaijan, United Arab Emirates, Libya, Turkey, Bahrain, Armenia, Egypt, Iran, Israel, Jordan, Kuwait, Oman, Saudi Arabia, Syria, and Yemen (Fet & Lowe, 2000; Dimitris et al., 2008).

Distribution in Iraq: A. crassicauda is widely spread in Iraq. A study by Pringle (1960) reported it for the first time in Iraqi cities of Baquba, Aqra, Basra, Mosul, and Hilla. Then, it was recorded from Babel, Najaf (Haider, & Mohammad, 2010), Baghdad, Diyala, Salah al-Din, Qadissiya, Wasit, and Thi-Qar provinces (Zeina, & Sabah, 2016).

Examined materials: Iraq, Zakho Prov., Sehela District, 690 m, 1♀ 1♂, Derabon Village, 4 July 2018, 37°08′5″N, 42°42′6″E. 1♀, Shenawa Village, 18 August 2018, 37°11′8″N, 42°51′9″E.

Hottentotta saulcyi (Simon, 1880) (Fig. 3B)

Comments: Hottentotta saulcyi are yellow in color with a black tail end. 28 H. saulcyi were captured accounting for 33% of all scorpions captured. H. saulcyi is distributed widely in northern region of Iraq and inhabits in calcareous soil. The specimens were collected in a mountain region at elevation between 650m to 1000 m. Previous studies in Turkey and Iran recorded H. saulcyi.
species at elevation between 1100m to 2000m, respectively (Yağmur, Koç, & Yağcı, 2008b; Moradi, Yağmur, Gharakhloo, & Ahmadi, 2015).

Distribution: *H. saulcyi* has only been known in Asian countries like Iraq, Turkey, Iran, Afghanistan, and Syria (Dimitri et al., 2008). This species in Turkey was recorded from the southeastern part of the country (Yağmur et al., 2008b), while according to Kovafik (2007) *H. saulcyi* records for Syria must be considered dubious.

Distribution in Iraq: *H. saulcyi* is known in Iraq from the city of Mosul (Lourenço, & Qi, 2007) and Kirkuk (Brawa, Kasim, Khalil, & Kamal, 2018).

Examined materials: Iraq, Zakho Prov., Betase District, 800 m, 1♀ 3♂, Armesht Village, 26 June 2018, 37°04’9”N, 42°80’0”E. 2♀ 1♂, Kolkan Village, 6 July 2018, 37°06’7”N, 42°71’7”E. 2♀, Dolla Village, 22 July 2018, 37°05’3”N, 42°77’1”E. 1♀ 3♂, Betas Village, 2 August 2018, 37°07’0”N, 42°73’0”E. Dashtmene District, 790 m, 1♀ 2♂, Kane Rahal Village, 19 June 2018, 37°09’5”N, 42°65’2”E. 2♂ 3♀, Hassan Ava Village, 8 August 2018, 37°08’5”N, 42°66’0”E. Tawke District, 740 m, 1♂, Wade Lawla Village, 3 July 2018, 37°14’3”N, 42°77’4”E. 1♀ 2♂, Terk Hassan Village, 20 July 2018, 37°12’8”N, 42°80’1”E. 1♀ 0♂, Omer Axa Village, 2 September 2018, 37°15’1”N, 42°78’6”E. Sehela District, 690 m, 0♀ 1♂, Derabon Village, 4 July 2018, 37°08’5”N, 42°42’6”E. 0♀ 1♂, Shenawa Village, 18 August 2018, 37°11’8”N, 42°51’5”E.

4. Discussion

Understanding local scorpion diversity is the starting point in identifying the main species responsible for envenomation. Over the previous decade, Scorpionism has become a common public health threat in central and southern America, Africa, the Middle East, and South and Central Asia (Masoud & Hasan, 2017) and particularly in the countries neighboring Northern Iraq, such as Turkey (Ozkan et al., 2006) and Iran (Dehghani, & Fathi, 2012). Northern Iraq is a mountainous region. It is likely that scorpion diversity in this region is greater than currently known as little work has been undertaken to date. Life in this predominantly rural area of Northern Iraq is strongly dependent on agriculture, and this results in increased risk of contact with scorpions, thereby increasing the incidence of stings among agricultural workers and children particularly when removing trees, wood, and stones (Zuhair, Renad, Nour, & Rihan, 2017).

This is the first report on scorpion envenomation and diversity in Zakho province spanning the 10-year period from 2008 to 2017. The presented data show that men (51%) and women (49%) are equally likely to suffer stings. This finding is in agreement with the finding from work undertaken in Saudi Arabia (Jarrar & Al-Rowaily, 2008). On the other hand, our result is in contrast with previous studies conducted in Iran (Khodadadi, 2013). The findings of the present investigation are in agreement with a previous investigation carried out in Iran by Esmaeil, Mulood, Shahla, Abedin, Nahid, Eslam, and Alireza (2018), while in other studies around the world different death rates have been reported after scorpion stings. This is presumably because of the species of scorpion responsible and the availability of medical care and anti-venom (El Hidain, Touloum, & Boumezzough, 2015; Araújo, Tavares, Marques, Vieira, & Leite, 2017).

The scorpion activity is highly temperature-dependent. Therefore, the highest rate of scorpion stings are reported in summer (Dehghani & Fathi, 2012; Kassiri et al., 2013). The findings of the present investigation are in agreement with the previous studies conducted in Iran (Esmaeil et al., 2018) which reports that scorpion stings are recorded during the hot period of the year (May to September), with the highest proportion of stings, 20% occurring in July (Esmaeil et al., 2018). The high sting incidences recorded in 2009 and after 2014 are likely attributed to the large increase in the numbers of displaced people to Zakho providence and their poor living standards.

Our study showed that more than half of all the scorpion stings (59%) occurred between the age range 15-49 years. In the related studies, this age range has been identified as high risk that may be due to outdoor working and activity outside the home. Kassiri et al., (2014) from Iran showed that young people aged between 15-24 years have the highest scorpion sting incidence. Similarly, the age group 20-29 years has more scorpion sting according to Barros, Pasquino, Peixoto, Targino, de Sousa, and Leite (2014). A study by Talebian and Dorooodgar (2006) showed that the highest numbers of scorpion stings occurred among the children aged less than 10 years.

The data from the second section of the present survey showed limited scorpion diversity among species collected in Zakho region, with two families and at least three species identified. To date, several scorpion species belonging to many families have been recorded in Iraq (Scorpions in Iraq, 2007), a few of them are medically important. In the current survey, *Androctonus crassicauda* (Man-Killer fat-tailed scorpion), one of the medically important venomous species, was found and this species has also been reported from neighboring countries such as Saudi Arabia, Jordan, Iran, Syria, and Turkey (Yagmur, Yalcin, & Calisir, 2008a; Karatas & Colak, 2005). According to the previous surveys in Iran, *A. crassicauda* was responsible for 28% of the scorpion stings (Vazirianzadeh, & Salahshoor, 2015). Their stings are painful to patients and sometime cause death among infants (Khodadadi, 2013). The findings of the present investigation are in agreement with the finding from work undertaken in Saudi Arabia (Jarrar & Al-Rowaily, 2008). On the other hand, our result is in contrast with previous studies conducted in Iran (Khodadadi, 2013). The findings of the present investigation are in agreement with the previous investigations carried out in Iran by Esmaeil, Mulood, Shahla, Abedin, Nahid, Eslam, and Alireza (2018), while in other studies around the world different death rates have been reported after scorpion stings. This is presumably because of the species of scorpion responsible and the availability of medical care and anti-venom (El Hidain, Touloum, & Boumezzough, 2015; Araújo, Tavares, Marques, Vieira, & Leite, 2017).

Several bioactive peptides have been identified and characterized previously from scorpion crude venom by
using high performance liquid chromatography. These peptides are structurally categorized as non-disulfide and disulfide bridge-containing peptides (Almaayyah & Albals, 2014; Santibanez-Lopez & Possani, 2015). The majority of the non-disulfide peptides act as antimicrobials by disrupting cell membrane structures (Harrison, Abdel-Rahman, Miller, & Strong, 2014). On the other hand, numerous disulfide bridge-containing peptides selectively interact with particular ion channels (Na\(^+\), K\(^+\), Cl\(^-\) and Ca\(^{2+}\)) in the nervous system (Zhijian, Feng, Yingliang, Xin, & Wenxin, 2006; Housley, Liddell, & Jennings, 2017).

The most abundant scorpion (55% of all collected) is S. maurus, belonging to Scorpioidae family; though, it is not considered medically important. Worldwide this family includes 265 scorpion species belonging to 17 genera and they are found on several continents including Oceania (Australia), Africa, Asia, and America.

5. Conclusion

It is important to provide information for Zakho province residents with regard to scorpion subtype diversity and prevention strategies toward Scorpionism. A. crassicauda is a dangerous, medically important scorpion and is present in the study area, along with two other scorpions, H. saulcyi and S. maurus. Further studies are required on the scorpion fauna of the Northern Iraq including various aspects such as ecology, distribution, morphology, abundance, biogeographic and association between scorpion species, and their clinical signs and symptoms. This region is not well studied in terms of scorpion species diversity. Therefore, the data presented in this study serve as novel knowledge regarding scorpion fauna of the Northern Iraq and the seasonal, age, and gender distribution of envenoming.

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