

Investigation of Scorpion Stings in Nineveh Province, Northern Iraq, for the Period 2022-2023

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Abstract: Scorpion stings are a challenging health problem in many hot and dry regions worldwide, including Iraq. Although studies on the epidemiology of scorpions in Iraq are rare, the northern areas, especially Nineveh province, have not witnessed comprehensive epidemiological studies related to these poisonous arachnids. This research is the first study in this region, providing detailed information on scorpion stings in Nineveh province during 2022 and 2023. The current study included 327 cases of scorpion stings recorded during 2022 and 2023 in Nineveh province, northern Iraq. Of the recorded cases, 185 (57.56%) were males and 142 (43.42%) were females. The data showed that the age group most exposed to scorpion stings is people aged between 15-49 years, as this group represented 70.34% of the total recorded cases, indicating that the socially and economically active group is most exposed to the risks associated with scorpions. It was also determined that the highest number of scorpion stings occurred in the summer months, highlighting the relationship between high temperatures and increased scorpion activity. These results indicate the need to take preventive and advisory measures directed at the most vulnerable groups, especially during the hot months.

Keywords: Epidemiology, scorpionism, stings, Mosul, venom.

2022-2023 Döneminde Kuzey Irak Ninova İli'ndeki Akrep Sokmalarının Araştırılması

Öz: Akrep sokmaları, Irak da dahil olmak üzere dünya çapında birçok sıcak ve kuru bölgede önemli bir sağlık sorunudur. Irak'taki akreplerin epidemiyolojisi üzerine yapılan çalışmalar nadir olmasına rağmen, özellikle kuzey bölgeleri ve özellikle de Ninova vilayeti, bu zehirli araknitler ile ilgili kapsamlı epidemiyolojik çalışmalar yapılmamıştır. Bu araştırma, bu bölgede yapılan ilk çalışma olup, 2022 ve 2023 yıllarında Ninova vilayetinde meydana gelen akrep sokmaları hakkında ayrıntılı bilgiler sunmaktadır. Mevcut çalışma, 2022 ve 2023 yıllarında Irak'ın kuzeyindeki Ninova vilayetinde kaydedilen 327 akrep sokması vakasını içermektedir. Kayıtlı vakaların 185'i (%57.56) erkek, 142'si (%43.42) ise kadındır. Veriler, akrep sokmalarına en çok maruz kalan yaş grubunun 15-49 yaş aralığında olduğunu ve bu grubun toplam kayıtlı vakaların %70.34'ünü oluşturduğunu göstermektedir. Bu durum, sosyal ve ekonomik olarak aktif grubun akreplerle ilişkili risklere en çok maruz kalan kesim olduğunu göstermektedir. Ayrıca, en fazla akrep sokması vakasının yaz aylarında meydana geldiği belirlenmiş olup, yüksek sıcaklıklar ile akrep aktivitesi arasındaki ilişkiyi ortaya koymaktadır. Bu sonuçlar, özellikle sıcak aylarda en savunmasız gruplara yönelik önleyici ve bilgilendirici tedbirlerin alınması gerektiğini göstermektedir.

Anahtar kelimeler: Epidemiyoloji, akrep sokmaları, Musul, zehir.

1. Introduction

Scorpions are venomous arthropods belonging to the arachnid order and are adapted to survive in a wide range of habitats such as tropical and temperate rainforests as well as grasslands, savannas, caves, and even snow-capped mountains (Leeming, 2003).

Scorpions are known for their stings and venom; humans often consider them dangerous and even deadly creatures. More than 1.2 million scorpion stings occur annually worldwide, mainly in tropical and subtropical regions (Ebrahimi et al., 2017). While all scorpion species possess venom, their level of danger is often exaggerated and some species can be dangerous to certain groups such as children, the elderly, and individuals with weak immune systems. However, most of the 1.270 to 1.300 known scorpion species worldwide are of no medical significance (Ren & West, 2024). There are 50 species of scorpions with venom dangerous to humans and the Buthidae family of scorpions is considered the most toxic group (Ali & Ali, 2015). In typical cases, a scorpion sting

results in pain, numbness, and swelling, while in severe cases, a scorpion sting may lead to severe pain, to serious illness or even death depending on the degree of toxicity of the venom (James et al., 2006). Nonetheless, scorpion stings are responsible for around 3.000 deaths globally each year (Chippaux, 2012). Worldwide, numerous epidemiological studies have been conducted on scorpion stings, particularly in Middle Eastern countries, including Iraq's neighboring countries such as Turkey (Ozkan et al., 2006), Iran (Dehghani & Fathi, 2012), and Saudi Arabia (Jarrar & Al-Rowaily, 2008). Locally, there are limited epidemiological studies on scorpion stings in Iraq, including Kachel (2020) study on scorpion fauna and scorpionism in a district in Duhok province, northern Iraq, followed by Hussein and Ahmed (2021), which addressed the epidemiological and clinical aspects of scorpion stings in the Kurdish region. Nineveh province is one of the most prominent provinces in northern Iraq as it enjoys a unique geographical location that connects diverse natural environments from the agricultural plains in the center to the mountainous regions in the north. The province's hot

and dry climate also contributes to the reproduction of many living organisms, including scorpions. Although scorpion stings represent a major health challenge in Iraq, epidemiological studies on this phenomenon in Nineveh, especially in rural and northern regions, are still rare. Despite the presence of six known scorpion species in this province, five of which belong to the Buthidae family and one to the Scorpionidae family (Kachel et al., 2021), research on scorpion epidemiology remains insufficient in most regions of Iraq, including Nineveh province, where epidemiological studies are still largely lacking. Accordingly, this study aims to provide information and data on the epidemiology of scorpion stings in this province during a specific period. This study is part of a master's thesis by the first author. It is the first of its kind in this region, providing detailed information about cases of scorpion stings in Nineveh province during 2022 and 2023.

2. Material and Method

2.1. Study Area

Nineveh Province is located in the northwestern part of Iraq at the following geographical coordinates: $36^{\circ}13'46.47''$ N, $42^{\circ}14'10.48''$ E (Fig. 1), bordered to the north by Dohuk Province, to the south by Salah al-Din Province, to the east by Kirkuk and Erbil Provinces, and the west by the Syrian Arab Republic. The Tigris River runs through the governorate from north to south, dividing it into two almost equal parts: eastern and western, known locally as the left and right coast. The province's topography is characterized by its geographical diversity, as it includes three main regions: mountainous areas in the north, hills in the center, and extended plateaus with winding terrain in the south.



Figure 1. Map of Iraq showing the study area (Nineveh province).

2.2. Data collection and statistical analysis

The data for this study were collected from the medical records in five public hospitals in three districts along the right side of Mosul City, Nineveh Province, for the period between January 2022 and December 2023 (Table 1). The data collection focused on basic demographic information (e.g., age, gender, area of residence), with no exploration into clinical or therapeutic details. The data were statistically analyzed using SPSS (version 24) and descriptive analysis to summarize demographic data using frequencies and percentages, the t-test for the comparison of means between two independent groups and the ANOVA test for the comparison of means among more than two groups.

Table 1. Coordinates of the locations of hospitals from which data on scorpion stings were collected in Nineveh Governorate for the years 2022 and 2023.

Data Collection Site	Coordinates	
Al-Qayyarah General Hospital	$35^{\circ}48'14.38''$ N	$43^{\circ}17'36.41''$ E
Al-Jumhuri General Hospital	$36^{\circ}20'27.07''$ N	$43^{\circ}7'7.78''$ E
Mosul General Hospital	$36^{\circ}19'23.23''$ N	$43^{\circ}7'24.68''$ E
Tal Afar General Hospital	$36^{\circ}23'7.76''$ N	$42^{\circ}27'14.90''$ E
Al-Baaj Hospital	$36^{\circ}2'34.32''$ N	$41^{\circ}43'0.07''$ E

3. Results

A total of 327 scorpion sting cases were recorded by five public hospitals located on the right side of Nineveh province during the study period, with the highest number of scorpion stings recorded during the study period in 2023, amounting to 186 cases, while the lowest number of cases was 141 during 2022 (Table 2).

Table 2. Seasonal average of scorpion stings in Nineveh province for 2022 and 2023.

Year	Seasons				Total
	Spring	Summer	Autumn	Winter	
2022	24	76	39	2	141
2023	22	89	71	4	186
Total	46	165	110	6	327
Percentage %	14.06	50.45	33.63	1.83	

Seasonally, the highest number of scorpion stings was recorded during the summer during the study period, amounting to 165 cases (50%) of all recorded cases, followed by the fall season, with 110 cases (33%) of all recorded cases, the spring season recorded 46 cases (14%) of the total cases, while the lowest number of injuries was during the winter season, amounting to 6 cases (1.83) of the total cases (Fig. 2). Monthly, August recorded the highest number of scorpion stings with 79 cases (41 males, 38 females) and 24% of the total number of stings. February recorded the lowest number of scorpion stings with 3 cases (2 males, 1 female) and approximately 1% of the total number of stings (Table 3) (Fig. 3). Most cases of scorpion stings were in patients aged between 15 and 49 years, with 70% of all cases, most of them males (Table 4). While the rate of infection in the age group less than five years was 4% of all cases, most of them males, while no cases were recorded in the age group less than one year. By reviewing the notes recorded in the documents of the emergency department of the public hospitals from which the data for our current results were collected, it was noted that most of the recorded cases of scorpion stings belong to patients whose place of residence is rural rather than urban but the place of residence was not recorded in all the hospitals studied; thus, we were unable to refer to it in our results in the form of precise numbers.

Based on the available data, a comprehensive statistical analysis was conducted to understand the distribution of scorpion stings injuries. The descriptive analysis included calculating the arithmetic mean, median, and standard deviation of the number of stings. The results showed that the average number of stings in 2023 was higher than in 2022 (46.50 vs. 35.25), with a standard

deviation of 34.50 and 29.34, respectively. A t-test was used to compare the average number of stings between males and females, with the results showing no statistically significant difference (0.2834) t-test. In addition, an analysis of variance (ANOVA) was used to compare the average number of stings between different seasons, with the results showing a statistically significant difference of 0.0456. The total number of stings was calculated, with 327 injuries. Pearson's correlation coefficient was also used to measure the relationship between age and number of stings with results showing a strong positive correlation ($r = 0.85$).

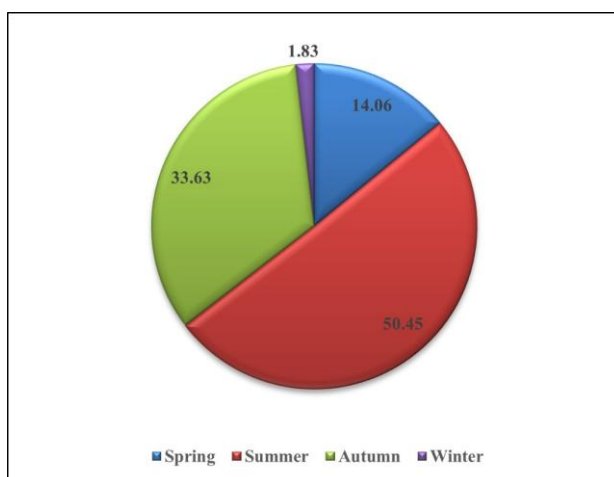


Figure 2. Percentages of the average number of scorpion stings by season in Nineveh province for 2022 and 2023.

Table 3. Monthly scorpion sting cases reported in Nineveh province for 2022 and 2023.

Age (Years)	Male	Female	Total	Percentage %
Less than 1	0	0	0	0
1 to 4	11	3	14	4.28
5 to 14	35	23	58	17.73
15 to 49	132	98	230	70.34
Over 50	7	18	25	7.65
Total	185	142	327	100

Table 4. Age distribution for scorpion stings in Nineveh province for 2022 and 2023.

Month	Male	Female	Total	Percentage %
January	3	1	4	1.22
February	2	1	3	1
March	5	3	8	2.44
April	2	5	7	2.14
May	16	15	31	9.48
June	14	9	23	7
July	36	23	59	18
August	41	38	79	24.15
September	30	19	49	14.98
October	22	18	40	12.24
November	13	7	20	6.12
December	1	3	4	1.23
Total	185	142	327	100

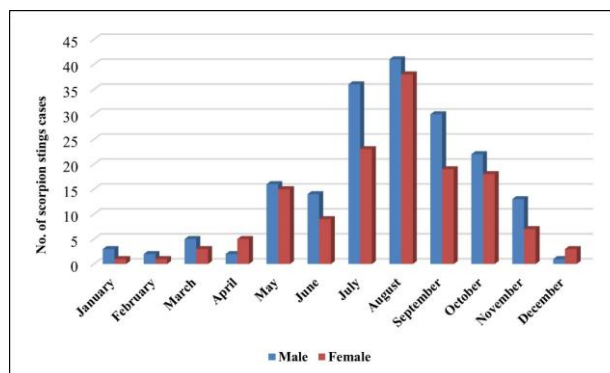


Figure 3. Monthly scorpion sting cases reported in Nineveh province for 2022 and 2023.

4. Discussion

Scorpionism represents a significant public health issue in various regions worldwide due to the high incidence and severity of envenomations, which are often challenging for healthcare systems to manage, or sometimes due to both factors simultaneously. Recent studies have identified seven regions at high risk of scorpionism: North Saharan Africa, Sahelian Africa, South Africa, the Near and Middle East, South India, Mexico, and southern Latin America east of the Andes (Chippaux & Goyffon, 2008). Scorpion stings are one of the most important health problems in Iraq, including the northern provinces, specifically Nineveh Province. The results of our current study showed that 327 cases of scorpion stings were recorded in public medical centers in this province during the two years of study (2022-2023). The highest number of cases of infection was during the summer, accounting for 50% of the total number of infections. This is consistent with the results of Hussen and Ahmed (2021), who studied the epidemiological and clinical aspects of scorpion stings in the Kurdish Region of Iraq, where they recorded the highest number of infections during the summer, accounting for 52.54%. It is also consistent with the results of Kachel (2020), who studied the epidemiology of scorpions in the city of Zakho in Dohuk Province, northern Iraq, where the highest number of infections was recorded during the summer months (July and August). Despite the limited number of scorpion stings recorded in the present study, as well as their geographical limitation, they affect approximately 2.5 billion people at risk (Chippaux & Goyffon, 2008). Summer in Nineveh province is characterized by significantly high temperatures, as daily temperatures may exceed 45 degrees Celsius in some areas. Scorpions are cold-blooded animals, which means that their temperature is greatly affected by the surrounding environment. In hot weather, scorpions are at their peak activity, as they emerge from their hiding places in search of food (usually small insects or rodents) and reproduce more. Scorpions also tend to seek shelter in dark, cool places during the hot hours of the day but they are more active at night, increasing the likelihood of being stung in the evening or late at night.

The results of the current study showed a significant discrepancy between scorpion stings in males (185, 56.57%) and females (142, 43.42%) among patients whose information was recorded in public hospitals during the study period. This is in complete agreement with the studies of Kachel (2020) and Hussen and Ahmed (2021),

which were conducted in some areas of the Kurdish Region of Iraq. However, these results are not consistent with Furtado et al. (2016) who found that the highest incidence of scorpion stings occurred in females in the state of Serra, northeastern Brazil. Also, in Ramhormoz, southwestern Iran, Karami et al. (2013) indicated that the number of scorpion stings in females was higher than in males.

Studying the age distribution of scorpion stings in patients who have been exposed is of great importance in understanding and analyzing the epidemiological consequences of scorpions in a region through identifying the most vulnerable groups, analyzing the severity of poisoning, improving treatment strategies, drawing up preventive policies, and studying the epidemiological factors more accurately. This in turn contributes to improving medical planning and reducing the number of injuries and deaths resulting from scorpion stings. The results of our study showed that the highest number of scorpion stings was in patients aged between 15-49 years, which is completely consistent with the results of Kachel (2020). It does not agree with the results of Furtado et al. (2016), who stated that most of the victims of scorpion stings are women aged between 20-29 years. The observations recorded in the results of the current study showed that most cases of scorpion stings were due to patients living in the countryside, which is consistent with what Celis et al. (2007) stated that the risk of injury is certainly higher in rural areas than in cities.

The results of the statistical analysis of the distribution of scorpion sting injuries showed that the average number of stings in 2023 was higher than in 2022, with a large standard deviation indicating a significant variation in the number of stings between time periods. This variation could be attributed to environmental factors or changes in scorpion activity. On the other hand, the t-test showed no statistically significant difference between the average number of stings in males and females, indicating that gender does not play a major role in increasing the likelihood of scorpion stings in this sample. Analysis of variance (ANOVA) showed a statistically significant difference between the average number of stings in different seasons, confirming that seasons play an important role in determining infection rates. In addition, Pearson's correlation coefficient showed a strong positive association between age and the number of stings, with the age group from 15 to 49 years being the most affected.

5. Conclusion

The study results indicate that scorpion stings are a significant health problem in Nineveh Governorate, northern Iraq, with 327 stings recorded during 2022 and 2023. The study showed that the age group most susceptible to scorpion stings is the 15-49 age group, which represents 70.34% of cases, reflecting the greater exposure of socially and economically active individuals at risk. It was also found that males constitute the largest proportion of those infected (57.56%), which may reflect their greater exposure due to outdoor activities in rural areas. Moreover, the study revealed a clear association between high temperatures in the summer months and increased stings, which calls for taking special preventive measures during these hot periods. Given the limited epidemiological studies in Iraq in general, this study

stands out as a fundamental contribution to documenting the phenomenon of scorpion stings in the Nineveh province, which calls for further ongoing research in this area to ensure improved prevention and treatment strategies. Therefore, the importance of directing awareness campaigns targeting the most vulnerable groups is highlighted, in addition to the need to provide appropriate preventive measures to reduce the health risks associated with this phenomenon.

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