

**Original Article**

Epidemiological Aspect of Scorpion Sting in Behbahan, Iran, During 2007-2018

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Abstract**Introduction**

Scorpion sting a public health problem in Iran, especially in Khuzestan Province, that can threaten human health. Investigating demographic and epidemiologic factors affecting scorpion stings is vital in preventing this issue. This study aimed to determine the epidemiology of scorpion sting patients referred to the clinical centers of Behbahan, Khuzestan Province, Iran.

Methods

This retrospective study was conducted on all stung people referred to clinical centers in Behbahan County from 2007 to 2018. The epidemiology of patients and demographic data were collected using a checklist and analyzed using SPSS version 16.

Results

Our results showed that 19600 scorpion stings (in 12 years) were recorded in Behbahan County, including 10315 males (53%) and 9285 females (47%). Their average age of the patients was 29.6 years, and 83% of the stings occurred at home. Sixty percent of scorpion stings happened between 6:00 pm and 6:00 am. The least and most frequent cases of sting were people aged 55-64 and 25-34 years, respectively. Scorpion stings mainly (75.3%) occurred during the warm seasons, such as spring and summer (n=14760), and 61.4% (n=12032) of the patients residing in rural areas and 38.6% (n=7568) residing in urban areas. Hands were the most prevalent sting sites, with a frequency rate of 39.4%. The average incidence rate of scorpion stings was estimated at 840.2 individuals per 100,000. Two deaths occurred due to scorpion stings during the study period (12 years).

Conclusion

The high incidence rate of scorpion stings observed in Behbahan supports the need for new prevention measures and policies to reduce the incidence, prevalence, morbidity, and mortality of such stings and the high cost of their treatment.

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1. Introduction

One of the most common health and medical problems in arid and semi-arid regions, especially in developing countries, is insect bites, particularly scorpions. Scorpion stings cause severe problems for humans and animals and even cause death. Every year, many reports of scorpion stings in different parts of the world, mostly from areas with hot and tropical climates, especially in the

Middle East, Africa, America, Mexico, India, and Brazil. It is estimated that about 1.2 billion people in the world live in areas where there is a risk of scorpion stings, and 1.2 million people are bitten by scorpions annually, of which about 2% lead to death. Considering the climatic conditions of Iran in most parts of the country, especially the southern and central regions such as Khuzestan,

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Kerman, South Khorasan, and Bushehr, scorpion stings are a severe problem. Despite the many cases of scorpion stings and the fundamental importance of the issue, this topic has received less attention [1].

Iran ranks third in the world regarding scorpion stings, with 50,000 to 60,000 bites per year after Mexico and Colombia, most of which occur in the Khuzestan Province. Every year, 800 to 2000 people -some sources report up to 5000 people in the world- die due to scorpion stings [2]. Despite significant advances in medical knowledge, the treatment of scorpion stings is still considered unsafe due to its various complications. This is because there is insufficient information about the function of scorpion venoms in different organs and how the clinical symptoms of scorpion stings occur [3].

After snake bites, scorpion stings are the most important causes of poisoning because their clinical symptoms in victims vary from mild skin reactions to neurological, respiratory, and cardiovascular reactions, depending on several factors, including the scorpion species. However, in most cases, they lead to mild skin symptoms that can be relieved by pain killers, antihistamines, and some supportive measures[4].

Scorpions are a phylum of the Arthropoda, the largest phylum of animals with more than 1500 genera, and are considered from the Araneae order [5]. Scorpion bites are a life-threatening emergency and are one of the most critical health challenges in tropical and subtropical regions [6].

Previous studies have shown the high prevalence of scorpion venom and its mortality in developing countries compared to developed countries, indicating a lack of adequate health facilities, low socio-economic background, and insufficient reliable information about the disease in poor areas [7]. Annually, more than 42,500 scorpion bites have been reported in Iran, of which, despite appropriate treatment, nearly 20 people

have died. Many have been hospitalized with irreversible cardiovascular and renal disorders in intensive care units [8]. Although medical science has advanced in recent decades, scorpion venom has been overlooked for two reasons: its unknown prevalence and the high number of low-income victims. Other factors that may increase its prevalence include poor resource management policies and treatment costs, which contribute to higher mortality and related injuries [9].

Behbahan county is located in the southeast of Khuzestan Province, with a population of 220,000. Due to the hot climate of this region, the bites caused by insects, especially scorpion stings, are one of the major problems [21]. During the hot months of the year, we face scorpion sting cases twenty-four hours a week in the emergency departments of hospitals and boarding clinics. This has caused many problems for the people and the organizational systems, and sometimes these short comings have led to people's death, dismissal, and designation. Therefore, the current retrospective and cross-sectional descriptive study aimed to obtain epidemiological information to determine the incidence and mortality rate of scorpion stings and their determining factors to provide an effective solution for reducing human-scorpion exposure. In addition, this research provided a practical and environmentally friendly solution to prevent the growth of scorpion stings, relieve pain and suffering in people caused by scorpion stings, and prevent exorbitant treatment costs.

2. Methods

This is a retrospective study about people stung by scorpions referred to scorpion sting treatment centers in Behbahan County from March 2007 to March 2018. The demographic information, including age, sex, bitten organ (hand, head, foot, and trunk), location (city, village), scorpion color (yellow, black, and unknown), history of being bitten, history of getting a serum (yes, no), bite



Table 1. Incidence rateand mortalityof scorpion stings during 2007-2018 in Behbahan County

Year	Population	Number of scorpion bites	Incidence rate	Number of scorpion sting deaths
2007	187650	1660	884.6	0
2008	189583	1889	996.4	1
2009	193291	1718	888.8	0
2010	191673	1563	815.5	0
2011	196062	1707	870.6	0
2012	195908	1766	901.4	0
2013	196210	1507	768.1	1
2014	195513	1647	842.4	0
2015	196940	1638	831.7	0
2016	194701	1579	811.0	0
2017	196511	1539	783.2	0
2018	198621	1387	698.3	0
Average	194389	1633	840.2	2.0

time, bite date, and the amount of anti-scorpion serum consumed, was collected. Treatment outcomes (death, hospitalization, and recovery) of the patients in these centers (including three hospitals and two boarding clinics) were recorded in the previously prepared check list. Then, the data were analyzed using SPSS statistical software, and the results were illustrated in tables and graphs. Also, an epidemiological map of scorpion sting cases in rural areas was drawnusing GIS software.

3. Results

The results showed that during 2007-2018 in Behbahan County, a total of 19600 cases of scorpion stings were recorded in scorpion sting treatment centers (an average of 1633 cases per year). The highest frequency was in 2008, with 1889 cases, and the lowest frequency was in 2018, with 1387 cases per year. From 2015 to 2018, the frequency of cases showeda decrease. Also, during these 12 years, a total of two deaths were reported in September 2013 and September 2008 due to scorpion stings. One of the cases was a 97-year-old woman, and the otherwas a 2-year-old boy, both living in the village;both cases were stung by the Great Black Scorpion (Table 1). The average incidence rateof scorpion stings in Behbahan

County is 840 per 100,000 people, but in 2018, this rate decreased to 698 per 100,000 people.

According to the results of this research, 83% of scorpion stings occurred at home, 7% at work, 3% in sports venues, 3% in public places, 3% on the street, and 1% in educational places. Also, 61% occurred in rural areas and 39% in urban areas.

Regarding gender, 53% of those bitten were male, while 47% were female. The highest frequency was in the 25-34age group, and the lowest was in the 55-64 age group (Figure 1). The age average of bitten cases was 29.6 (26.9 female and 32.5male); the age span also ranged from a 15-day-old child to a 99-year-old older adult.

The study showed that 39.4% of stung cases occurred in the upper limbs (hands), 39.2% in the lower limbs (legs), 11.8% in the trunk, and 9.6% in the head and neck. Scorpion stings occurred between 18-24 midnight in 30.5% of cases, 24-6 in the morning in 29.4%, 6-12 at noon in 20.8%, and 12-18 in the afternoon in 19.3%.

The study showed that 67.5% of patients referred to the medical centers receivedanti-scorpion serum below 1.5 hours after the bite, 16.9% between 1.5 to 3 hours after the bite, and 15.6% above 3 hours after the bite. Also, 98% of them received anti-scorpion serum, and 2% were



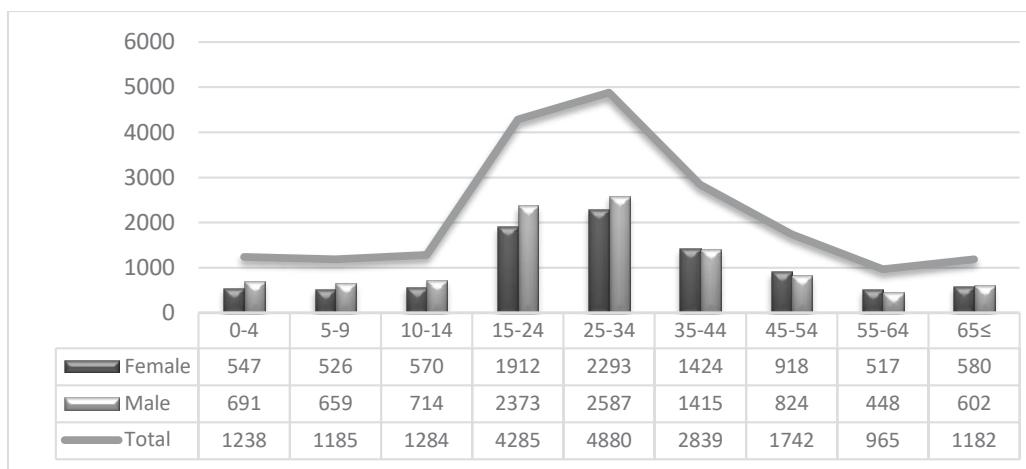


Figure 1. Frequency of scorpion stings by age group

discharged without serum injection. Of these, 22% had a history of previous scorpion stings, and 17% had a history of receiving anti-scorpion serum; additionally, 83% of cases recovered within 6 hours of receiving the serum, 10.7% between 6-12 hours of receiving the serum, and 6.3% more than 12 hours after receiving the serum. The average level of hospitalization was 1.9 days. 41% of hospitalized cases were less than 10 years old, and 58% were female.

Research shows the possibility of scorpion stings in Behbahan County all year round, with its frequency increasing since February and reaching its peak in August. However, the rate has a downward trend and reaches its lowest number in

January (Figure 2). All in all, there were 42.3% of bites in summer, 33% in spring, 19.2% in autumn, and 4.5% in winter.

Regarding the type of scorpion that causes the sting, in most cases, the scorpion that caused the sting was taken to the treatment center with the injured person. However, because the identification of scorpion species requires specialist verification and most of the treatment staff did not have this specialty, only the color of the scorpion was mentioned. Accordingly, 66% of scorpions were yellow, 22% were black, and 12% were unspecified.

A total of 20089 vials of anti-scorpion serum were used for 19,243 scorpion stings, with an average of 1.04 anti-scorpion serum used per

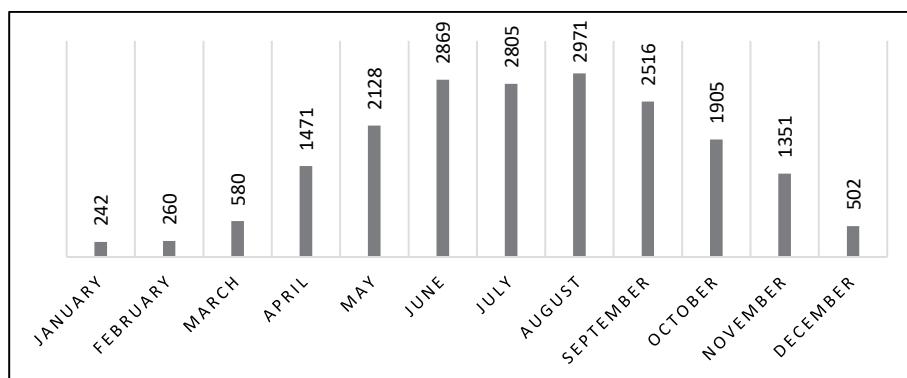


Figure 2. Frequency of scorpion stings by months



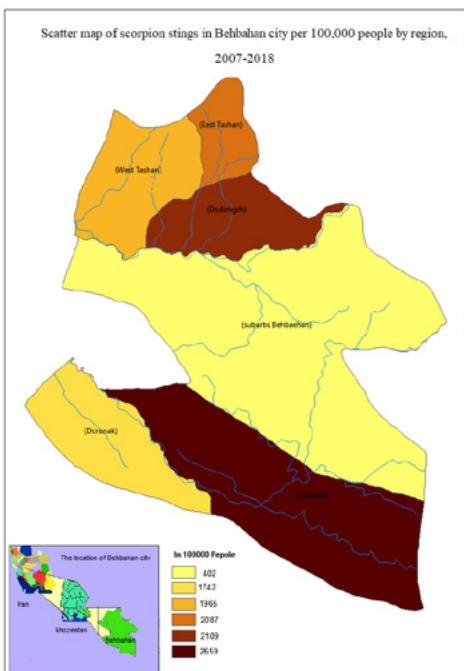


Figure 3. Epidemiological map of scorpion stings in one hundred thousand people in Behbahan 2007-2018

person. A total of 357 out of 19600 patients were not injected with anti-scorpion serum either due to lack of need to receive serum or the lack of anti-scorpion serum. However, in some hospitalized cases, more than one serum was used.

According to the location of scorpion stings in the files and using the GIS map of the city by village, the epidemiological map of scorpion stings to the population of each village was prepared. Accordingly, the highest frequency was respectively reported in Sardasht Village (2659 cases per one hundred thousand), Dodangeh Bozorg Village (2109 cases per one hundred thousand people), and West Tashan Village (2087 cases per one hundred thousand people). All three villages are densely populated, have rivers and extensive irrigation networks, and are considered to be located in an active agricultural part of Behbahan. The lowest incidence was in the suburbs of Behbahan County (268 cases per one hundred thousand people) (Figure 3).

4. Discussion

This study investigated patients stung by scorpion referred to Behbahan's medical centers in south eastern Khuzestan for 12 years (2007-2018). The province has a semi-desert (foothill) climate, with a maximum temperature of more than 50 degrees in July and August and a minimum temperature of less than zero in late December and January, suitable climatic conditions for scorpions. A total of 19600 cases of scorpion stings were reported, most of which were males (53%), in line with results of studies in Qom, Kashan, Hamedan, Sirjan, Haftgel, and Brazil. In contrast, in the Ramhormoz study, the percentage of cases was higher in females, and in the Bandar Abbas study, there were reported to be equal between both genders [10-17]. This difference may be due to the working conditions of individuals in scorpion habitats, especially for farmers and construction workers, the majority of whom are males. They can be trained to use thick boots and gloves, to use beds with long metal legs when moving stones and building materials, lumber, and objects in scorpion-prone areas, to keep a distance of at least 50 cm from the wall, to shake clothes and shoes before putting them on, not to sleep on the floor, not to put clothes and bedding on the floor, not to walk barefoot, especially at night, and other simple tips.

Rural people constituted 61% of the scorpion cases, and the rest were urban people. This issue was confirmed in many studies [10-16, 18], and in a study in Kerman and Sirjan, there were more sting cases in the urban area [12, 17]. Based on the epidemiological map (Figure 1), scorpion sting mostly occurred in areas at the crossing points of the great rivers of Khairabad, Zohreh, and Maroon, with numerous gardens and agricultural and horticultural farms (especially numerous groves), where most of the inhabitants are engaged in agriculture. As a result, these people are more likely to encounter scorpions, which can be the



leading cause of the higher incidence of scorpion stings in rural areas than in cities. The most critical points in preventing scorpion stings are training and giving sufficient warnings and information to people to prevent scorpion stings. Raising chickens at home, especially in rural areas, is an excellent way to fight scorpions at home, which should be emphasized in training. Other methods of preventing scorpion stings include improving the home environment by using tiles and ceramics with smooth surfaces and light colors, whitewashing the interior surfaces of rooms, filling gaps and seams in walls, removing construction debris and dirt and debris away from the living environment and not loading extra items into the house.

Most of the patients in this study were in the 25-34 age group, which is similar to the results of some studies [11,13,14,15] and different from the results of other studies [12, 17, 18]. One of the main reasons for the high frequency of scorpion stings in this age group is the active and productive nature of this group, especially in agriculture, animal husbandry, horticulture, tourism, companies related to work and construction materials, oil companies, and construction in scorpion-prone areas on the outskirts of the city, leading to the higher likelihood of encountering scorpions in this group. In terms of organs bitten, most bites occurred on the hands and feet, which are similar to results in most studies, including studies in French Guiana and Morocco [19, 20].

The highest number of scorpion stings was recorded in summer and August, which corresponded to the results of most studies in terms of season. The highest incidence was recorded in Ramhormoz and Haftgel in June and Kerman and Kashan in July. Scorpions can tolerate temperatures from -3 degrees to + 53 degrees, but their most significant activity is in the hot months of the year, and most bites occur during these days [10, 13, 15, 17].

Most people are bitten between 6 pm and 6

am when scorpions are active at night. This result is in line with results in other similar studies in different regions [10, 11, 13-16, 18].

In our study, 67% of the patients were referred to the medical centers in less than 1.5 hours. The distance between the farthest point and the medical centers is less than an hour, and the fact that 17% of the patients were admitted to these centers more than three hours after the bite indicates that patients are not sufficiently aware of the importance of timely treatment and the complications that can occur if not receiving treatment on time. The referral index of less than one and a half hours was 91% in Qom and 80% in Kerman, but in Ramhormoz, similar results were obtained [15, 17, 18]. Most cases(82%)discharged up to 6 hours after the injection of anti-scorpion serum, of whom 94% were outpatients, and 6% were hospitalized.

According to the report, two death cases of scorpion stings in the period of 12 years account for the mortality rate of 0.01%; this rate is 1.9% in Kashan and 0% in Hamedan. Also, 75% of scorpion deaths occur in the three provinces of Khuzestan, Sistan and Baluchestan, and Kerman. This index depends on several factors, including the sex and species of scorpion, which are the most critical factors in determining scorpion sting mortality, age, health status, degree of sensitivity and weight of the injured, the bitten organ (distance from the bitten organ to vital organs), geographical region (in the tropics due to drought there is a higher concentration of venom in scorpion stings), the state of health services in the region, the frequency of bites, the amount of venom in the body, time of visiting medical centers (if you visit the center longer than 3 hours after the bite, the probability of complications is higher), and the season. In most patients, scorpion stings were treated with anti-scorpion serum, dexamethasone, and promethazine [10, 11].

Regarding the type of scorpions causing



scorpion stings, 66% of scorpions were yellow, and 22% were black. Fifty species of scorpions have been identified in Iran, of which seven are of medical importance, and six exist in Khuzestan (including the Gadim scorpion and Great Black scorpion known to be the leading cause of death). It seems that only mentioning the color of the scorpion is not enough to identify scorpions, and scorpion species can only be detected with the help of specialized and trained staff. However, 35-40% of spring and 60% of summer bites in Khuzestan were reported to be related to black scorpions [15].

During this period, 20089 vials of anti-scorpion serum were used, and each vial has a financial value of more than 130 thousand tomans. By allocating some of this money to trained doctors, nurses, and health care providers regarding scorpion sting prevention, culture growing, and raising public awareness of personal protection methods, the waste of these resources can be prevented.

5. Conclusion

Due to the high prevalence of scorpion stings and their financial and spiritual impacts, it is necessary to take serious action to control and prevent this public health threat in Behbahan County. At the same time, these animals are useful in the natural cycle and play an essential role in controlling other vermin and agricultural pests. Thus, it is essential to use environmentally friendly methods to control these animals.

The best solution to reduce the prevalence of this challenge is to raise public awareness about ways to prevent scorpion stings, especially in rural areas and in the hot seasons of the year. This can be achieved by holding training classes and internal and external coordination meetings with officials to control this issue and encouraging the general public to implement scorpion control programs.

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Conflicts of interests

The authors declare that there is no conflict of interest in this study.

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