



## Study of The Frequency and Incidence of Scorpion Envenomation in Aghajri County, Khuzestan Province, Southwestern Iran

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### ABSTRACT

Scorpion sting is a medical problem and a life-threatening hazard in many parts of the globe including Iran. Data on scorpion envenomation is available for many parts of Iran, but not for Aghajri County. Scorpions are widely distributed in Iran. Sixty-four species have been identified in Iran, with at least 18 of these recorded in Khuzestan Province. The present study aims to assess the risk of scorpionism and to clarify the epidemiological characteristics of scorpionism in this county. This study was based on 553 cases of scorpion stings submitted to the medical and health centers of Aghajri County (30°42'02"N 49°49'53"E), Iran, over a period of 4 years. Epidemiological information of victims in Aghajri was obtained from a standard data sheet and analyzed by SPSS 16 software. Values obtained were considered to be significantly different if  $p < 0.05$ . The total number of scorpion stings reviewed in Aghajri County over the period 2012-2015 was 553, including 295 males (53.3%) and 258 females (46.7%). Of total cases 55.7% were residing in urban areas and 44.3% were in rural areas. Stings were found throughout the year with the largest seasonal incidence during the summer (46.3%) and the lowest in the winter (4.9%). Most cases of scorpion stings occurred during August, July and September with highest rates 15.7%, 15.4% and 15.2%, respectively. The highest and lowest rates were recorded in people aged 25-44 (39%) and 0-9 (11.2 %), respectively. Most of the scorpion stings were located mainly on the exposed limbs (84.1%), especially the upper limbs (42.3%). Nocturnal stings exceeded the diurnal ones with a ratio of 1.89:1. All patients were treated and no deaths were reported. Most of the patients (60.6%) had not a history of scorpion sting in the past. In terms of scorpion body color, yellow and black scorpions accounted for 56.4% and 43.6% of stings, respectively. Our results indicate that scorpionism is common in Aghajri County, particularly during the summer. The highest rate of stings were recorded in urban areas, therefore, training programs should be noticed for preventing scorpion sting in urban areas.

**Keywords:** Scorpion Sting, Epidemiology, Incidence, Iran

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### INTRODUCTION

From the time that humans appeared on Earth, their health has always been threatened by various factors. Wild animals, pathogenic agents, arthropod bites and stings are among factors that have caused human health problems. Although it seems that arthropod bites and

stings are less risky than pathogenic factors for human health, the ability of arthropods to transmit a large number of infectious agents, and also the fact that some arthropod species including scorpions are venomous, have made them an important and effective factor influencing human health. Due to their abundance in nature and their entry into areas of human habitation, scorpions are ranked first among venomous animals in the number of stings inflicted in humans and in the number of deaths in humans caused by these stings [1].

The reported incidence rates for scorpion stings in different geographical regions and countries varies depending on lifestyle, socioeconomic status, housing conditions, system of healthcare provision and scorpion species [2]. Mortality rates due to scorpion stings are related to many factors such as season, age of victim, geographic region, scorpion species and scorpion habitat among which scorpion species is the most important [3]. Iran, located between 25-40° north latitude, is a region with a moderate climate. Due to its diverse geographical locations and different climate conditions in each one, Iran has a relatively considerable diversity of scorpion species and distribution. However, we have a very incomplete and limited knowledge of their biological properties and exact geographical distribution across the country [4]. There are nationwide reports of deaths from scorpion stings, but Khuzestan, Sistan - Baluchestan and Kerman Provinces account for approximately 75% of the total cases of scorpion stings [5].

Scorpion stings are a major health issue in Khuzestan and cause heavy loss of life every year [6, 7]. What made scorpionism more prevalent in Khuzestan was the outbreak of the war imposed by Iraq on Iranians because this Province was directly involved in the war that led to the exodus of people from border towns and villages. In addition, military movements increased the number of scorpion stings by enhancing the contact of military personnel with scorpion nests and shelters [6-8]. The scorpionism phenomenon is not limited to Khuzestan and involves other provinces, specifically the southern ones. Moreover, Khuzestan has a high diversity of scorpion species. Different scorpion species have various types of venom and can cause different clinical complications among people [6].

Undoubtedly, knowledge of different epidemiological aspects of scorpion stings in each region is among the central principles required in scorpion control and scorpion sting treatment management. Since no studies were conducted in this relation in Aghajari County in the past, the present research intended to determine some epidemiological characteristics related to cases of scorpion stings.

#### **MATERIALS AND METHODS:**

In this descriptive-analytical cross-sectional study, all cases of scorpion stings referred to health-medical services centers in Aghajari between 2012 and 2015 were investigated. All of the patients were examined and received required treatments. Demographic and epidemiologic information on each patient including age, gender, time of the sting, the sting site on the body, the location (city or village), color of the scorpion, history of scorpion sting and the month of the incidence was obtained using a questionnaire. The obtained data was entered into SPSS and analyzed using descriptive and analytical statistics (chi-square and t-test). Significance level was considered to be  $P < 0.05$  at all stages of the study.

This study has been approved by the research ethics committee of the Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran. This project was in accordance to the ethical principles and the national norms and standards for conducting medical research in Iran. The confidentiality of the records of patients was assured.

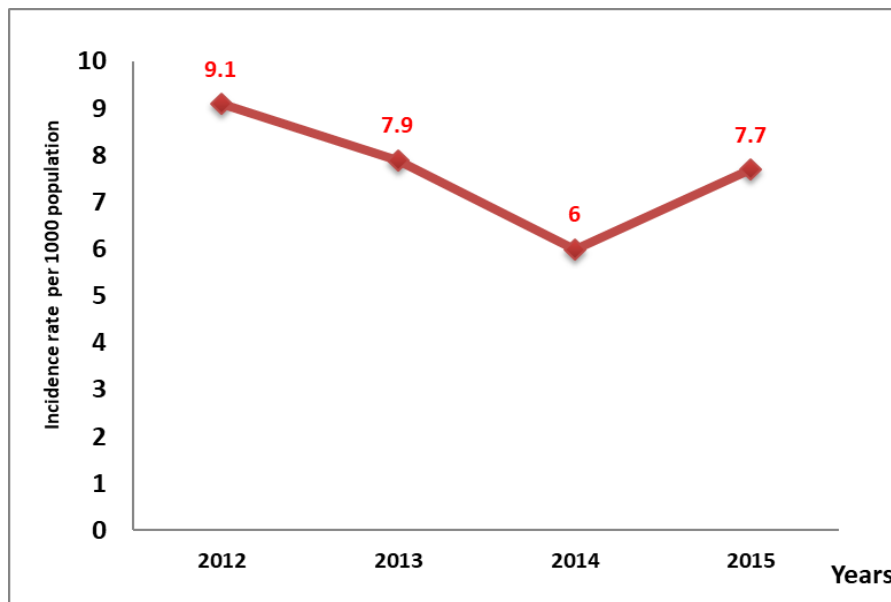
#### **RESULTS:**

There were 553 cases of scorpion stings in Aghajari over the research period. Since this county had an average population of 18,000 people, the estimated mean incidence rate of scorpion stings was 7.67 per 1000 people during the four mentioned years (Figure 1). Scorpion stings were more common among males (53.3%) than females (Table 1). However, the t-test results indicated there were no significant difference between the genders in this respect. The majority of the scorpion sting cases (39%) were in people between 25 and 44 years of age. The lowest percentage of cases (11.2%) happened in the age group under the age of 10 (Table 1). The nonparametric chi-square test result showed that there was a significant difference between the age groups and the incidence rates of scorpion sting ( $p < 0.001$ ). Based on geographical distribution, the majority of scorpion sting cases (55.7%) were in urban areas (Table 1). According to the paired t-test result, there was no significant difference between urban and rural areas in the incidence rates of scorpion sting. Results also showed that the second month of summer and the first

month winter with 15.7 and 0.9 percent, respectively, had the highest and lowest annual incidence rates of scorpion stings (Table 2). The seasonal distribution of scorpion sting cases showed that spring, summer, fall and winter accounted for 31.6%, 46.3%, 17.2% and 4.9% of the cases, respectively (Table 2). The nonparametric chi-square test result showed there was significant difference between the months of the year in the incidence rates of scorpion stings ( $p < 0.001$ ).

With respect to sting site on the body, the legs, hands, trunk and head accounted for 41.8%, 42.3%, 11.2% and 4.7% of cases, respectively (Table 1). According to the chi-square test, these

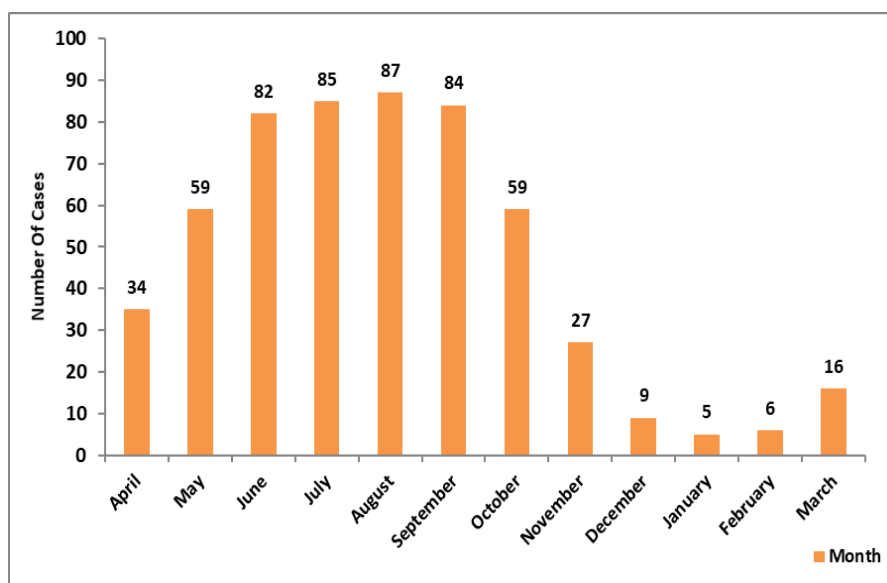
differences were statistically significant ( $p < 0.001$ ). According to the results, 12 am to 6 am and 12 pm to 6 pm accounted for the highest and lowest incidence of scorpion sting (34.7% and 14.5%), respectively (Table 1). With respect to the color of the scorpions, yellow and black scorpions accounted for 43.6% and 56.4% of the scorpion sting cases (Table 1). The chi-square test showed that this difference was statistically significant ( $p < 0.001$ ). The majority of cases (60.6%) had not a history of scorpion sting (Table 1). All the patients were successfully treated and discharged, with the survival rate of 100% over the research period.



**Fig. 1.** Trend of scorpion stings by incidence rate/ 1000 population in Aghajri County, southwestern Iran (2012-2015)

**Table 1.** Frequency distribution of scorpion stings cases by age group, gender, sting time, residential area, site of sting on the body, scorpion body color, season and previous sting history in Aghajri County, southwestern Iran (2012-2015)

Year	Age Group					Gender		
	0-9	10-24	25-44	45<	Total	Male	Female	Total
	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)
2012	14 (8.6)	51 (31.3)	56 (34.3)	42 (25.8)	163 (100)	92 (56.4)	71 (43.6)	163 (100)
2013	16 (11.2)	43 (30.0)	56 (39.2)	28 (19.6)	143 (100)	76 (53.1)	67 (46.9)	143 (100)
2014	16 (14.8)	27 (25.0)	44 (40.7)	21 (19.4)	108 (100)	55 (50.9)	53 (49.1)	108 (100)
2015	16 (11.5)	30 (21.6)	60 (43.1)	16 (11.5)	139 (100)	72 (51.7)	67 (48.3)	139 (100)
Total	62 (11.2)	151 (27.3)	216 (39.0)	108 (19.5)	553 (100)	295 (53.3)	258 (46.7)	553 (100)
Year	Sting Time during Day and Night					Residential Area		
	0-6	6-12	12-18	18-24	Total	Urban	Village	Total
	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)
2012	67 (41.1)	26 (16.0)	19 (11.6)	51 (31.3)	163 (100)	92 (56.4)	71 (43.6)	163 (100)
2013	52 (36.4)	40 (28.0)	16 (11.2)	35 (24.5)	143 (100)	81 (56.6)	62 (43.4)	143 (100)
2014	50 (46.3)	20 (18.5)	8 (7.4)	30 (27.8)	108 (100)	60 (55.6)	48 (44.4)	108 (100)
2015	23 (16.5)	25 (18.0)	37 (26.6)	54 (38.8)	139 (100)	75 (54.0)	64 (46.0)	139 (100)
Total	192 (34.7)	111 (20.1)	80 (14.5)	170 (30.7)	553 (100)	308 (55.7)	245 (44.3)	553 (100)
Year	Site of Sting on the Body					Scorpion Body Color		
	Hand	leg	Trunk	Head	Total	Yellow	Black	Total
	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)
2012	75 (46.0)	67 (41.1)	15 (9.2)	6 (3.7)	163 (100)	73 (44.8)	90 (55.2)	163 (100)
2013	59 (41.3)	63 (44.1)	14 (9.7)	7 (4.9)	143 (100)	60 (42.0)	83 (58.0)	143 (100)
2014	45 (41.6)	41 (38.0)	14 (13.0)	8 (7.4)	108 (100)	48 (44.4)	60 (55.6)	108 (100)
2015	55 (39.7)	60 (43.1)	19 (13.6)	5 (3.6)	139 (100)	60 (43.2)	79 (56.8)	139 (100)
Total	234 (42.3)	231 (41.8)	62 (11.2)	26 (4.7)	553 (100)	241 (43.6)	312 (56.4)	553 (100)
Year	Season					Previous Sting History		
	Spring	Summer	Autumn	Winter	Total	No	Yes	Total
	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)
2012	46 (28.2)	77 (47.2)	31 (19.0)	9 (5.6)	163 (100)	111 (68.1)	52 (31.9)	163 (100)
2013	53 (33.1)	58 (40.6)	25 (17.5)	7 (4.8)	143 (100)	75 (52.4)	68 (47.6)	143 (100)
2014	35 (32.5)	52 (48.1)	17 (15.7)	4 (3.7)	108 (100)	68 (63.0)	40 (27.0)	108 (100)
2015	41 (29.5)	69 (49.6)	22 (15.8)	7 (5.1)	139 (100)	81 (58.3)	58 (41.7)	139 (100)
Total	175 (31.6)	256 (46.3)	95(17.2)	27 (4.9)	553 (100)	335 (60.6)	218(39.4)	553 (100)

**Fig. 2:** Trend of scorpion stings by month in Aghajri County, southwestern Iran (2012-2015)

**Table 2:** Frequency distribution of scorpion stings cases by month in Aghajri County, southwestern Iran (2012-2015)

Year Month	2012 No. (%)	2013 No. (%)	2014 No. (%)	2015 No. (%)	Total No. (%)
April	13 (8.0)	11 (7.7)	6 (5.6)	4 (2.9)	34 (6.1)
May	18 (11.0)	11 (7.7)	11 (10.2)	19 (13.7)	59 (10.7)
July	15 (9.2)	31 (21.7)	18 (16.7)	18 (12.9)	82 (14.8)
June	22 (13.5)	23 (16.1)	21 (19.4)	19 (13.7)	85 (15.4)
August	31 (19.0)	16(11.2)	17(15.7)	23 (16.5)	87 (15.7)
September	24 (14.7)	19 (13.3)	14 (13.0)	27 (19.4)	84 (15.2)
October	14 (8.6)	16 (11.2)	17 (15.7)	12 (8.6)	59 (10.7)
November	14 (8.6)	7 (4.9)	0 (0.0)	6 (4.3)	27 (4.9)
December	3 (1.8)	2 (1.4)	0 (0.0)	4 (2.9)	9 (1.6)
January	1 (0.6)	2 (1.4)	0 (0.0)	2 (1.4)	5 (0.9)
February	3 (1.8)	1 (0.7)	0 (0.0)	2 (1.4)	6 (1.1)
March	5 (3.1)	4 (2.8)	4 (3.7)	3 (2.2)	16 (2.9)
Total	163 (100)	143 (100)	108 (100)	139 (100)	553(100)

**DISCUSSION:**

Scorpion stings are among the health issues in many countries, causing great annoyance, serious complications, and even death [9]. There were 553 recorded cases of scorpion stings over the research period at Aghajari health-medical services centers with the mean incidence rate of 7.67 per 1000 and range of 9.1 – 7.7 per 1000 in 2012 and 2015, respectively.

Various age groups are exposed to scorpion stings. According to the findings, the majority of scorpion sting cases (39%) happened to people who were 25-44 years old, and 80.5% of the victims were less than 45 years of age. Ozkan and Kat [10] reported the highest incidence rate of scorpion stings (36.2%) among the age group of 15-29. Consistent with the findings of the current study, Al-Sadoon and Jarrar showed that 65.46% of scorpion sting cases were in people older than 15[11]. In agreement with the findings of the current study, Jarrar and Al-Rowaily reported that 36.3% of the victims in Saudi Arabia were 20-29 years old [12]. Vazirianzadeh et al. showed that the age group of 20-30 accounted for the majority of scorpion sting cases in Khuzestan with the incidence rate of 22.3% [13]. In the two studies conducted by Kassiri et al. in Abdanan [14] and Mahshahr [15], the age group of 20-29 formed the majority of victims. The high prevalence of scorpion stings among this age group can be attributed to

their greater curiosity and risk-taking behavior such as lifting rocks with unprotected hands, walking barefoot outside of the house and putting clothes and shoes on before checking them [16].

The analytical tests showed no significant differences in the incidence of scorpion sting cases between males and females in Aghajari. According to the results, male and female victims accounted for 53.3% and 46.7% of scorpion sting cases, respectively. In two separate studies conducted in two different regions of Saudi Arabia, 77.3% and 61.8% of the victims of scorpion stings were male [11, 12]. The findings of this study were consistent with those of Vazirianzadeh et al. [13] and Chitnis et al. [17] in Khuzestan Province . This gender similarity in incidence can be attributed to the active cooperation between the males and females in Aghajari.

In this study, 42.3% and 41.8% of scorpion sting sites were in the upper and lower extremities of the body, respectively. Ozkan and Kat reported that the lower limbs of the body accounted for 38.2% of scorpion sting cases, which is not consistent with our findings [10]. Al-Sadoon and Jarrar reported that 29.9% and 56.58% of scorpion sting cases happened to the upper and lower extremities , respectively [11]. Scorpion stings in the lower parts of the body can be attributed to the use of inappropriate shoes in the yards and on farms. On the other hand, a victim at rest is less likely to see a scorpion

approaching the lower limbs of the body compared to the upper limbs.

The majority of international reports show that most scorpion sting cases happen during summer [18, 19]. This may be due to the severely lower level of scorpion activity in winter because of hibernation, and can also explain the smaller number of scorpion sting cases in cold seasons. On the other hand, venom concentration in the venom-producing glands of scorpions is lower during winter than in summer and spring. Therefore, higher venom concentration may be another reason for a greater number of hospital visits of people stung by scorpions in summer. In the current study, the majority of scorpion sting cases occurred in summer, which can be attributed to higher activity levels of scorpions in warm seasons. On the other hand, winter had the least incidence of scorpion stings. These findings are consistent with those of other studies [20-22]. For example, studies conducted in Tunisia [23], Mexico [24], and Saudi Arabia [8] reported that the periods between the last month in spring to the last month in summer, between the last month in spring and the first month in autumn, and the last month in spring, respectively, accounted for the majority of scorpion sting cases, whereas most cases of scorpion stings in Brazil happened during the second month of summer [25].

The current study showed greater incidence of scorpion sting cases in urban areas with the incidence rate of 55.7%. Farghly and Ali reported that scorpion sting cases were prevalent in rural areas of many countries [26]. Talebian reported that the highest frequency of scorpion sting cases (58.3%) was observed in rural areas [27], which is inconsistent with the findings of the current study. The proximity of the urban areas in Aghajri to scorpion habitats justifies this difference.

According to studies, the poisoning symptoms were more severe during the early hours of the night. During the night a scorpion may sting several times, which will gradually decrease its amount of venom [28]. In the current study, the majority of scorpion stings (75.4%) happened between 6 pm and 6 am. Scorpions usually hide in secure places such as wall cracks, holes in the ground, under stones, piles of brush and wood, beneath mats, fallen tree leaves,

loose bark of such trees as eucalyptus, in palm trunk holes, construction waste and inside shoes (including boots and closed toe slippers) during the day and become active at night.

#### CONCLUSION:

Scorpion envenomation cases have been reported from all regions of the country; however, Khuzestan Province ranks first in the number of scorpion sting cases and complications accompanying them. An important issue in scorpion sting management is the identification of symptoms and complications caused by dangerous scorpions. This is because knowledge of symptoms and complications caused by different scorpion species can be helpful in finding the treatment strategy specific to each species. Logical scorpion sting prevention solutions depend on environment protection. Teaching personal safety principles, taking environmental considerations into account, raising the quality of housing construction and observing urban planning principles in building new towns are effective in reducing the incidence rate of scorpion stings. The majority of educational programs for preventing scorpion stings at health - medical services centers should be focused on housewives. This is because these programs reduce the prevalence rate of scorpion stings among housewives and they can transfer what they learn to their children and thus play a significant role in controlling scorpion sting cases among students.

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#### Conflict of interest statement

The authors report no conflict of interest.

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