

## Spatial Distribution of Scorpionism in Ardabil Province, North West of Iran

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### Abstract

#### Background

Scorpion stings are the most important health problems in tropical and subtropical countries. The aim of this study was to assess spatial distribution of scorpions and scorpionism in Ardabil province, Iran.

#### Materials and Methods

This descriptive-analytic study was carried out in all 10 counties of Ardabil province, Northwestern Iran. The clinical and demographic data of scorpion sting cases were collected from questionnaires belonging to an 8 year - period of 2010 to 2017. In addition, scorpions were captured using Ultra-violet (UV) light, Pitfall traps and digging methods. After species identification, Arc GIS 9.3 software was applied for mapping spatial distribution of them. Data were analyzed by SPSS software (version 21.0).

#### Results

A total of 958 scorpion sting cases were documented. One hundred ninety cases (19.83%) of them were occurred in age group <19 years. Stings were mostly recorded in rural areas after midnight and in the early morning hours from April to September. Also, nocturnal envenomation was observed with the highest frequency (52.50%). A total of 142 scorpions were collected and identified. The collected scorpions belonged to Butidae and Scorpionidae families. They were classified into two genera (*Mesobuthus*, *Scorpio*), and two species: *Mesobotus eupeus* (99.29%), and *Scorpio maurus* (0.71%).

#### Conclusion

There was a high prevalence of scorpion stings in rural areas in Ardabil province among age group less than 19 years old. This finding suggests the necessity of preventive programs for decreasing this higher incidence.

**Key Words:** Children, Iran, Scorpionism, Spatial distribution.

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## 1- INTRODUCTION

Scorpions (Arachnida: Scorpions) often live in desert areas, but some species are found in mountainous regions under the rocks. These creatures have a venomous sting which they use to catch insects and they defend themselves (1). As to the breeding place, scorpions are classified to three groups including: digger, semi-digger and none diggers (2, 3). Non-digger species may enter into human dwelling places via wind and other climatic and environmental factors (4). They can cause health problems and in some cases, possibly lead to human mortality (5). Scorpions are widely distributed especially in tropical areas of the world, at the latitude of 23 to 38°C (6).

According to previous studies, there are three reported families of scorpions in Iran including Buthidae, Scorpionidae, and Hemiscorpionidae, under 19 genera and 59 species (7-9). Currently, scorpion stings are considered to be public health problems in Southern Africa, South America, the Middle East and the Indian subcontinent (10). It is estimated that around 1.2 billion people are living in areas where they are likely to encounter scorpions and each year there are about 1.23 million people in the world suffering from scorpionism, of which 0.27% lead to death (11). Scorpionism is considered a medical issue and a real concern in many developing countries (12).

Annually, many cases of human scorpion sting are occurring in the world, some of which result in death or non-healing consequences. In Iran, the reported scorpion sting cases were more than approximately 42,500 during 2001 to 2009, of which almost 19.5 deaths have been recorded annually (13). In Ardebil province, the level of contact of the human community with wildlife has increased due to the rural texture and the lack of improvement of rural houses, agriculture, livestock farming and gardening, and the

expansion of construction in urban areas as well as tourism landscape. These issues can cause more human exposure to scorpions and an increase in the probability of human scorpion sting cases. This study tries to clarify spatial distribution of scorpions and scorpionism in Ardabil province, Northwest of Iran over an eight-year period of 2010 to 2017.

## 2- MATERIALS AND METHODS

### 2-1. Study design and population

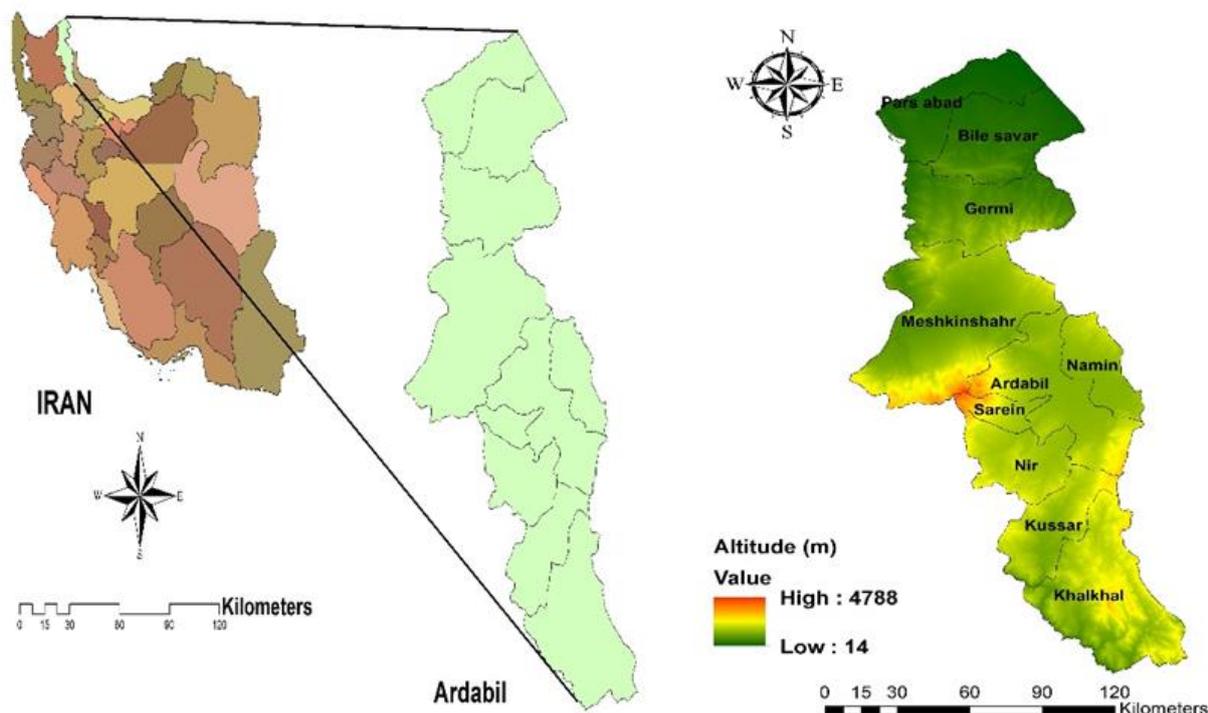
Ardabil Province is located in Northwest of the Iran (37° 36'- 39° 65' N and 47° 1'-48° 48' E) which has an area of 17953 km<sup>2</sup>, neighboring the Caspian Sea in the east and the Republic of Azerbaijan in the north and east Azerbaijan province in west (**Figure.1**). This Province has a subtropical and mild climate (14, 15). The study area is located in the mountainous and coastal part of the province. The total annual rainfall is in the range of 277.2-436.3 mm, and the mean of annual relative humidity is 63.12%. The maximum and minimum mean annual temperatures are 18 and 8 °C, respectively.

### 2-2. Methods

In this cross-sectional retrospective study, a total of 958 cases of scorpion stings were assessed based on individual information and demographics such as area, age, gender, time of sting, sting site, and time of the year, it should be mentioned that all of the cases had been previously recorded in health centers and hospitals in 10 selected counties of Ardabil province in Northwestern Iran during the years 2010 to 2017. In this study, all of urban and rural areas of Ardabil province were investigated with regard to factors such as climatic conditions (Temperature, humidity, etc.), geographical factors (Elevation, vegetation status, soil type, rainfall, etc.), and topological features (deserts, mountains, etc.) between Jan to Dec 2017 (16). Twenty-seven locations

were determined for the purpose of collecting scorpions (**Figure.1**). Scorpions were captured using three methods: **a.** Ultra-violet (UV) light (17); **b.** Pitfall traps, (18); and **c.** Digging methods (19). For morphological identification, after encoding, the collected scorpions were

stored in plastic containers containing 70% ethanol and transferred to the medical entomology lab of the Tehran University of Medical Sciences for species identification based on morphological keys (20).



**Fig1:** The study area in Ardabil province, Northwestern Iran.

### 2-3. Ethical consideration

Firstly, the data of scorpion sting cases were taken from Department of Prevention and Diseases Control of Ardabil province Health Center. It should be noted that before the start of the study, a code was considered for each patients and their personal and demographical details remain confidential.

### 2-4. Inclusion criteria

The inclusion criteria were included: Being confirmed scorpion sting case, resident in urban or rural districts of

Ardabil province and existence patient's complete surveillance form health center.

### 2-5. Exclusion criteria

The exclusion criteria were included: Not confirmed scorpion sting case, not living permanently in Ardabil province and just partial completing of patient's surveillance form.

### 2-6. Data Analyses

Statistical analysis such as mean of incidence, standard deviation, frequency, and percentage- was carried out using SPSS software (version 22.0). Arc GIS 9.3

software was applied for mapping spatial distribution of scorpions. P-value less than 0.05 were statistically significant.

### 3-RESULTS

A total of 958 cases of scorpion stings were documented in the health centres and hospitals. The majority of stung people 502 (52.4%) were males (**Table.1**). One hundred ninety cases (19.83%) of scorpion stings occurred in age group < 19 years. Most of cases (768/958) were reported age group > 20 years and lowest percentage scorpion stings occurred in the age group 0 - 4 (2.08%) years (**Figure.2A**).

The majority of cases 703 (73.4%) occurred in rural areas (**Table.1**). The highest number of scorpion sting cases were in the exposed upper and lower limbs 835 (87.16%); (**Figure.2B**). In addition, 597(62.31%) of cases occurred after midnight and in the early morning hours (**Figure.2C**). Sting rates were higher at night. Nocturnal envenomation 503 (52.50%) was more common than diurnal (**Table.2**). Based on data analysis, the number of scorpion sting cases recorded in

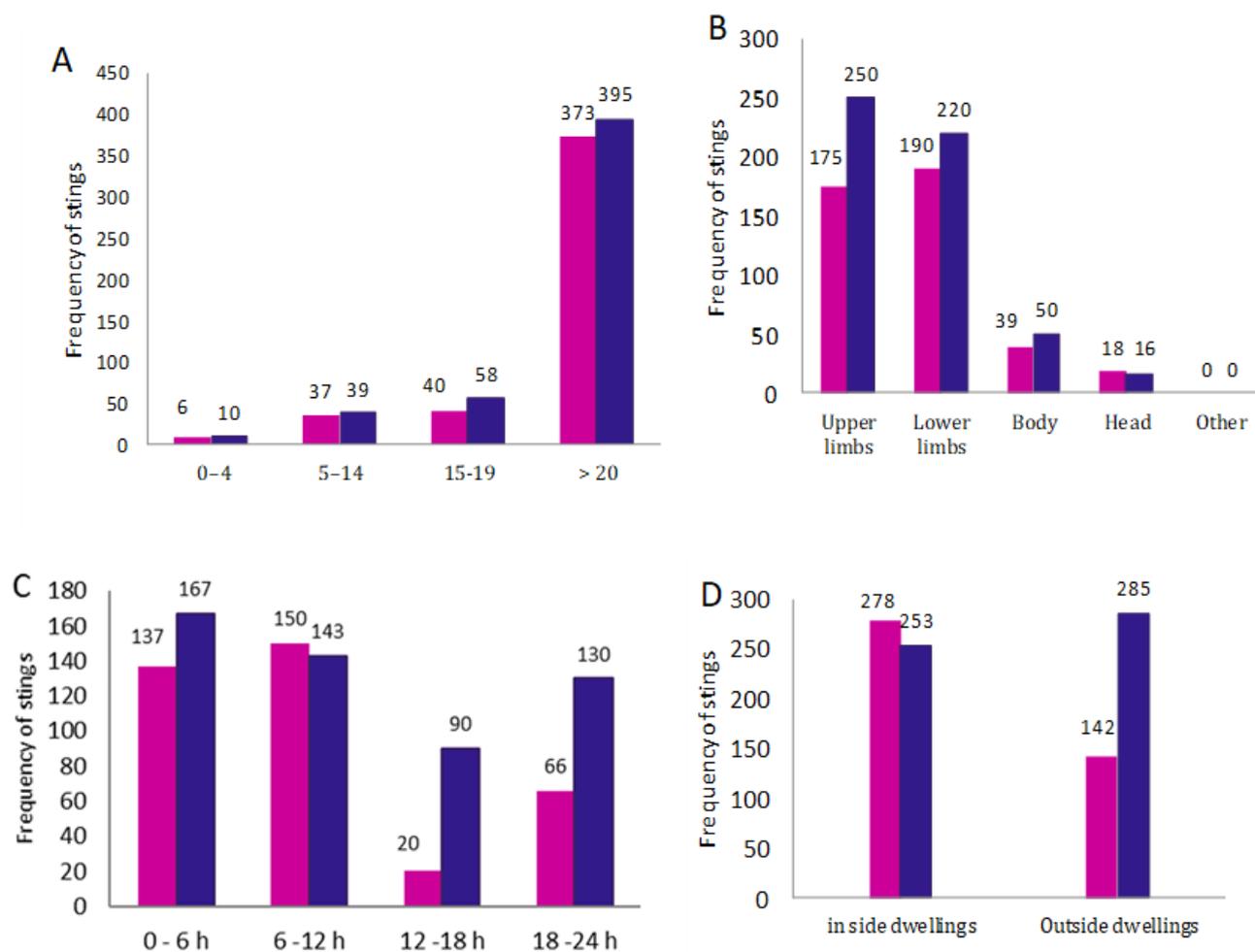
the summer months of May to September was found to be 858 (89.57%) (**Figure.3** and **Table.2**). Five hundred thirty-one (55.42%) of cases were reported from inside the dwellings places; while 427(44.58%) of the cases were in outside dwelling areas (**Figure.2D**).

The highest rate of scorpion stings was in the year 2017 (**Figure.4**). Furthermore, spatial distribution of scorpion sting cases in Ardabil province, North West of Iran has been presented in **Figure.5**. According to the results, the highest relative frequency of 958 cases of scorpion stings was recorded in Germe county (30.81/10000) (**Figure.5** and **Table.3**).

Totally, 142 scorpions were collected and identified. The collected scorpions belonged to Butidae and Scorpionidae families. They were classified into two genera (*Mesobuthus*, *Scorpio*) and two species: *Mesobuthus eupeus* (99.29%), and *Scorpio maurus* (0.71%). Furthermore, spatial distribution of scorpions was performed in this area (**Figure.6** and **Table.4**).

**Table-1:** The prevalence of ulcers by demographical characters in Ardabil province (2010 to 2017)

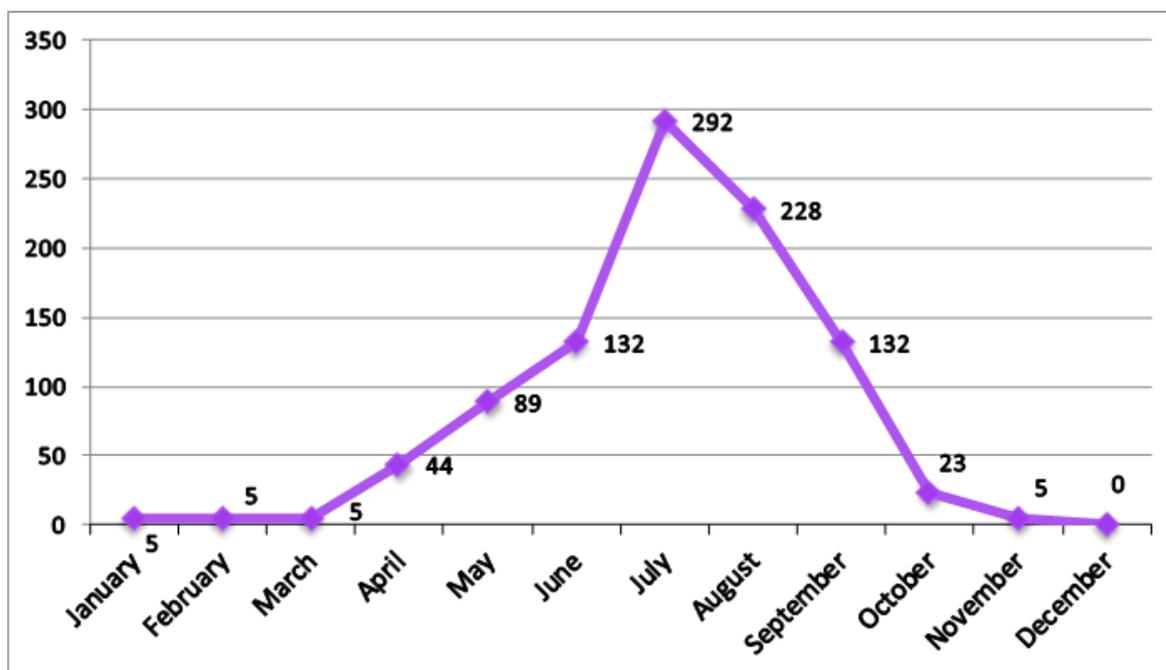
Demographical characters		Scorpion stings N (%)
Gender	Male	502 (52.4)
	Female	456 (47.6)
Resident	Urban	255 (26.62)
	Rural	703 (73.38)
Job	Students	152 (15.86)
	Farmer	253 (26.41)
	Housekeeper	302 (31.52)
	Others	251 (26.21)



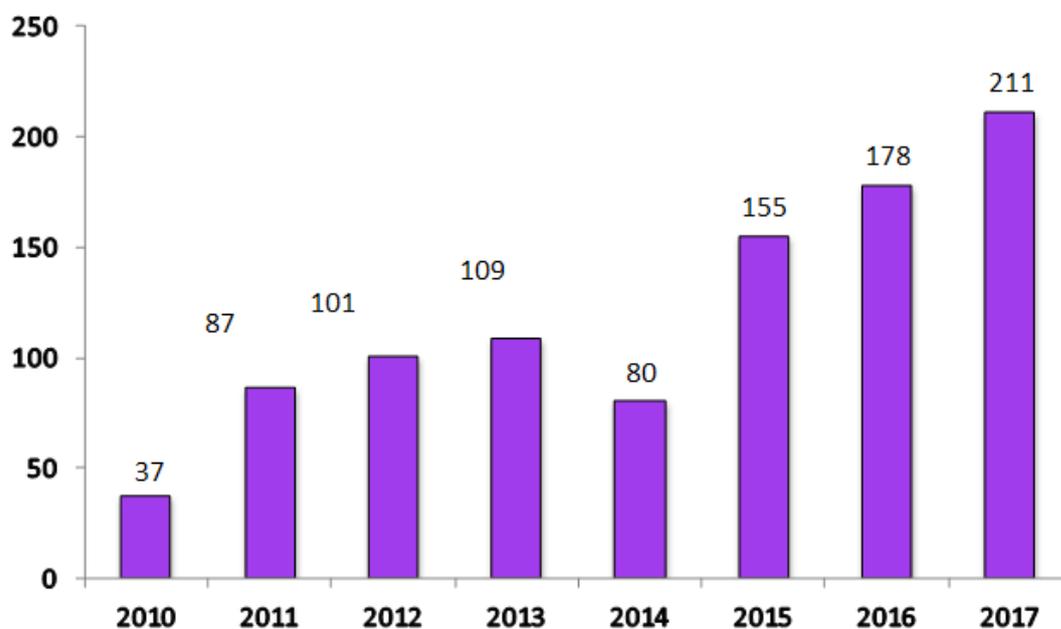
**Fig.2:** Envenomed patients classified by gender. Blue bars: The number of stung men; Pink bars: The number of stung women; A: Age group B: Anatomical site sting; D: sting hours; C: Locations.

**Table- 2:** Time of scorpion stings in Ardabil Province during 2010 to 2017

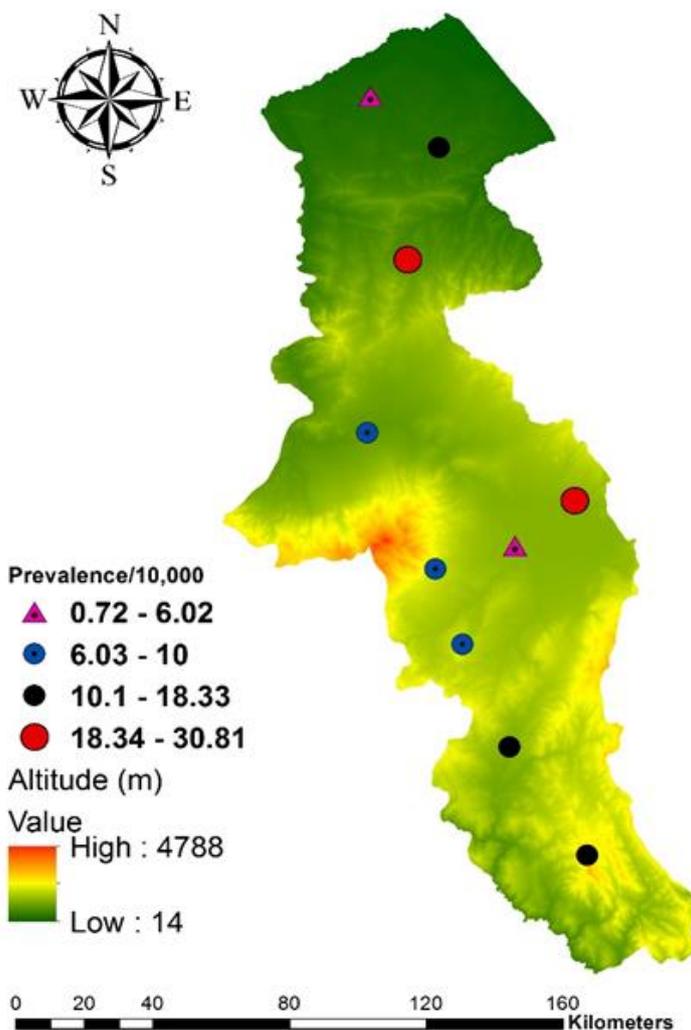
Month	Nocturnal sting (Number)	Diurnal sting (Number)
January	3	2
February	5	0
March	3	2
April	29	15
May	45	44
June	66	66
July	162	130
August	108	120
September	66	66
October	13	10
November	3	2
December	0	0
Total	493	465



**Fig.3:** Monthly evaluation of recorded scorpion sting cases in Ardabil Province from January 2010 to December 2017.



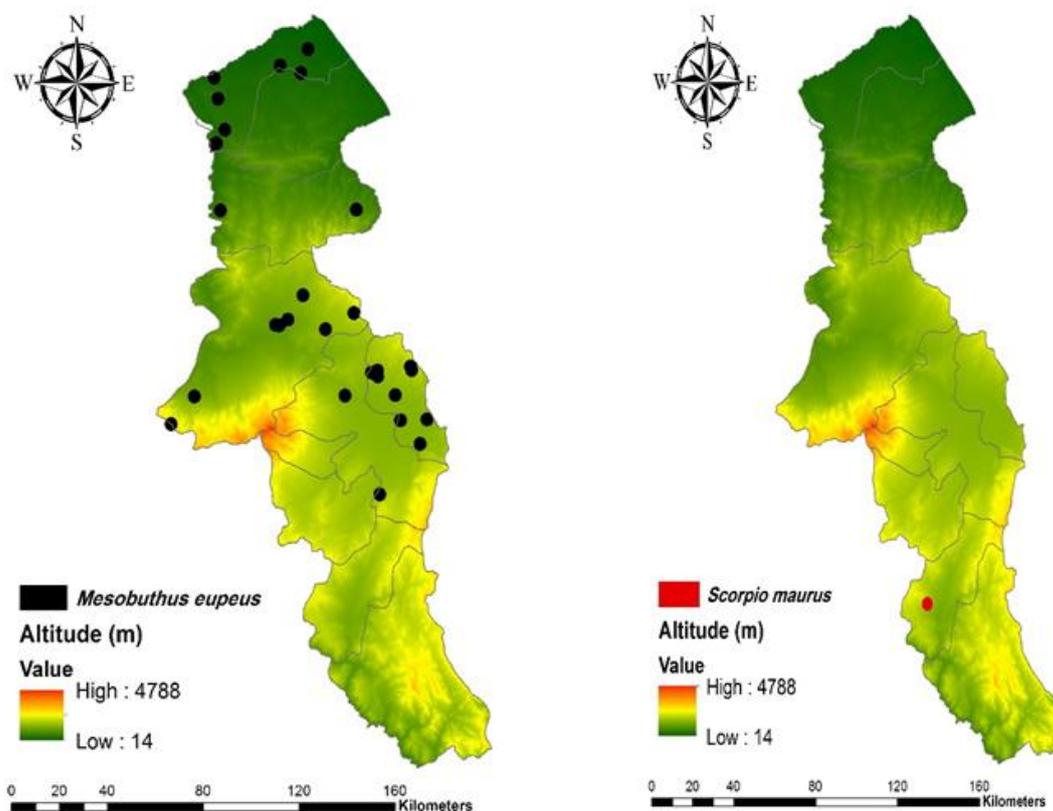
**Fig.4:** Yearly evaluation of recorded scorpion sting s cases in Ardabil Province from 2010 to 2017.



**Fig. 5:** Spatial distribution of scorpion sting cases in Ardabil province, Northwestern Iran.

**Table-3:** Prevalence of scorpion sting cases in Ardabil province, Northwest of Iran (2010 to 2017)

Area	Number of case (Number)	Prevalence/10,000
Namin	117	19.28
Pars abad	107	6.02
Germi	237	30.81
Meshkinshahr	150	10.00
Sarein	16	8.79
Kussar	37	16.72
Nir	19	6.70
Bile savar	72	14.00
Ardabil	44	0.72
Khalkhal	159	18.33



**Fig.6:** Spatial distribution of captured scorpions, Northwestern Iran, 2017.

**Table-4:** Species composition and spatial distribution of scorpions collected in North West of Iran

Mesobuthus eupeus			Scorpio maurus		Total (Number)	
Location	Male (Number)	Female (Number)	Male (Number)	Female (Number)	Male (Number)	Female (Number)
Parasad	18	20	-	-	18	20
Germi	4	6	-	-	4	6
Namin	27	16	-	-	27	16
Ardabil	4	8	-	-	4	8
Meshkinshahr	17	21	-	-	17	21
Kussar	-	-	1	-	1	-
Total	70	71	1	-	71	71

#### 4- DISCUSSION

This study is the first cross-sectional study on spatial distribution of scorpions and scorpionism in Ardabil province, Iran. It reflects the intensity of the epidemiological trend of scorpion sting

that scored 958 cases during this eight - year period. This study showed that the scorpion sting can be on an alarming increase in temperate and subtropical climates. Despite the high rate of scorpion stings, the mortality rate is almost zero. This may be due to the desirable medical

and supportive care development combined with the availability of effective antivenoms which significantly reduced mortality in this region of Ardabil province. This finding is in agreement with other scorpion envenomation in Iran (21, 22). Meanwhile, some other investigations have reported deaths following stings in some areas in Iran (13). In other studies, in different places such as the Zagoa oases in Morocco (23), some regions of Brazil (24), and some areas of Saudi Arabia, high mortality was reported due to scorpion stings (25). In the current study, most stings were in exposed upper and lower limbs 835 (87.16%). In another similar research, conducted in Algeria, the majority of cases were reported in upper and lower limbs (26).

Furthermore, in a study conducted by Kassiri et al. in Iran, it was reported that 43.6% of the investigated patients were stung in their feet (27). Some other epidemiological studies have reported that the afflicted body parts are mostly the extremities including hand, arm, leg, thigh and foot (23, 28). These findings may be explained on the basis that the exposed hands and arms are usually used in most manual and farm-related activities. In addition, the findings of present study showed that most cases of scorpion sting occur in rural areas (73.4%). Other research also reported findings similar to those of the current study (13, 21).

The present results indicate that the environmental situation of the poor rural areas is an important and adverse factor in increasing the cases of scorpion sting in Ardabil province. In the present study, scorpion stings were seen mostly in males (52.4%). Other researchers have reported more scorpion stings in female than male patients (28). In other studies, scorpion stings were recorded in more male than female patients (13, 23). In warm climates, scorpions become more active, a finding which corroborates other studies which

found that the highest incidence of scorpion stings was recorded in the summer (13, 22). In the present study, it was found that scorpion stings are frequent during hot months (May to September), with a maximum frequency being in July (27.03% of all stings). These similar findings show that scorpion stings occurred during May to September in several areas of Iran (29). In the present study, about 20 % of scorpion stings occurred in age group < 19 years; also, Taliban and Doroodgar reported that the highest rate happened among children younger than 10 years of age (30).

Moreover, Kassiri et al. reported the greatest rate among people in 15-24 years old age group (22, 31). Barros et al. showed that the 20-29 years old age group presented more scorpion stings (28). Moosavy et al. reported the greatest rate of scorpion stings occurring among people in the age group of 21-30 years old (21). Furthermore, in the present study, most cases of scorpion sting occurred after midnight and in the early morning hours. Despite the differences between northern

#### **4-1. Limitations of the study**

In this present study we considered the registered data in health center of Ardabil province, Iran. In our knowledge results of this study, can state just some of the epidemiological status of Scorpionism in Ardabil province. So, this situation can be one of the limitations of the study.

#### **5- CONCLUSION**

This study showed that there was a high incidence of scorpion stings in rural areas among age group less than 19 years old, suggesting the necessity of preventive programs for decreasing the incidence. It is recommended that programs such as public education and better sanitation services be implemented in the rural areas. Adequate training and raising awareness about personal protection for those who

work on farm lands, or work out-doors at night around the sites can help health and medical organizations in better prevention and treatment of scorpion sting.

**6- CONFLICT OF INTEREST:** None.

### 7- ACKNOWLEDGMENT

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