

Epidemiological and Climatological Factors Influencing on Scorpion Envenoming in Baghmalek County, Iran

¹Hamid Kassiri, ²Khadijeh Shemshad, ³Ali Kassiri,
⁴Masoomeh Shemshad, ⁵Ali-Azghar Valipor and ⁵Ali Teimori

¹Department of Medical Entomology and Vector Control, School of Health, Ahwaz Jundishapur University of Medical Sciences, Ahwaz, Iran

²Department of Entomology, School of Health, Mazandaran University of Medical Sciences, Sari, Iran

³School of Medicine, Ahwaz Jundishapur University of Medical Sciences, Ahwaz, Iran

⁴Department of Agricultural Extension and Education, Science and Research Branch, Islamic Azad University, Tehran, Iran

⁵Baghmalek Health Center, Ahwaz Jundishapur University of Medical Sciences, Iran

Abstract: Scorpionism is a serious public health problem throughout the globe, especially in tropical and sub-tropical areas. In Iran, Khuzistan province and its counties including Baghmalek is one of the regions most affected by this burden. This survey aimed to trace the epidemiological profile and certain risk factors including climatological factors affecting on scorpionism and some common clinical signs in Baghmalek to improve patient care. This research is a descriptive-analytical cross-sectional study on scorpion stings based on previously designed questionnaire for stung patients referred during 2006-2007. mean monthly precipitation (mm), the maximum monthly wind speed (m/s) the maximum and minimum monthly relative humidity (%) and the maximum and minimum monthly temperatures (°C) were obtained from Iran Meteorological Organization and were studied in relation to cases of scorpion sting. About 991 cases were found in this county, during the study period. There were approximately 0.96 stings/year per 100 people in the study areas. About 35.3% of the scorpion victims were from urban areas. The highest average age of victims was 15-24 years old (37.8%). The stings were more frequent in spring. Of all registered cases, 74.5% of the patients received medical aid in less than three hours after the sting. Based on the results of this study, scorpionism is of clinical importance in this area and public awareness and physician readiness along with the accessibility to effective antivenom significantly reduce scorpionism in this area.

Key words: Scorpion Envenoming • Risk Factors • Climatological Variables • Baghmalek County

INTRODUCTION

Scorpion envenomations are one of the most serious health problems in different parts of the world. Scorpions of medical importance cause severe envenomations because of their defensive stings [1, 2]. Scorpions play an important role in severe cases of human envenomation in different parts of Iran. According to the data from the national strategy against scorpion stings, approximately 50,000 stung patients are recorded annually, in Iran that put Iran in the second grade after

Mexico [3, 4]. Epidemiological data compiled by the antivenom of Razi Research Vaccine and Serum Institute, Iran showed that scorpion stings are the leading cause of poisoning in Iran. Species specific antivenom therapy is a main strategy for scorpion envenomations in different parts of Iran [5-7].

The Iranian scorpion fauna consists of over 44 species from 23 genera in three families [8, 9]. The survey of scorpion fauna in Khuzistan province shows that exist minimum 12 scorpion species :*Androctonus crassicauda*, *Apistobuthus petrygocercus*, *Hottentotta leptochelys*,

Corresponding Author: Khadijeh Shemshad, Department of Entomology, School of Health, Mazandaran University of Medical Sciences, Sari, Iran.
Hamid Kassiri, Department of Medical Entomology, School of Health, Ahwaz Jundishapur University of Medical Sciences, Ahwaz, Iran.

H.saulcyi, *H. schach*, *Compsobuthus mattheinseni*, *Mesobuthus eupeus*, *Odontobuthus odonturus*, *Orthochirus scrobiculosus*, *Razianus zarudnyi*, *Scorpio maurus* and *Hemiscorpius lepturus*. The province of Khuzistan has high scorpion sting incidence and lethality and is known for its richness of scorpion species among which, those of the family Buthidae were the most implicated and threatening public health, in particular: *A.crassicauda*, *M.eupeus* of Buthidae family and *H.lepturus* of Liochelidae family. A review of the available medical literature on Iranian scorpionism involving identified scorpions reveals that the majority of severe cases have been caused by the *H.lepturus*. In 1807, Oliver described the clinical features of middle regions of Iran including Kashan County and listed the scorpion species [5-7].

The main aim of this article is to describe a case series of scorpionism in one important endemic region, Baghmalek County, to describe the specific epidemiological characteristics of scorpionism in this county and to define the factors having influences on the stung people. As little is known about the true magnitude and transcendence of scorpion stings in Baghmalek since few epidemiological data on the subject have been recorded. In this paper, we present the analytical investigation on epidemiology of scorpionism and certain risk factors including climatological factors of Baghmalek County, influencing during 2006-2007.

MATERIALS AND METHODS

Study Area: The county of Baghmalek located at between 49° 33' longitudes and 31°13' latitude. Its area is 225, 870 hectare. Based on the reports of the 2006 census, the county's population was 103,217. The county is subdivided into three districts including the central, Seydon and Meidavoud. The county has three cities including Baghmalek, Seydon and Qaletoll. The climate of Baghmalek County that has located in Khuzistan province is generally hot and occasionally humid, while winters are much more pleasant and dry. Summertime temperatures mainly are above 50 °C and in the winter it can drop below freezing. Sand-storms and dust-storms are frequent with the arid and desert-style terrains. Average elevation of the Baghmalek plain is 917 meter above sea level.

Patients: In this descriptive-analytical study, data were collected from all patients' using a pre-designed questionnaire during 2006-2007. The initial data including age distribution of patients, sex of patients, the main clinical signs and symptoms, sting site of biting, time of the day, month, geographical locality of the event, the incidence rate of stings, probable type of the scorpion,

treatments including antivenom and other drugs administered and final outcome of the patients were derived and recorded in a researcher-made questionnaire. The correlation of the number of scorpion stings with the climatological variables: the mean monthly precipitation (mm), the mean monthly maximum and minimum temperature (°C), the mean monthly relative humidity (%) and the maximum monthly wind speed (mps) collected from Iranian meteorological organization were calculated. Data were analyzed using SPSS software version 18, by analysis of Spearman method; differences were considered significant with less than 5% of the associated probabilities.

RESULTS

Analysis of questionnaire data revealed the distribution of the scorpion sting cases according to age, gender, body location, month of sting, residential location and local symptoms. During this descriptive-analytical study period, from 2006-2007, totally 991 stung cases with an average incidence of 0.96% had been reported from the study area. 642 stung cases (64.8%) were from rural areas and 349 cases (35.2%) were reported from urban areas of the county. These results showed that the frequency of stung patients in the age groups of 0-4, 5-9, 10-14, 15-24, 25-34, 35-44, 44-54 and >55 years old were 3.1%, 5.95%, 9.4%, 27.85%, 19.4%, 11.6%, 10.6% and 12.1%, respectively. Most of the patients were female (58.7%) and 41.3% were male. In the study period, the sex ratio favored females (F/M, 1.42: 1). Results of the study based on weight group showed that 44.5%, 30.3%, 15.6% and 9.6% of them were in weight group of 50-60 kg, 70-90 kg, 25-49 kg and 0-24 kg, respectively.

Frequency distribution of scorpionism among patients based on their jobs has been presented in Fig. 1. Results of the Spearman Rank Correlation Coefficient showed that there was no correlation between the job and number of scorpion sting ($p > 0.05$). Results explain that 39.65%, 39.45%, 15.5% and 5.4% of the stings have been taken place in the hands or arms, feet, trunk and head or neck, respectively. Nearly 1.6% of the patients were stung more than one time and 0.5% of them had received antivenom.

The most common signs and symptoms frequencies following stung were local pain (87.9%), muscular severe pain (4.1%), anesthesia (3.2%), erythema (2.9%) and muscular spasm (1.9%). Urine analysis showed haemoglobinuria in 58.2% of the stung patients. The scorpion stings occurred in spring, summer, autumn and winter were 41.2%, 40.5%, 14.9% and 3.4%, respectively (Fig. 2).

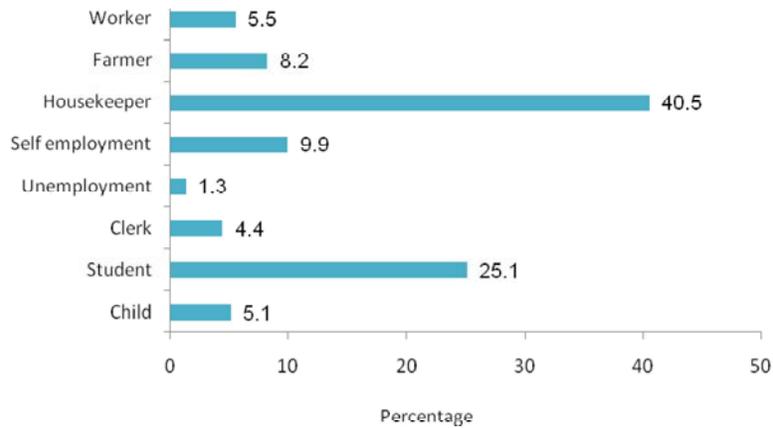


Fig. 1: Frequency distribution of scorpion sting among patients according to jobs in Baghmalek County, Khuzistan Province, South-west of Iran (2006-2007).

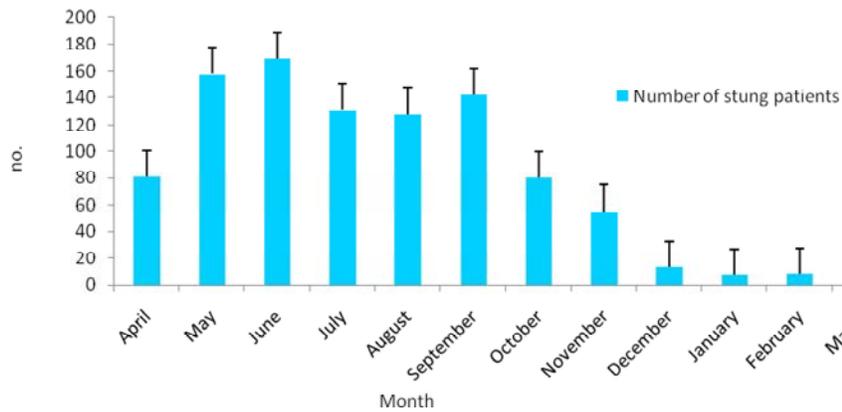


Fig. 2: Distribution of scorpion sting cases by months in Baghmalek County, Khuzistan Province, South-west of Iran (2006-2007).

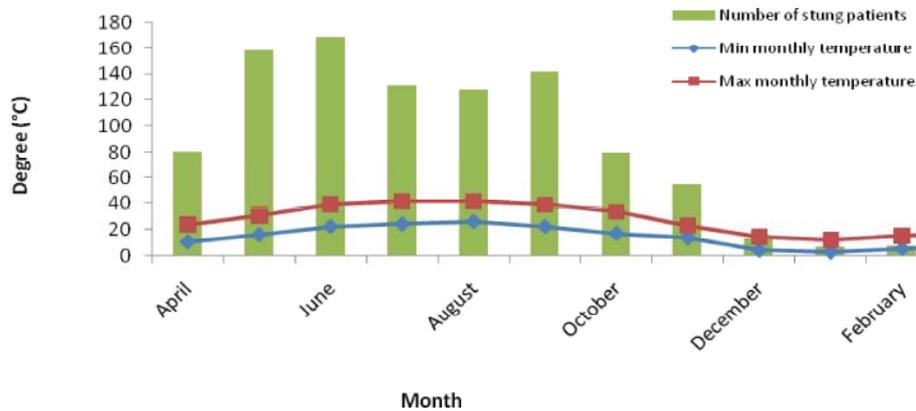


Fig. 3: The minimum and maximum monthly temperatures in different agroclimatic and topographic zones of the Baghmalek County, Khuzistan province in relation to number of stung patients during 2006-2007.

The number of cases of scorpion sting showed a seasonal pattern that correlates well with the temperature and the rainy season ($p < 0.05$) when the mean maximum temperatures surpass 40°C in the months of June through September (Fig. 3), period in which the scorpion

activity increases. The highest scorpion sting incidence was reached when the minimum and maximum monthly temperatures were 27.4°C and 45.1°C (Fig. 3). In the lowest precipitation scorpion sting cases reached to its highest values in the spring and summer, respectively.

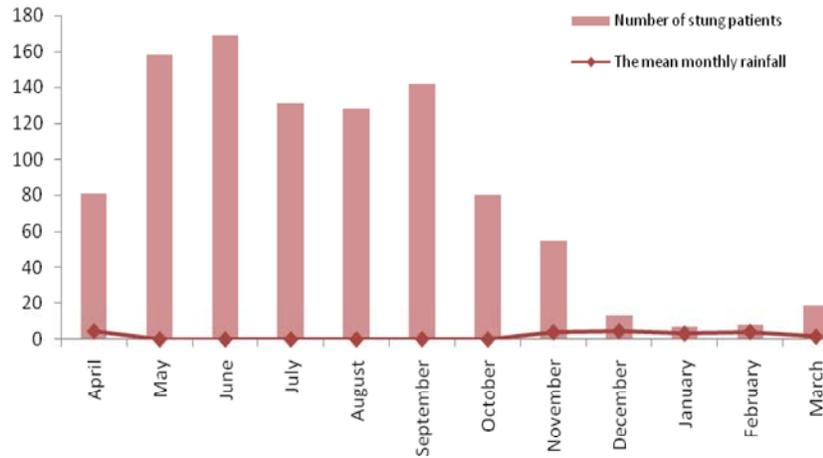


Fig. 4: The mean monthly rainfall of the studied areas in different agroclimatic and topographic zones of Baghmalek County, Khuzistan province, in relation to number of stung patients during 2006-2007

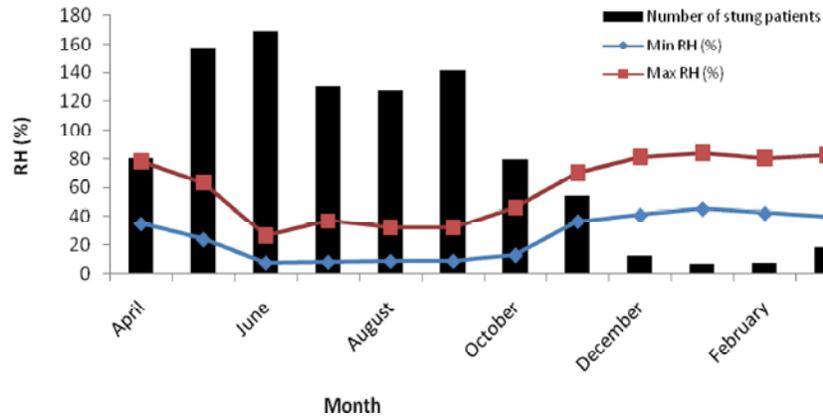


Fig. 5: The minimum and maximum monthly relative humidity of the studied areas in different agroclimatic and topographic zones of Baghmalek County, Khuzistan province, in relation to number of stung patients during 2006-2007.

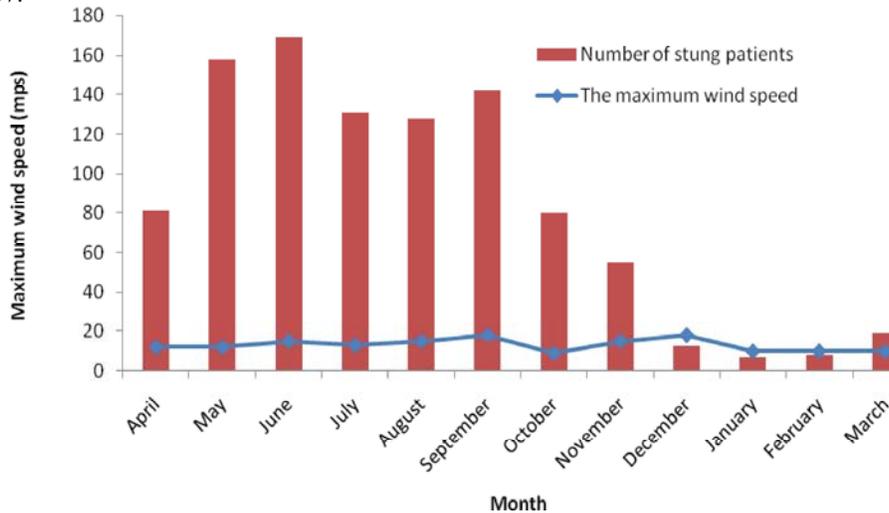


Fig. 6: The maximum monthly wind speed (m/s) of the study areas in different agroclimatic and topographic zones of Baghmalek County, 2006-2007.

There were very few stings incidences when the rain in the autumn and winter increased ($p < 0.05$) (Fig. 4). Threshold was seen between mean relative humidity, wind speed and scorpion sting incidence (Fig. 5, 6). When the minimum relative humidity was about 11%/month, there were the highest incidences of scorpion stings (Fig. 5). Results of the study based on sting time showed that 32.5%, 28.2%, 21.5% and 17.8% of the patients were stung at 6-12 a.m., 0-6 a.m., 18-24 p.m. and 12-18 p.m., respectively. Most of the stung cases (32.5%) occurred in 6-12 a.m. and the least (17.8%) in 12-18 p.m. Moreover, 95.8% and 4.2% of the stung cases were stung inside and outside of their home, respectively. As to the post-sting time, the results showed that 74.5%, 16% and 9.5% of patients were able to receive medical attention in less than 3 hours, more than 6 hours and 3-6 hours, respectively. Furthermore, 99.3% and 0.7% of the patients treated with injection of intramuscular antivenom and intravenous, respectively. The medications that were used as treatments among the stung cases were 38.7%, 31.2%, 19.4% and 10.7% by antihistamine, corticosteroids, antibiotics and non-Narcotic-analgesic, respectively. About 94.05%, 5.35% and 0.6% of the stung cases had been discharged without hospitalization, hospitalized and transmitted to center of the province hospitals, respectively. Yellow, black body color scorpions and unidentified scorpions comprised 46.84%, 29.56% and 23.6%, respectively. The scorpion species responsible for the stings in Baghmalek County was unclear, because of the lack of physicians' knowledge about scorpion identification.

DISCUSSION

This is the case series to describe the epidemiological aspects of scorpionism in Baghmalek County, Khuzistan Province, Iran. Of the 991 patients in the study, none died. The results of this study approved that the 64.7% of scorpion stung people have been recorded in rural areas which are in contrast the scorpionism cases in another parts of Khuzistan [10]. Researchers documented that in the mountainous eastern regions of Turkey nearly about half of the reported cases occurred in urban areas [11]. The presence of a lower scorpion density in the city was because of the smaller number of suitable habitats for their subsistence; the number of people occupied in agricultural activities in the city is minimal; and the lower socio-economic level in rural regions relates with lower hygiene in households [11].

Results showed that the age group of 15-24 years old is the high risk age group and age is a risk factor in stung patients. This shows that age is a risk factor in

determining the prognosis of patients. Scorpionism was observed mainly among youths that were active outside. This is because these age groups are more active in the area and these results were not according to results many studies [12-15] that explain teenagers and pediatrics as high risk groups. The results of our study are in accordance with the results of other researchers that reported scorpion stings mostly seen in individuals of the age of 15 and over [16, 17]. It is considerable that there was difference in scorpion stings among the sexes in age groups of our study. Most of the patients were females (58.7%) and 41.3% were males. As the sex ratio favored females (F/M, 1.42: 1), it seems that women are often in the outdoors, especially the farmland and their knowledge about scorpionism were lower than males. This rate is equal with other results in Khuzistan [18]. However, it is not accordance with the other reports in Kashan that they documented that the scorpion stung people were males (53.04%) than females (46.95%) [19]. Although this finding is in accordance with the findings of previous researches in Tunisia [20], other studies indicated more frequent male contacts in comparison to female gender [21-23], while other studies reported that females accounted for the majority of victims [24, 25].

Our data showed that the 50-69 kg body weigh group had the highest risks. Statistical analysis showed that there was no correlation between the job and number of scorpion sting ($p > 0.05$). As the numbers of scorpion stings were the most in housekeepers so, the quality of the households is an important factor in the number of scorpion stings and the socio-economic status of the population is another important factor to be considered. Epidemiological surveys have reported that the afflicted body parts are mostly the extremities including hand, arm, leg, thigh, foot [17, 26, 27]. Most of the stung cases were stung inside and during agricultural activities. In parallel we found that 39.6% of the investigated patients were stung in their hands. Scorpion stings were reported to be seen mostly in the upper limbs in Turkey [14, 28, 29]. These findings may be explained on the basis that the exposed hands and arms are usually used in most manual activities and farm activities. Clinical observations of patients stung by various species of scorpions (such as, *A. crassicauda*, *M. eupeus*, *H. saulcyi*, *O. odontorus* and *H. lepturus*) have shown that the patients in general display local symptoms including pain, hyperemia, swelling, burning and itching [14, 26, 30]. The clinical reports from different scorpion species have indicated that patients stung show an immediate local pain [17, 31, 22]. This and other studies all point out that

the frequency of stings increase in the spring [14, 29] and the incidence of scorpion poisoning was low in the winter. This may be because the rainfall destroys the scorpions' nests, leading them to search for new refuges. In other studies, the rainy season has been documented to be positively related to scorpion activity [32, 33]. In contrast, the results of this study, showed the highest prevalence of scorpion stings were in the seasons with the low rainfall and there was an increase in the number of scorpion stings in the study area at the end of the rainy season. This indicates that the scorpion activity in the county of Baghmalek is greatly associated to climatological changes and the low minimum and maximum relative humidity, high mean monthly minimum and maximum temperature. It seems that, high wind speed makes scorpion nests unsuitable environments for their subsistence, as in the current study the highest envenoming were seen in the seasons that, the average wind speed were higher. High wind speed also, has influence on distributing scorpion pheromones and mating.

The black scorpions, *A. crassicauda* and *H. schach* and the yellow scorpions, *M. eupeus*, *H. saulcyi*, *O. doriae* and *H. lepturus*, are the most dangerous scorpions in Iran and are responsible for the majority of stings in Khuzistan Province [12,34]. In this survey, the most abundant scorpion species were determined, *M. eupeus*, *A. crassicauda* and *H. lepturus*. But, the scorpion species responsible for the stings in Baghmalek County was unclear, because of the lack of physicians' knowledge about scorpion identification and unavailability of scorpions in most stings. Therefore the most scorpionism emergencies among the inhabitants in Baghmalek should be paid to different species.

Results of the study confirm that using the antivenin made in Razi Research Vaccine and Serum Institute, Iran is useful to treat the exposed cases and in a significant reduction of mortality rate, thereby showing the antivenom to be cost-effective ($p < 0.001$). This is almost accordance to the results that made a pessimist conclusion in the effectiveness of using the earliest species-specific antivenin [34]. With our best knowledge this study is the first study of climatological factors influencing on scorpion stings in Iran. Following general approach to the management of scorpionism in the study area is suggested as it is a major medical problem, as the global warming are occurring in different parts of the world including Iran and many potentially lethal scorpions are expanding their range of distribution. It is concluded that prevention of stings should be part of

integrated primary health care. Scorpionism is a widespread problem in the tropical and sub-tropical areas (33, 34). Studies have reported that some epidemiological characteristics of different scorpions vary from one part of the world to another [17, 20, 22].

CONCLUSIONS

Scorpion sting is one of the main and important health challenges in Iran and has the widespread in Iran country. The exact program for sustain obtaining the cut and clear information by health system could able to guide the researchers and responsible persons for reducing the cases and / or the related impacts cause by scorpionism.

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REFERENCES

1. Ozkan, O. and Z. Karaer, 2003. The scorpions in Turkey. Turk. Bull. Hygiene. Exp. Biol., 60(2): 55-62.
2. Ozkan, O. and A. Filazi, 2004. The determination of acute lethal dose-50 (LD50) levels of venom in mice, obtained by different methods from scorpion *androctonus crassicauda* (Oliver 1807). Acta.Parasitol.Turcica, 28(1): 50-53.
3. Bush, S.P. and G. Charles, 2003. Scorpion venomations. E-Medicine. Available online at: <http://www.emedicine.com/merg/topic524.htm>.
4. Dehghani, R. and N. Valayi, 2005. Review on scorpions' taxonomy and Iranian scorpions' key identification. Feiz. Scien. Res. J., 32: 73-92 (In Persian).
5. Ghaderi, H., Z. Shariati, A. Godousi, A. and M. Ziyae, 2005. Scorpion sting cases in north-western of Khuzistan province from April 2002 till November 2002. Hayat Journal of Faculty of Nursing and Midwifery Tehran University of Medical Sciences, 12(2): 73-78 (In Persian).

6. Dehghani, R., N. Dinparast-Djadid, D. Shahbazzadeh and S. Bigdeli, 2008. Study on scorpionism and factors influencing on it in Khuzistan province in 2003. Feiz. Scien. Res. J, 12(3): 68-74 (In Persian).
7. Gheshlaghi, F., A. Yaraghi and E.S. Hashemi, 2011. An Epidemiological Study on Scorpionism in Isfahan Province. J. Isfahan. Med. Sci, 28(114): 885-891.
8. Farzanpay, R, 1988. A catalogue of the scorpions occurring in Iran, up to January 1986. Rev. Arachnol., 8(2): 33-44. (In Persian).
9. Kovarik, F., 1997. Results of Czech biological expedition to Iran part 2. Scorpions, with description of *Iranobuthus krali* sp.n and *Hottentotta zagrosensis* sp. (Buthidae). Acta Soc Zool Bohem; 61(12): 39-52.
10. Vaziriznzhadeh, B., R. Hajihossieni, B. Amiri, B. and H. Bagheri, 2008. Epidemiological study of scorpionism in the hospitals of Ahvaz, SW Iran, 2nd six month of 2006. J. Health. Sci, 2(2): 17-25. (In Persian).
11. Altinkaynak, S., V. Ertekin and H. Alp, Scorpion envenomation in children, 2002. Turk. Arch. Pediatr, 37: 48-54.
12. Radmanesh, M., 1990. *Androctonus crassicauda* sting and its clinical study in Iran. J. Trop. Med. Hyg., 93: 323-326.
13. Osnaya-Romero, N., T.J. Medina-Hernandez, S.S. Flores-Hernandez and G. Leon-Rojas, 2001. Clinical symptoms observed in children envenomated by scorpion stings, at the children's hospital from the state of Morelos, Mexico. Toxicon. 39(6): 781-785.
14. Ozkan, O. and I. Kat, 2005. *Mesobuthus eupeus* scorpionism in Sanliurfa region of Turkey. J. Venom. Anim. Toxins. Incl. Trop. Dis, 11: 479-491.
15. Jarrar, B.M. and M.A. Al-Rowaily, 2008. Epidemiological aspects of scorpion stings in Al-Jouf Province, Saudi Arabia. Ann. Saudi. Med, 28: 183-187.
16. Ghalim, N., B. El-Hafny, F. Sebti, J. Heikel, N. Lazar and R. Moustanir, 2000. Scorpion envenomation and serotherapy in Morocco. Am. J. Trop. Med. Hyg, 62: 277-283.
17. Al-Sadoon, M.K. And B.M. Jarrar, 2003. Epidemiological study of scorpion stings in Saudi Arabia between 1993 and 1997. J. Venom. Anim. Toxins. Incl. Trop. Dis, 9(1): 54-64.
18. Vaziriznzhadeh, B., M. Samie and M. Montazeri, 2006. Epidemiological study of scorpionism in the Khuzestan. The 2nd Medical Entomology Congress, 2006 May 16-18, Tehran Medical Sciences University, Tehran, Iran. pp. 91. (In Persian).
19. Dehghani, R., B. Vazirianzadeh, M. Rahimi Nasrabadi and S.A. Moravvej, 2010. Study of scorpionism in Kashan in central of Iran. Pak. J. Med. Sci., 26: 955-958.
20. Pardal, P.P., L.C. Castro, E. Jenings, J.S. Pardal and M.R. Monteiro, 2003. Epidemiological and clinical aspects of scorpion envenomation in the region of Santarem, Para, Brazil. Rev. Soc. Bras. Med. Trop, 36(3): 349-353.
21. Bergman, N.J., 1997. Scorpion sting in Zimbabwe. S. Afr. Med. J., 87: 163-167.
22. deRoodt, A.R., S.I. Garcia, O.D. Salomon, L. Segre, J.A. Dolab, R.F. Funes and E.H. Titto, 2003. Epidemiological and clinical aspects of scorpionism by *Tityus trivittatus* in Argentina. Toxicon, 41: 971-977.
23. Al-Asmari, A.K. and A.A. Al-Saif, 2004. Scorpion sting syndrome in a general hospital in Saudi Arabia. Saudi. Med. J., 25(1): 64-70.
24. Silva, R.M.L., M. Andrea and T.K. Amorim, 2000. Envenomation by *Tityus stigmurus* (Scorpiones; Buthidae) in Bahia, Brazil. Rev. Soc. Bras. Med. Trop, 33(3): 229-245.
25. Forrester, M.B. and S.K. Stanley, 2004. Epidemiology of scorpion envenomations in Texas. Vet. Hum. Toxicol, 46: 219-221.
26. Efrati, P., 1978. Epidemiology symptomatology and treatment of buthinae stings. In: Bettini, S. (Ed.), Handbook of Experimental Pharmacology-Arthropod Venoms, vol. 13. Springer, Berlin, pp: 312-317.
27. Soker, M. and K. Haspolat, 2000. Scorpion sting in children. Çocuk Sagligive Hastalklar Dergisi, 43(1): 43-51.
28. Goyffon, M., M. Vachon and N. Broglio, 1982. Epidemiological and clinical characteristics of the scorpion envenomation in Tunisia. Toxicon, 20: 337-344.
29. Chowell, G., J.M. Hyman, P. Diaz-Duenas and N.W. Hengartner, 2005. Predicting scorpion sting incidence in an endemic region using climatological variables. Int. J. Environ. Health. Res., 15: 425-435.

30. Gajre, G. and A.S. Dammas, 1999. Scorpion envenomation in children: should all stings be given antivenom? *Ann.Saudi. Med*, 19(5): 444-446.
31. Mirdehghan, M.M. and M.I. Motlagh, 2001. Scorpion stings survey (including: residence, sex and age) and treatment strategy in Abuzar hospital-Ahvaz, Khuzestan during 1994–1999, Iran. *J. Trop. Med. Hyg*, 14: 62-64 (In Persian).
32. Mazzotti, L. and M.A. Bravo-Becherellee, 1963. Scorpionism in the Mexico Republic. In: KEEGAN, HL., MACFARLANE, WV. (Eds.). *Venomous and poisonous animals and noxious plants of the Pacific area*. London: Pergamon Press, pp: 47-51.
33. Chippaux, J.P. and M. Goyffon, 2008. Epidemiology of scorpionism: A global appraisal. *Acta. Trop*, 107: 71-79.
34. Yildizdas, D., H. Levent Yilmaz and S.S. Erdem, 2008. Treatment of cardiogenic pulmonary oedema by helmet-delivered non-invasive pressure support ventilation in children with scorpion sting envenomation. *Ann. Acad. Med. Singap*, 37: 230-233.