Tropical Biomedicine 34(2): 425–432 (2017)

Scorpionism in Sidi Okba, Algeria: a cross-sectional study of 2016 stung patients between 2014 and 2015

Selmane, S.[1*], Benferhat, L.[1], L'Hadj, M.[2] and Zhu, H.[3]
[1]Faculty of Mathematics, University of Sciences and Technology Houari Boumediene, Algiers, Algeria
[2]Health and Hospital Reform Services, Ministry of Health, Population and Hospital Reform, Algiers, Algeria
[3]Department of Mathematics and Statistics, York University, Toronto, Canada
[*]Corresponding author e-mail: cselmane@usthb.dz
Received 22 August 2016; received in revised form 1 March 2017; accepted 3 March 2017

Abstract. The present cross-sectional study aimed to highlight some epidemiological and clinical features of scorpion stings in Sidi Okba, Algeria. The 2016 designed questionnaires for stung patients admitted between January 2014 and December 2015 in the different care units affiliated to public health care establishment Sidi Okba were reviewed and analysed. The analysis revealed that scorpion stings occur mainly in rural areas (66.1%), outside dwellings (54.2%), are observed round the clock throughout the year with the highest seasonal incidence in summer (43.2%). There were approximately 11 stings per year per 1000 inhabitants. Males were more affected than females with 62.5% of recorded stings. Almost half of the victims were aged between 20 and 40 years old and the most prone human body areas to stings were the upper and lower limbs (93.7%). The majority of cases (99%) were classified as mild and systemic toxicity was observed in 19 cases including two deaths. An efficient management of scorpion envenomation requires an active involvement of the public in decision-making processes along with the development of intersectoral actions. Scorpionism, as a health issue, requires not only more attention from scholars and researchers, but also multidisciplinary scientific collaboration.

INTRODUCTION

Algeria is faced to scorpionism and ranks among the leading endemic countries in the world (Chippaux & Goyffon, 2006). Annually, thousands are victims of scorpion stings with an average of around 50000 stings per year. Eighty-one percent of the country's provinces are affected by scorpionism and the province of Biskra ranks first at national level in terms of recorded cases. The incidence varies between less than 7 scorpion stings per 100000 population in the northern provinces to more than 1000 scorpion stings per 100000 population in those of the south (Laïd *et al.*, 2012; Laïd *et al.*, 2000-2015). More than 35 species are catalogued for the country, including four dangerous species to human, namely, *Androctonus australis*, *Buthus tunetanus*, *Androctonus aeneas*, *and Androctonus crassicauda* (Dupre, 2016; Vachon, 1952). Scorpions are venomous arthropods. They use their venom for both prey capture and defence. Usually they sting when they are disturbed inadvertently, threatened, or cornered. The scorpion has the ability to control the venom flow; the existence of scorpion sting with mild envenomation, or even, without the inoculation of venom seems established. Scorpion envenomation must be treated immediately and efficiently given that the scorpion toxins are distributed speedily in the body. Delays in seeking medical treatment may prove fatal, especially in children. The only specific treatment for scorpion envenomation is antivenom immunotherapy; which is widely used in many affected

countries like Mexico, Saudi Arabia and North Africa (Chippaux, 2012; Chippaux & Goyffon, 2008).

The present cross-sectional study aimed to examine the 2016 designed questionnaires of stung patients admitted between January 2014 and December 2015, in the nearby public healthcare establishment Sidi Okba in Biskra province, and this to highlight some clinical, demographic, and epidemiologic features of scorpion stings, and to identify risk factors related to scorpion envenomation.

MATERIALS AND METHODS

Envenomings by scorpion stings was recognised as a public health issue in Algeria from the mid 80s. To deal with this problem, a national committee against scorpion envenomation (NCSE) was created in 1987. The Algerian Ministry of Health jointly with the NCSE published a manual for management of scorpion envenomation in 2009 that includes, in addition to the clinical classification of scorpion stings, therapeutic Datasheets, care protocols and evaluation canvas (Ministère de la santé, 2009). With the objective of enhancing available information, improved scorpion envenimation notification forms were designed in 2012 (Ministère de la santé, 2012).

A case of scorpion envenomation has been defined by the NCSE as any case of scorpion sting who visits a health facility. The patient first undergoes a clinical examination (including the state of consciousness, heart rate, pulse, temperature), which allows thus to determine the envenomation grade. The patient's grade can be changed and the passage to the following grade is generally unforeseeable, rapid and often brutal.

Grade I (mild sting) is characterised by the presence of one or more local symptoms such variable intensity pains at the point of sting, tingling, paresthesias or burns that may be accompanied by a numbness sometimes triggered by percussion or touch. In that case, the patient receives an antivenom vial intramuscularly and when necessary an adjuvant therapy, and he/she is kept under observation between 4 to 6 hours ; the absence of worrisome symptomatology justifying its release.

Grade II (moderate envenoming) is characterised, in addition to local signs, by the presence of one or several general symptoms (Predictable severe signs are essentially: bradycardia, fever, sweating, priapism, hyperglycaemia greater than 2 g/l. Other general symptoms : diarrhoea, vomiting). In that case, hospitalisation for at least 24 hours is recommended, and resuscitation is related to the observed symptoms.

Grade III (severe envenoming) is characterised by the failure of at least one of the vital functions, namely, cardiovascular (low blood pressure, cardiac rhythm disorders), respiratory (respiratory failure, acute cardiogenic pulmonary edema), neurological (coma, convulsions). In case of vital failure, the patient is conveyed immediately to an intensive care unit (ICU). At this stage, the evolution can be fatal within hours and sometimes even within minutes.

The study region is located in the Biskra province in east central Algeria at the desert's gates and is made up of five municipalities (Ain Naga, Chetma, El Haouch, M'chouneche, and Sidi Okba) covering an estimated population of 88941 inhabitants by December 31, 2015. The Saharan climate of this region is characterised by weak and irregular precipitation, intense evaporation and wide variations in temperature with a monthly average of 34.5°C in July and a monthly average of 12.3°C in January.

Data were supplied by the nearby public healthcare establishment of Sidi Okba; an administrative institution on which the five municipalities depend. This healthcare establishment manages six polyclinics and nineteen care rooms (Etablissement public de santé de proximité Sidi Okba http://www.dsp-biskra.dz/index.php/epsp/epsp1). In addition to yearly sting cases by municipality, the establishment of Sidi Okba provided us with the designed questionnaires of stung patients admitted between January 2014 and December 2015. The information on the designed questionnaires included data on: gender, age, date, sting hour, location of the sting accident, the anatomical sting site, class

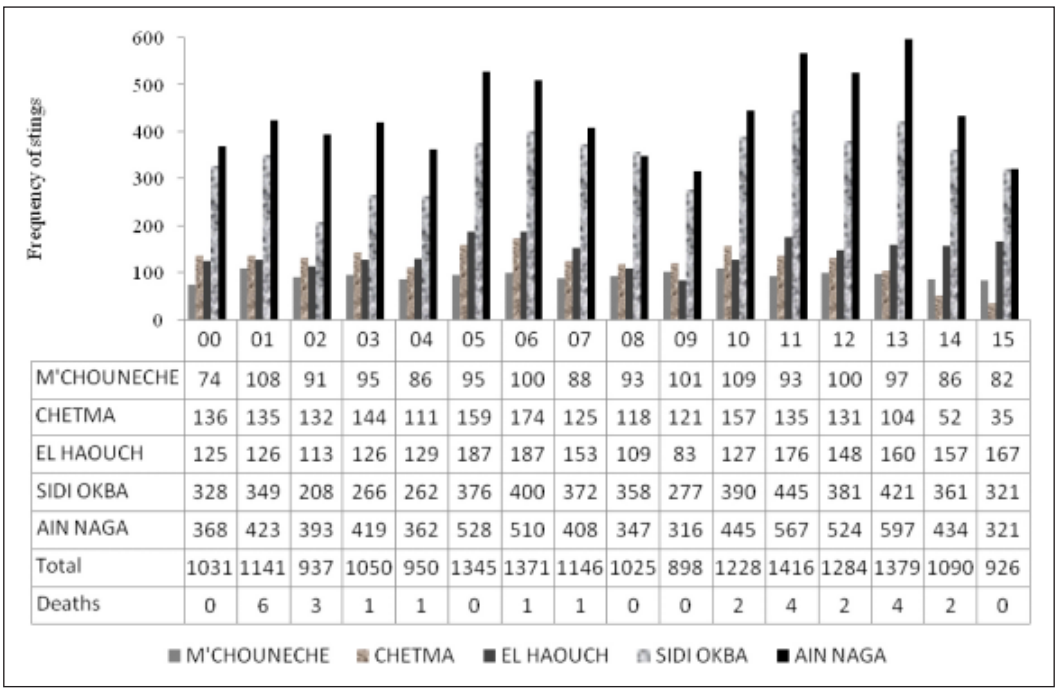
on first clinical examination, date and hour of antivenom vial administering, prescribed adjuvant therapy. Identification and personal information of patients were kept confidential. The data were analysed and graphs were generated using two software applications; Epi Info 7.1.5 (http://www.cdc.gov/epiinfo/) and EViews 9.5 (http://www.eviews.com/home.html).

RESULTS AND DISCUSSION

The yearly recorded sting cases from 2000 to 2015 for each one of the five municipalities corroborate the endemic character of scorpion envenomation in the study area (Figure 1). Over the 16 years, 18217 sting cases were recorded with an annual average of 1139 cases. The highest yearly recorded sting cases occurred in 2011 with 1416 sting cases. A total of 27 deaths were recorded. The five municipalities are affected by scorpionism at different levels; the incidence rate per 100000 population is 2640 for El Haouch, 2241 for Ain Naga, 805 for Sidi Okba, 681 for M'Chouneche, and 214 for Chetma, exceeding largely the national incidence rate estimated at 134 cases per 100000 population (Laïd *et al.*, 2000-2015).

The analysis of the designed questionnaires on the related accidents to scorpion envenomings revealed some clinical, demographic, and epidemiologic features (Table 1), as well as the seasonal distribution of scorpion stings (Table 2).

The analysis showed a predominance of male victims; of the 2016 recorded sting cases, 1259 (62.5%) were male and 757 (37.5%) were female, giving a male-female ratio of 1.7. Different studies have shown similar tendencies (Jarrar & Al-Rowaily, 2008; Rafizadeh *et al.*, 2013), while other studies have indicated a female predominance (Cesaretli & Ozkan, 2010; Ozkan *et al.*, 2006). The male predominance is also observed in outside dwellings with 82.3% of males against 17.7% of the females. Males have more contact with scorpion than females owing to their outdoor activities. The human body parts more prone to scorpion stings were the upper limbs with 50.5% of cases followed by the lower limbs with 43.2% of cases, a frequency not very different from



	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
M'CHOUNECHE	74	108	91	95	86	95	100	88	93	101	109	93	100	97	86	82
CHETMA	136	135	132	144	111	159	174	125	118	121	157	135	131	104	52	35
EL HAOUCH	125	126	113	126	129	187	187	153	109	83	127	176	148	160	157	167
SIDI OKBA	328	349	208	266	262	376	400	372	358	277	390	445	381	421	361	321
AIN NAGA	368	423	393	419	362	528	510	408	347	316	445	567	524	597	434	321
Total	1031	1141	937	1050	950	1345	1371	1146	1025	898	1228	1416	1284	1379	1090	926
Deaths	0	6	3	1	1	0	1	1	0	0	2	4	2	4	2	0

Figure 1. Yearly evolution of recorded scorpion stings by municipality, 2000–2015.

Table 1. Demographic and epidemiological features of scorpion stings

	2014				2015			
	Female	Male	Total	%	Female	Male	Total	%
Anatomical sting site								
Lower Limbs	161	306	467	42.8	155	248	403	43.5
Upper Limbs	201	352	553	50.7	191	275	466	50.3
Head/Neck	16	22	38	3.5	15	17	32	3.5
Trunk	9	23	32	2.9	9	16	25	2.7
Age groups								
< 1	0	1	1	0.1	1	0	1	0.1
1–9	43	60	103	9.4	38	50	88	9.5
10–19	67	128	195	17.9	60	81	141	15.2
20–29	91	223	314	28.8	90	167	257	27.8
30–39	66	137	203	18.6	73	129	202	21.8
40–49	58	64	122	11.2	44	47	91	9.8
50–59	40	41	81	7.4	31	34	65	7
60–69	11	28	39	3.6	23	37	60	6.5
70–79	7	14	21	1.9	8	7	15	1.6
80–89	3	6	9	0.8	2	4	6	0.6
>90	1	1	2	0.2	0	0	0	0
Sting time								
0–5 H	45	68	113	10.4	40	59	99	10.7
6–11 H	142	245	387	35.5	145	214	359	38.8
12–17 H	87	183	270	24.8	87	134	221	23.9
18–23 H	113	207	320	29.4	98	149	247	26.7
Location								
Outside dwellings	104	506	610	56	89	394	483	52.2
Inside dwellings	283	197	480	44	281	162	443	47.8
Grade on first clinical examination								
Grade I	379	692	1071	98.26	370	556	926	100
Grade II	7	11	18	1.65	0	0	0	0
Grade III	1	0	1	0.09	0	0	0	0

the results is reported by other authors (Jarrar & Al-Rowaily, 2008; Kassiri *et al.*, 2012). The age group 15-49 years was the most affected with 68.8% of stung cases; this age group represents also the active population. Children less than 14 years old account for 16.4% of cases. People older than 65 years were the least stung (4%).

These results corroborate the observations made in other regions (Jarrar & Al-Rowaily, 2008; Ozkan *et al.*, 2006). The scorpions sting round the clock recording peaks between 6 am and 11 am, then between 6 pm and 11 pm corresponding to population high-activity periods in this Saharan region. Note that 33.9% of stings were from urban and remaining (66.1%) from rural areas; similar trend is observed in other affected region in the world (Kassiri *et al.*, 2013). All the patients, on admission, were given antivenom vial. A total of 2195 anitivenom vials were used; 1841 patients have received one antivenom vial, 171 have received 2 antivenom vials and 4 have received 3 antivenom vials. The global medical cost for the 99% of mild sting cases is estimated at 12000 us dollars, which represent a heavy financial burden.

Nearby health services and the outreach campaigns resulted in improved management of stung patients. Indeed, the time elapsed between sting accident and

Table 2. Monthly and Seasonal Distribution of scorpion stings

	2014				2015			
	Female	Male	Total	%	Female	Male	Total	%
Monthly distribution								
Jan	4	3	7	0.6	0	3	3	0.3
Feb	3	4	7	0.6	2	8	10	1.1
Mar	15	26	41	3.8	5	22	27	2.9
Apr	39	58	97	8.9	47	53	100	10.8
May	35	99	134	12.3	38	66	104	11.2
Jun	64	117	181	16.6	46	70	116	12.5
Jul	51	73	124	11.4	54	48	102	11
Aug	63	119	182	16.7	71	95	166	17.9
Sep	62	103	165	15.1	60	117	177	19.1
Oct	36	65	101	9.3	37	53	90	9.7
Nov	14	22	36	3.3	6	17	23	2.5
Dec	1	14	15	1.4	4	4	8	0.9
Seasonal distribution								
Winter	8	21	29	2.7	6	15	21	2.3
Spring	89	183	272	24.9	90	141	231	24.9
Summer	178	309	487	44.7	171	213	384	41.5
Autumn	112	190	302	27.7	103	187	290	31.3

antivenom vial administration were less than one hour for 1652 cases (81.9%), between one and 3 hours for 304 cases (15.1%), and between 3 and 6 hours for 25 cases (1.2%) and more than 6 hours for 35 cases (1.7%). At the first clinical examination, all patients were classified in grade I in 2015, while in 2014 eighteen patients were classified in grade II and one patient in grade III while the remaining were classified in grade I. Of the 18 patients in grade II, 11 were males and 7 were females of whom 7 children aged less than 15 years old. 12 accidents occurred inside dwellings and 6 outside dwellings and 11 cases were from rural areas. Seven accidents occurred in April, 6 in July, 4 in May and 1 in September. Eleven patients were stung on the lower limbs and 7 on the upper limbs. The injection of one antivenom vial and one HCH (Hydrocortisone Hemisuccinate) vial were given to 10 patients, of whom three patients have received also an adjuvant therapy. The remaining 8 patients were treated by injection of two antivenom vials, one HCH vial, and one SMD (Solu-Medrol) vial, in addition to adjuvant therapy. Two patients, a child aged 34 months and a woman aged 29 years, evacuated towards the intensive care unit of Biskra hospital died following envenoming complications. The child was stung on May 9, 2014 at 13:30 on the lower limb, outside dwelling in a rural area of Ain Naga municipality. On admission at Ain Naga polyclinic at 14:15, the child presented local signs (pain, tingling, paresthesia, numbness) together with some general symptoms (bradycardia, fever and vomiting). He received two antivenom vials, the first was at 14:15 and the second 10 minutes later in addition to one SMD vial and symptomatic treatment. Due to complications of his scorpion envenomation, the child was evacuated at 14:30 to Biskra Hospital. Unfavourable developments led to his death on May 10, 2014 at 10:15 am. The woman was stung by a yellow scorpion on the lower limb on July 26, 2014 at 1:50 am, inside of a traditional house in a rural area of M'Chouneche municipality. She visited the M'Chouneche care unit at 2:30 am. At the first clinical examination, the woman presented the local signs (pain, tingling, paresthesia, numbness) together with some general symptoms (bradycardia, fever and vomiting). She received two antivenom vials by

intramuscular injection, the first at 2:20, the second at 2:30, then three HCH vials and one atropine by direct intravenous injection, metoclopramide by intramuscular injection. Following complications and achieving grade III, she was evacuated to Biskra Hospital on July 26, 2014. During her transfer, she received another antivenom vial in addition to the isotonic saline infusion. On her arrival to medical emergencies at 3 am, she was conscious, agitated, and dyspneic. After the administration one antivenom vial, Cefotaxime, and Dobutamine, she underwent an oxygentherapy. Following unfavourable developments, the tracheal intubation was accomplished on the patient at around 10 am. Unfortunately, the woman died due to complications of her scorpion envenomation (acute edema of the lungs) on July 26, 2014 at 10:55 am.

Scorpion sting accidents were observed throughout the year, peaking in the summer months. The highest rates were in August and September, while the lower ones were in winter months. All studies on affected regions worldwide point out that the frequency of stings shows an increase during the warmest months of the year (Chippaux & Goyffon, 2008; Kassiri *et al.*, 2014) which comes into agreement with our findings. It should be noted that a marked increase in cases begins well before summer, and more precisely, from April to September. The high number of scorpion sting accidents for the months of April and May, September and October compared to other affected regions in Algeria (Selmane *et al.*, 2016) with similar climatic conditions is attributed, on the one hand, to picking date fruit during September and October, and on the other hand, to greenhouse cultivation adopted and used by some farmers in this agricultural and pastoral region. Indeed, during the months of April and May the farmers remove greenhouses and during the months of September and October they put them back, thus occasioning more scorpion stings accidents given that these latter often do not meet the protection guidelines on feet and hands.

The highest daily numbers of scorpion stings were recorded on September 6, 2015 and on October 8, 2015 with 16 cases, and on August 2, 2014 with 14 cases. Over 19 days, between 10 to 13 daily stings occurred during May (2 days in 2014), June (4 days in 2014), August (3 days in 2014 and 3 days in 2015) and September (3 days in 2014 and 4 days in 2015).

The monthly climate variables, extracted from climate data (Available from: http://en.tutiempo.net/climate/ws-605250.html accessed on August 22, 2016), with the highest correlation coefficients are temperature (r = 0.92), and relative humidity (r = -0.79). Moreover, the examination of the scatter plot between the scorpion stings, the temperature and the relative humidity, respectively, illustrates the relationship between the three variables (Figure 2). Indeed, when the temperature is less than 20°C the number of scorpion stings does not exceed the 45 cases. This number exceeds 100 cases when the temperature is above 20°C if the relative humidity is below 45%. Note further that the month of July records the lowest relative humidity of the year and the highest temperature, which can explain a drop in the number of sting cases in this month compared to August and September. The temperature and relative humidity are risk factors; the frequency of scorpion stings accidents is closely associated with these two factors; which is in accordance with the results in other regions (Kassiri *et al.*, 2013; Selmane, 2015; Selmane *et al.*, 2016; Taj *et al.*, 2012).

The organisation of training days for medical and paramedical staff on the management of stung cases, the creation of the observation rooms in polyclinics as well as health facilities in remote and isolated areas, immediate care for stung people round the clock, and supply of antivenom vial in sufficient number in health facilities, allowed to improve the management of stung people. In addition to the establishment of community-based care services, the awareness campaigns organised regularly have contributed significantly in improving the post-sting time, namely, the time between sting and a first medical consultation. Indeed, approximately 82% of stung people went to the health facility by less than one hour. However, awareness campaigns have proved

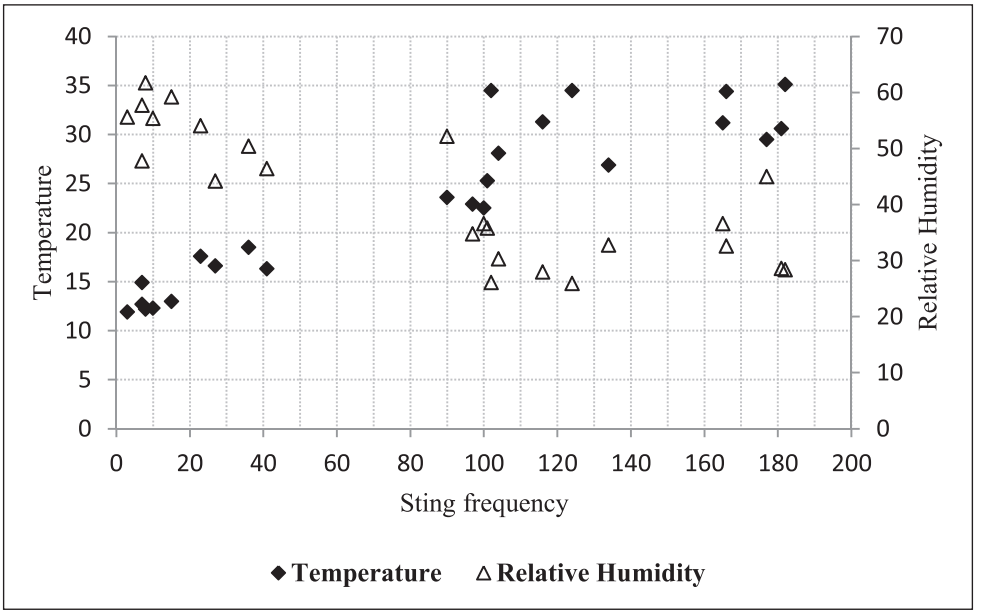


Figure 2. Scatterplots of monthly scorpion sting cases, monthly mean temperature and relative humidity.

limited in the prevention against scorpion sting accidents; the frequency of events remains high. The fact that the upper and lower limbs are the most affected parts of the body (93.7% of reported victims) reveals that the human has a great responsibility in these accidents through its negligence and/or its ignorance. An active involvement of the public in decision-making processes regarding this issue would significantly reduce the incidence.

The passive immunotherapy in the mild envenomings, which represent the majority of cases, although controversial with regard to its usefulness, should be maintained as long as the zoogeography and species involved in the envenomation are not well known in the region. The designed questionnaire for scorpion sting, need again to be reviewed in order to identify more epidemiologic aspects, and more importantly, involve local medical staff in the elaboration of an improved questionnaire owing their experience. Furthermore, the development of intersectoral actions is needed to achieve preventive and effective control strategies. We need to go beyond mere information campaigns, and find effective ways to involve the representative population in consultation and decision making related to this issue and this over the long term while taking into consideration the environmental, social and economic factors.

Scorpionism, as a health issue, requires not only more attention from scholars and researchers, but also multidisciplinary scientific collaboration.

Acknowledgement. The authors thank the person in charge and the staff of the nearby public healthcare establishment Sidi Okba. Zhu is partially supported by NSERC and CHIR of Canada and NFSC-11171267, China.

Conflict of interest statement

The authors have no conflicts of interest to declare for this study.

REFERENCES

Cesaretli, Y. & Ozkan, O. (2010). Scorpion stings in Turkey: epidemiological and clinical aspects between the years 1995 and 2004. *Revista do Instituto de Medicina Tropical de São Paulo* **52**: 215-220.

Chippaux, J.P. (2012). Emerging options for the management of scorpion stings. *Drug Design, Development and Therapy* **6**: 165-173.

Chippaux, J.P. & Goyffon, M. (2006). Envenimations et intoxications par les animaux venimeux ou vénéneux: I. Généralités. *Médecine tropicale* **66**: 215-220.

Chippaux, J.P. & Goyffon, M. (2008). Epidemiology of scorpionism: A global appraisal. *Acta Tropica* **107**: 71-79.

Dupre, G. (2016). Nouveaux taxa de scorpions en 2015. *Arachnides* **77**: 1-60.

Jarrar, B.M. & Al-Rowaily, M.A. (2008). Epidemiological aspects of scorpion stings in Al-Jouf Province, Saudi Arabia. *Annals of Saudi Medicine* **28**: 183-187.

Kassiri, H., Mohammadzadeh, M.N., Hasanvand, Z., Shemshad, M. & Shemshad, K. (2012). Epidemiological survey on scorpion sting envenomation in South-West, Iran. *Zahedan Journal of Research in Medical Sciences* **14**: 80-83.

Kassiri, H., Shemshad, K., Kassiri, A., Shemshad, M., Valipor, A.A. & Teimori, A. (2013). Epidemiological and climatological factors influencing on scorpion envenoming in Baghmalek County, Iran. *Academic Journal of Entomology* **6**: 47-54.

Kassiri, H., Kassiri, E., Veys-Behbahani, R. & Kassiri, A. (2014). Epidemiological survey on scorpionism in Gotvand County, Southwestern Iran: an analysis of 1 067 patients. *Journal of Acute Disease* **3**: 314-319.

Laïd, Y., Boutekdjiret, L., Oudjehane, R., Laraba-Djebari, F., Hellal, H., Guerinik, M., Griene, L., Alamir, B., Merad, R. & Chippaux, J.P. (2012). Incidence and severity of scorpion stings in Algeria. *Journal of Venomous Animals and Toxins including Tropical Diseases* **18**: 399-410.

Laïd, Y., Boutekdjiret, L., Oudjehane, R. & Bachiri, K. (2000-2015). Envenimation scorpionique: rapport annuel sur la situation épidémiologique en Algerie. Unité Santé Environnement, Institut National de Santé Publique. ISSN 1112-3303.

Ministère de la santé, de la population et de la réforme hospitalière (2009). Comité national de lutte contre l'envenimement scorpionique. Prise en charge de l'envenimation scorpionique.

Ministère de la santé, de la population et de la réforme hospitalière (2012). Instruction n 04/MSPRH/DP du 04 mars 2012. Available from http://www.sante.dz/inst_env_scorp.pdf

Ozkan, O., Adiguzel, S., Yakistiran, S., Cesaretli, Y., Mehmet, O. & Karaer, Z. (2006). Androctonus crassicauda (Olivier 1807). Scorpionism in the Saniliurfa provinces of Turkey. *Türkiye Parazitoloji Dergisi* **30**: 239-245.

Rafizadeh, S., Rafinejad, J. & Rassi, Y. (2013). Epidemiology of scorpionism in Iran during 2009. *Journal of Arthropod-Borne Diseases* **7**: 66-70.

Selmane, S. (2015). Scorpion envenomation and climate conditions: the case of Naama Province in Algeria. *International Journal of Mathematical Models and Methods in Applied Science* **9**: 261-268.

Selmane, S., Benferhat, L., L'Hadj, M. & Zhu, H. (2016). Modelling the scorpion stings using surveillance data in El Bayadh Province, Algeria, *Asian Pacific Journal of Tropical Disease* **6**: 961-968.

Taj, S., Vazirian, M., Vazirianzadeh, B., Bigdeli, S. & Salehzadeh, Z. (2012). Effects of climatological variables on scorpion sting incidence in Ramshir area south west of Iran. *Journal of Experimental Zoology India* **15**: 575-577.

Touloun, O., Boumezzough, A. & Slimani, T. (2012). Scorpion envenomation in the region of Marrakesh Tensift Alhaouz (Morocco): epidemiological characterization and therapeutic approaches. *Serket* **13**: 38-50.

Vachon, M. (1952). *Etude sur les scorpions*. Institut Pasteur d'Algérie, Alger. 482pp.