

SCORPION STING: A PUBLIC HEALTH PROBLEM IN EL KELAA DES SRAGHNA (MOROCCO)

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ABSTRACT: The present study aimed at verifying the impact of a Moroccan strategy against scorpion stings and specifically at identifying the epidemiological features of patients envenomed or just stung by scorpions. It included 11,907 patients from El Kelaa des Sraghna Province, Morocco, who were evaluated over five years (2001–2005). Most stings occurred during the hot period and mainly at night. The average incidence was 3.2 per 1,000 inhabitants; patients ≤ 15 years accounted for 34%, and the envenomation rate was 12%. Average lethality rate was 0.7%. Our work evaluated the efficacy of the adopted strategy based on indicators of follow-up, morbidity and lethality due to scorpion sting and envenomation.

KEY WORDS: epidemiology, scorpions, strategy, indicators, El Kelaa, Morocco.

CONFLICTS OF INTEREST: There is no conflict.

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INTRODUCTION

Scorpions play an important role in severe cases of human envenomation in Morocco (10–16). A previous epidemiological study (10) showed that scorpion stings accounted for 30%–50% of all the poisoning cases reported to the Poison Control Center of Morocco (PCCM) mainly in the south and central-south provinces of the country, where the highest lethality rate was reported.

Ninety percent of the fatal victims were younger than 15 years old (10). According to the data from the National Strategy Against Scorpion Stings, approximately 25,000 stung patients are recorded every year in Morocco (12).

There are more than 30 scorpion species in Morocco, but not all of them are dangerous to humans. *Androctonus mauretanicus mauretanicus* is one of the most lethal scorpion species (6, 16, 17) in El Kelaa des Sraghna Province, where humans and scorpions share the same habitat. During the study period, 83 death and 11,907 stings were recorded in this region.

One component of the National Strategy Against Scorpion Stings is an information system which was established based on the national records in order to trace morbidity and mortality indicators.

The aims of the present study were: to investigate morbidity and mortality indicators using the records of the system for El Kelaa des Sraghna Province over five years (2001–2005); to describe the specific epidemiological map of this province, defining the disease prognosis; to assess the impact of the National Strategy on scorpionism; and to compare the obtained data with regional and national data.

MATERIALS AND METHODS

Studied Area

The province El Kelaa des Sraghna belongs to the region of Marrakech Tensift Al Haouz (MTH), one of the 17 regions of the Kingdom of Morocco. MTH region is limited by Chaouia Ouardigha and Doukkala Abda on the north, the Atlantic Ocean on the west, Tadla Azilal on the east and Souss Massa Daraa on the south (Figure 1). The majority of its territory presents arid climate, hot in the summer and cold in the winter.

El Kelaa des Sraghna is located in the center of Morocco, with approximately 750,000 inhabitants (epidemiological data of population projection from the medical

delegation of El Kelaa des Sraghna), rural in its majority. Administratively, it comprises five urban and 62 rural communes.

Since about fifteen years, PCCM has been concerned with the problem of scorpion stings in this region and, through exploratory studies, the Center defined the first epidemiological data (10) and established a national strategy to combat scorpion stings (11).

One of the main components of this strategy is the installation of an information system (including the record, reference form, against-reference form, monthly statement and hospitalization form) which defines follow-up indicators. Based on it, the first national and regional data were already published (13–15).

The system was established in all medical structures of Morocco and monthly declared to PCCM as a statement (summary of the records in all medical structures. The headings composing this statement (Figure 2) are as follows:

Elements of the Information System:

• Characterization of the Epidemiological Data:

a. Date and Province

Name of the medical delegation (province) and month of the statement.

b. Patients

- Age: children ≤ 15 years or patients older than 15 years.
- Sex: male or female.

c. Classification of the Admission

The patient was admitted:

Directly (**R0**), referred by another medical structure (**R1**), or referred to a better organized medical structure if complications developed (**R2**).

• Characterization of the Clinical Data:

a. Class of Gravity (4)

Class I: Presence of local signs.

Class II: Presence of systemic symptoms without risk of death.

Class III: Presence of vital failure.

b. Monitoring

Observation (Ob) up to 4h after sting (Class I), until total disappearance of the signs (Class II), or hospitalization (H: Class III and the complicated cases of Class II).

c. Treatment

The patient needed symptomatic treatment (T1-T2) or not (T0).

d. Prognosis

Favorable (E1) or death (E2).

Methods

1 - Criteria of inclusion: All patients living in El Kelaa des Sraghna Province, who were victims of scorpion stings and reported to one of the medical structures of the Ministry of Health, were retained for the study.

2 - Criteria of exclusion: All scorpion-stung patients, who reported to a medical structure other than that of the Ministry for Health (private center, military), or those cases not reported were not included in the investigation.

Information was progressively collected by the recorder starting from the patient admission. Monthly, the provincial epidemiologic cell organizer compiles the statement data and transmits them to the Toxicovigilance Department of PCCM for the study of the following regional and national follow-up indicators:

- Number of scorpion sting cases according to the month and the year;
- Incidence rate: number of new cases among the general population during the study period;
- Children ≤ 15 years: proportion of 15-year-old or younger victims;
- Sex ratio: male/female ratio;
- Envenomation rate: proportion of envenomed subjects (Classes II+III) among stung patients during the study period;
- General lethality rate: proportion of subjects that died among stung patients during the study period;
- Specific lethality rate due to envenomation: proportion of subjects that died among envenomed patients (Classes II+III) during the study period;
- Specific lethality rate in children ≤ 15 years: proportion of ≤ 15 -year-old stung subjects that died during the study period;

- Percentage of hospitalized patients: ratio of hospitalized subjects among the total number of stung patients;
- Percentage of patients not requiring treatment: report/ratio of subjects that were not treated among the total number of stung patients; and
- Adequacy of reference: percentage of hospitalized subjects among those referred by another medical structure.

Data Analysis

The program Microsoft Office Excel was used to compare valid information about the patients. In case of significant differences, intragroup comparison was made using the Duncan's test to determine the number of subgroups for each parameter. Values of p lower than 0.05 were considered statistically significant.

RESULTS

National Results

From 2001 to 2005, 107,337 scorpion sting cases were reported to PCCM (Table 1), with a significant increase in reported cases, regions and provinces. In 2005, the majority of the areas of Morocco (16 out of 17) sent their statements to PCCM. The average national incidence of scorpion stings ranged from 1 to 1.2 per 1,000 inhabitants per year. According to areas, it varied from 0.004 to 2.9 per 1,000 inhabitants. Children ≤ 15 years represented 30% of the stung population per year and the sex ratio was invariably between 0.9 and 1. During these five years, the average of patients belonging to Severity Class I was 90.5%, whereas those belonging to Classes II and III accounted for 8% and 1.1%, respectively. The average rate of national envenomation was 9.1%, varying from 7.8% to 11.6%, according to years. The national and regional characteristics are mentioned in Tables 2 and 3.

Provincial Results

Over these five years of investigation, 11,907 data about scorpion stings were collected. The frequency of victims yearly increased and the average incidence rate was 3.2 per 1,000 inhabitants (Table 1).

Distribution of Envenomed Patients according to Age and Sex

Thirty percent (30%) of the patients were 15 years old or younger. The male/female ratio was 0.9.

Seasonal Distribution of Scorpion Sting Cases

Stings were mainly observed between May and September with a peak in July-August (43.2%).

Clinical Data

The great majority of patients belonged to Severity Class I (88%), followed by Classes II (11%) and III (1%). The envenomation rate was 12%. The percentage of cases referred to a medical structure better than that of the admission was 10.7%. In 85.6% of the cases, no treatment was given to stung patients, and only 11% of the patients required hospitalization. No patient received antivenoms. Reference from a medical structure to the hospital was adequate in 96.7% cases.

Prognosis

From 2001 to 2005, lethality rate was 0.55%, 0.62%, 0.70%, 0.71% and 0.96%, respectively. The average lethality rate during these five years was 0.7%. In children ≤ 15 years, this rate was 2.05%. In El Kelaa des Sraghna, the lethality rate due to envenomation was 5.9%.

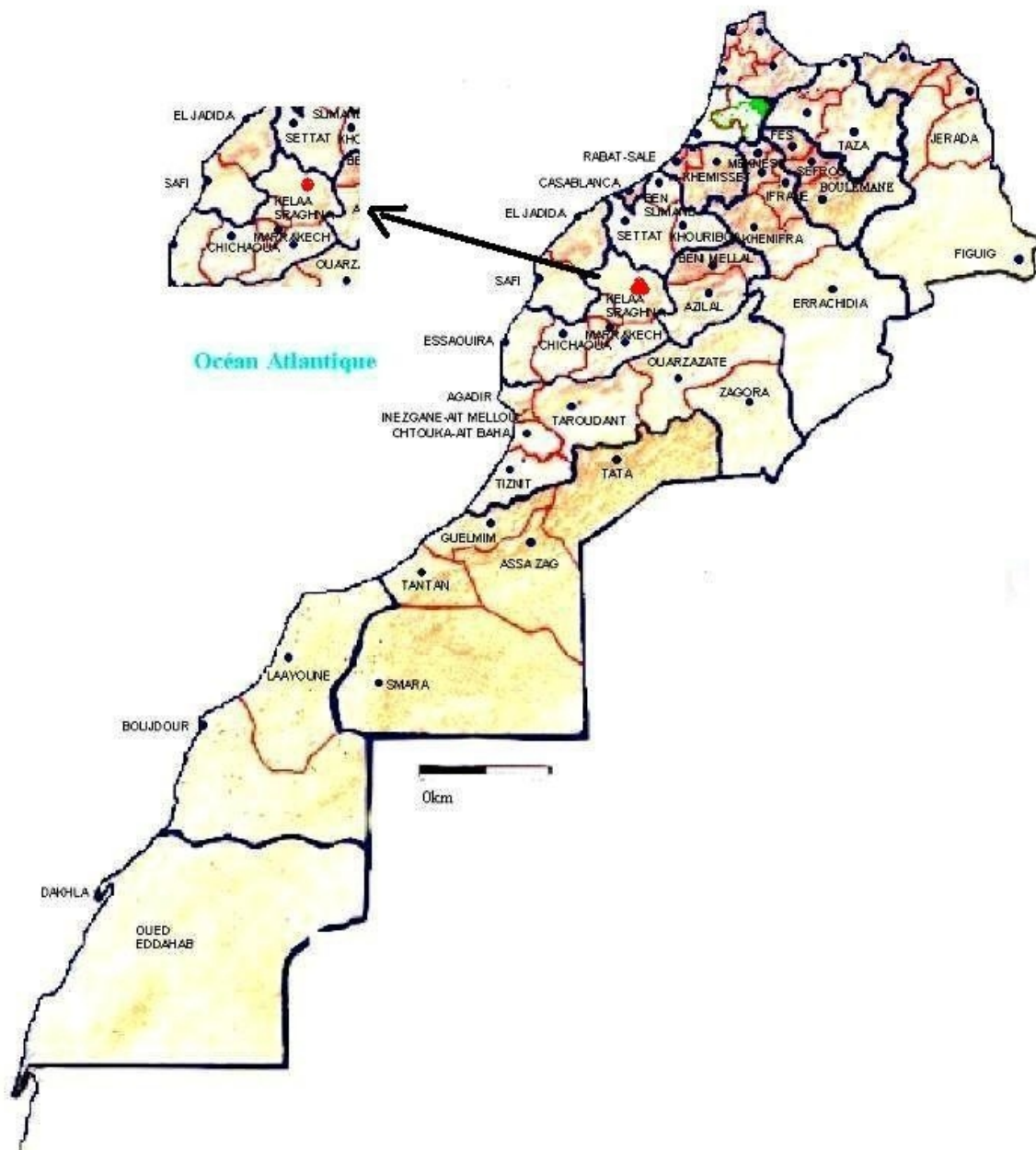


Figure 1. Geographical chart of Morocco indicating Marrakech Tensift Al Haouz region and the province EL Kelaa des Sraghna.

KINGDOM OF MOROCCO

MINISTRY FOR HEALTH

Poison Control and

Pharmacovigilance Centre of Morocco

MENSUEL STATEMENT OF SCORPION STIGN (*)

Medical Province: *El Kelaa des Sraghna*

Month/year: /_/_//_/_/_/_/

Medical structures	Sex		Age (years)		Class of gravity			Sitting in Observation (Ob)	Hospitalization (H)	Referes (R)			Treatment (T)			outcome (E)	
	M	F	≤ 15	> 15	I	II	III	Effectif	Effectif	R 0	R 1	R 2	T 0	T 1	T 2	E 1	E 2
Total																	

Figure 2. Model of the monthly statement about scorpion sting cases.

(*) This statement must be sent by fax at the end of each month.

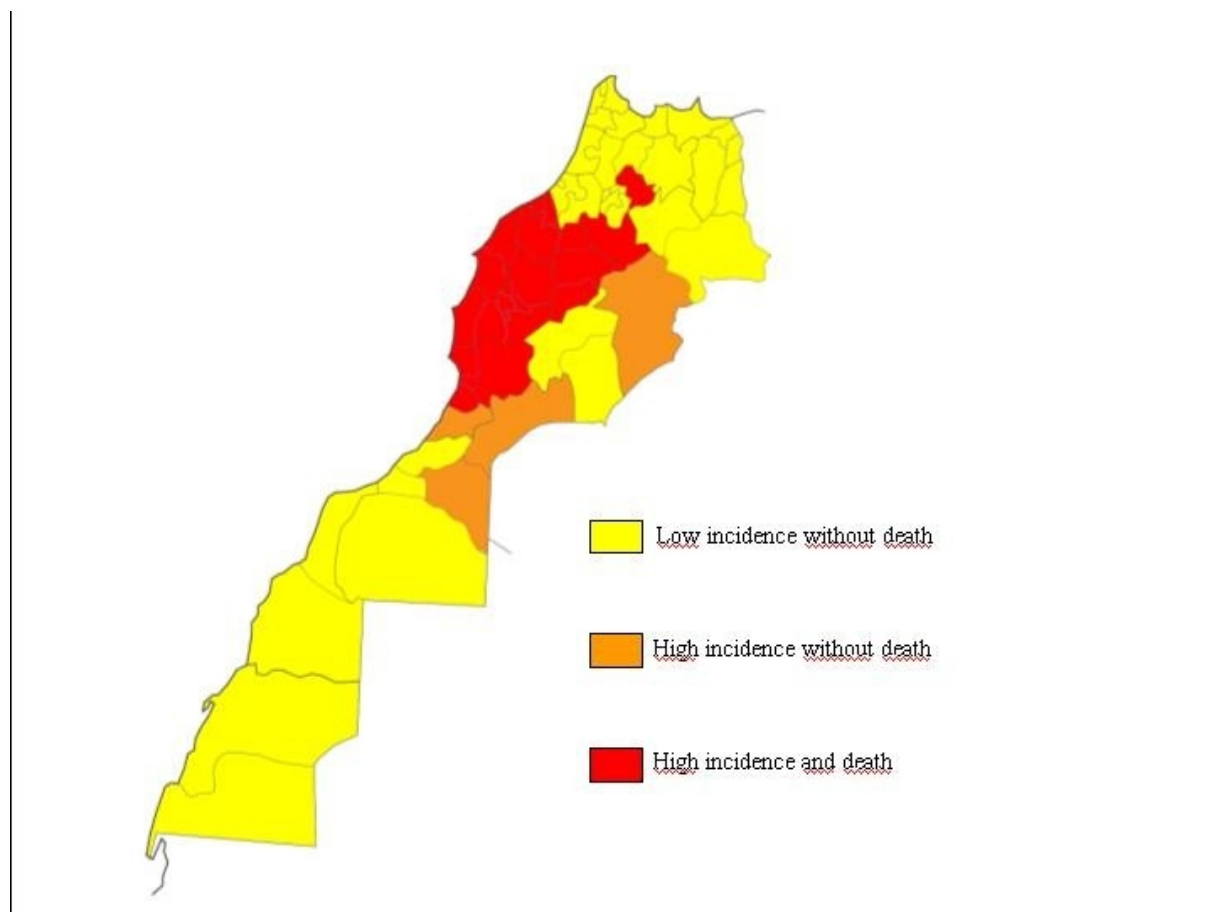


Figure 3. Distribution of scorpion stings in Morocco showing three different areas: low incidence without death; high incidence without death; and high incidence with death.

Table 1. Follow-up indicators of scorpion stings in the province El Kelaa des Sraghna, Morocco, over five years.

Indicators	2001	2002	2003	2004	2005
Stung patients (n)	3222	2244	2396	1983	2062
Incidence among inhabitants (‰)	4.3	3.0	3.2	2.6	2.7
Incidence among ≤15-year-old children (%)	33.6	33.7	35.2	36	30.7
Sex ratio	0.9	0.9	0.9	0.9	0.8
Envenomation rate (%)	10.6	10.9	10.6	12.3	15.6
Deaths (n)	18	14	17	14	20
General lethality rate (%)	0.55	0.62	0.70	0.71	0.96
Lethality rate due to envenomation (%)	5.2	5.7	6.7	5.7	6.1
Hospitalization rate (%)	X	5.2	10.5	13.7	15.6
Patients who did not need treatment (%)	X	90.1	88.5	84.5	78.5

X= No statement.

Table 2. Comparison of the evolutionary indicators of scorpion stings among El Kelaa des Sraghna Province, Marrakech Tensift Al Haouz (MTH) region, and Morocco.

Indicators	El Kelaa	MTH Region	Morocco
Stung patients (n)	11907	38440	107337
Envenomation rate (%)	12	10.4	9.1
Deaths (n)	83	208	429
General lethality rate (%)	0.7	0.54	0.4
Lethality rate due to envenomation (%)	5.9	5.2	4.7
Hospitalization rate (%)	11	5.2	4.6
Patients who did not need treatment (%)	85.6	75.4	57.7

Table 3. Comparison of the evolutionary indicators of scorpion stings between El Kelaa des Sraghna Province and Marrakech Tensift Al Haouz (MTH) region.

Indicators	El Kelaa des Sraghna	MTH Region (Except for El Kelaa)	Statistical Significance*
Stung patients (n)	11907	26533	($p < 10^{-9}$)
Envenomation rate (%)	12	9.8	($p < 10^{-8}$)
General lethality rate (%)	0.7	0.47	($p < 0.01$)
Lethality rate due to envenomation (%)	5.9	4.8	($p > 0.05$)
Hospitalization rate (%)	11	2.9	($p < 10^{-9}$)
Patients who did not need treatment (%)	85.6	71.4	($p < 10^{-9}$)

* $p < 0.05$ was considered statistically significant.

Table 4. Comparison of the evolutionary indicators of scorpion stings between Marrakech Tensift Al Haouz (MTH) region and Morocco.

Indicators	MTH Region	Morocco (Except for MTH)	Statistical Significance*
Stung patients (n)	38440	68897	($p < 10^{-8}$)
Envenomation rate (%)	10.4	8.5	($p < 10^{-9}$)
General lethality rate (%)	0.54	0.32	($p < 10^{-7}$)
Lethality rate due to envenomation (%)	5.2	3.8	($p < 10^{-3}$)
Hospitalization rate (%)	5.2	4.4 (n=91,778)	($p < 10^{-7}$)
Patients who did not need treatment (%)	75.4	48.7	($p < 10^{-11}$)

* $p < 0.05$ was considered statistically significant.

DISCUSSION

The present results show that the established information system allowed PCCM to refine, year after year, the epidemiology of scorpion stings in Morocco; to define follow-up indicators which can be a tool for the comparison of morbidity and mortality among provinces, areas of the same country and countries; and to evaluate the impact of the adopted measures. The participation of health professionals in the established information system allowed the yearly assessment of the increase in the number of scorpion stings in the Moroccan territory and the stabilization of the number of cases in El Kelaa des Sraghna (on average 2,380 scorpion stings/year).

According to the obtained results, scorpion sting cases are not negligible in this province since it accounts for 31% of the statements in MTH area, 11% of the national statements and 19.3% of the deaths in the Kingdom of Morocco. The lethality and incidence rates in El Kelaa des Sraghna are higher than the national average; the incidence rate was 3.2 per 1,000 inhabitants in the province in contrast to 1.1 per 1,000 inhabitants in the Kingdom, and the lethality rate was 0.7% in the province in contrast to 0.4% in the Kingdom.

The information system showed that certain data remained stable without any specificity, compared to data from other countries (2, 3, 10). These data include age, sex ratio and period of sting, which invariably reflect the scorpion habits and the accidents randomness; thus, scorpion stings are recorded throughout the year, but the most perilous period are hot summer days, when more deaths were recorded.

Scorpions are nocturnal arthropods. Heat increases their activity and obliges them to seek freshness (8), which explains the increase in the number of stings in this period, specially between 6 p.m. and midnight, which was consistent with scorpion ontological data (12).

The envenomation rate is an essential indicator to compare the effects of scorpion venoms in real situations. The evaluation of this indicator can have a direct effect on the treatment of victims. The concept of white sting (88% of the cases in our study: Class I) is defined as cases in which the patient was stung by a non-venomous species (10), the scorpion did not inject its venom because its venom glands were empty, or the amount of injected venom was insufficient compared to the weight of the stung subject.

The health professional in Morocco is able to differentiate among stung patients (Class I) which require no treatment or only a local treatment, those who need observation for 4h from the time of the sting (9), and envenomed patients (Classes II and III) who require a symptomatic treatment or hospitalization in intensive care unit. The envenomation rate found in the province of El Kelaa des Sraghna (12%) is in agreement with the distribution of *Androctonus mauretanicus*, *Buthus occitanus* and *Hottentota franzwernerii* (16), which are considered dangerous species in this province. Similar data were found for the other provinces of MTH region, where this rate is very significant: 22.3% in Essaouira, and between 7% and 8% in Marrakech, Al Haouz and Chichaoua.

In literature, death due to scorpion stings is expressed as absolute figures, which reflect neither the severity of the cases, nor the effectiveness of the therapeutic procedures. Besides the death rate, the general lethality rate is an important indicator to evaluate the envenomation severity in an area or a country; but it can be distorted by the number of white stings.

In Morocco, the general lethality rate was on average 0.40% over the five years of monitoring; it clearly decreased after the installation of the strategy of fight (11), especially among children younger than 15 years. In Tunisia, this rate was estimated as 0.25% (5, 7); in Algeria, in a 15-year study, it was 0.35% (1); in Argentina, according to a study in 2003, this rate was 0.59% (3), all lower than that of El Kelaa des Sraghna.

The specific lethality rate due to envenomation, not mentioned in literature, could be a better indicator of the effectiveness of the therapeutic procedures. The comparison

of this rate in El Kelaa des Sraghna (5.9%) with that in the other provinces of the same area, such as Marrakech (7.7%), Chichaoua (0.82%), Essaouira (2.3%) and Al Haouz (1.8%), showed that the adopted therapeutic procedures in El Kelaa was better than that in Marrakech, i.e. out of 100 envenomed patients (Classes II and III), 7.7 died in Marrakech and 5.9 in El Kelaa des Sraghna.

Unfortunately, this same rate in El Kelaa des Sraghna is higher than the national rate (4.7%), which draws the discussion to the adopted therapeutic procedures for scorpion envenomation cases in this province. A clinical audit system in the case of death was established at the hospital of El Kelaa des Sraghna in order to identify any irregularity in the adopted therapeutic procedures for envenomed patients and to solve it by improving the actions to be taken.

Studying the incidence and lethality according to the areas allowed us to establish an epidemiologic chart of scorpion stings and to distinguish three zones (Figure 3).

The reduction in the medical expenses is achieved by therapeutic abstention for Class-I cases, reduction in hospitalization, and rationalization of the reference structure. The percentage of patients that do not need treatment (Class I; admitted at a health center) yearly increases. Before the strategy, all stung patients (Classes I, II and III) often received useless associations of drugs (10). Today, in Morocco, 57.7% of the patients do not require any treatment; they receive systematic medical supervision until 4h after the sting as well as advices from an educational program. Ideally, this data should be 90.6%, i.e. all the only stung patients should not need any treatment. It is the case of the province El Kelaa des Sraghna, where the positive impact of the strategy is confirmed by the fact that 85.6% of the cases did not require treatment, which agrees with Class-I cases (88%), also the impact is confirmed by the fact that the majority of patients (96.7%) referred to hospital really needed hospitalization, and it is almost ideal because this figure tends to 100%. No international data approaches this issue.

Statistically, in Morocco, the MTH region is endemic for scorpion stings (Table 4), whereas the province El Kelaa des Sraghna is significantly affected by these accidents (Table 3).

CONCLUSIONS

Scorpion stings are very frequent in the province of El Kelaa des Sraghna, constituting a true public health problem with a lethality rate of 0.7%, superior to the

national rate (0.4%). Our work evaluated some indicators of follow-up, morbidity and lethality due to scorpion sting and envenomation to assess the efficacy of the established strategy, which was confirmed by:

- a) The change in the population behavior;
- b) The health professionals' ability to differentiate between scorpion stings and envenomation cases,
- c) The considerable reduction in expenses due to the decisions of PCCM, which indicates that the communication, information and continued formation constitute the basis for any high-quality process.

The efforts remain to provide a decrease in the lethality rate of children younger than 15 years; for this purpose, PCCM organizes every year: training sessions for health professionals, supported by national and international experts in the field of therapeutic procedures for envenomation, who send medical materials and drugs; days of Information, Education and Communication (IEC) on scorpion stings for auxiliary doctors and the general population; a clinical audit for death cases and IEC campaign in the educational circle of the province El Kelaa des Sraghna in order to instruct children ≤ 15 years on the habits of scorpions and prevention measures against scorpion stings and consequently death.

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