

Urbanization of human visceral leishmaniasis in Morocco



Kholoud Kahime^{a,b,*}, Samia Boussaa^c, Haddou Nhammi^d, Ali Boumezzough^{e,*}

^a Laboratory of Applied Sciences for the Environment and Sustainable Development, Ecole Supérieure de Technologie-Essaouira, Cadi Ayyad University, Marrakesh, Morocco

^b Research Group on impact, Vulnerability and Adaptation to Climate Change in Morocco (GRIVAC), FSSM, Cadi Ayyad University, Marrakesh, Morocco

^c ISPITS—Institut Supérieur des Professions Infirmières et des Techniques de Santé, Marrakesh, Morocco

^d Direction d'Epidémiologie et de Lutte contre les Maladies, Ministère de la Santé, Rabat, Morocco

^e Laboratory of Environment and Ecology, FSSM, Cadi Ayyad University, Marrakesh, Morocco

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ABSTRACT

Human visceral leishmaniasis one of the seven most neglected tropical diseases in the world. In Morocco, HVL is widespread in all regions; but it is more common in the northern part with sporadic cases observed in the South.

During the period between 2004 and 2013, the most affected Moroccan provinces were Taounate province, with 220 cases (16.09% of all cases), followed by Chefchaouen with 13.17% and Taza with 10.46% of the total cases. Children < 5 years old are the most affected age group, most cases registered were male.

Geographic distribution of HVL showed predominance in rural areas but we noted that it's opening to be urban.

1. Introduction

Human visceral leishmaniasis (HVL), also known as kala-azar, is the most several form of leishmaniasis, able to cause mortality in absence or inadequately of treatment. According to Alvar et al. (2012), the incidence of this form was about 150 cases/year between 2006 and 2008. More than 90% of global VL cases occur in just six countries: India, Bangladesh, Sudan, South Sudan, Brazil and Ethiopia (Alvar et al., 2012).

In Morocco, leishmaniasis are endemic diseases posing a major threat to public health. HVL is caused by *Leishmania infantum*, protozoan parasite, and transmitted by the bite of certain species of sandfly (Diptera, Psychodidae, Phlebotominae), belonging to the subgenus *Larrousius*: *Phlebotomus ariasi* and potentially *P. perniciosus* and *P. longicuspis* (Guessous-Idrissi et al., 1997; Kahime et al., 2015b). *L. infantum* in Morocco can cause also zoonotic cutaneous leishmaniasis and canine leishmaniasis in the north and center-south regions of the country (Kahime et al., 2015a; Boussaa et al., 2014) with the domestic dog is the main reservoir host for all forms (Rhajaoui, 2011; Kahime et al., 2014).

HVL evolution in Morocco shows 154 cases in 2004 against 76 cases reported in 1997 (Tamimy, 2011). Children less than 4 years are the most affected population (Amro et al., 2013). Almost all of these cases were from Northern traditional foci like Chefchaouen, Taounate, Taza, Fès, My Yacoub, Meknes, Sefrou, Sidi Kacemand Al Houceima. In Central and South of Morocco, *L. infantum* infections are sporadic. However, their appearance becomes more frequent recently (Moroccan Ministry of Health (MMH), 2015; Kahime et al., 2015b).

* Corresponding authors at: Laboratory of Applied Sciences for the Environment and Sustainable Development, Ecole Supérieure de Technologie-Essaouira and Department of Biology, FSSM, Boulevard Prince My Abdellah, B.P. 2390, 40000 Marrakesh, Morocco.

E-mail addresses: kahimkholoud@gmail.com (K. Kahime), aboumezzough@gmail.com (A. Boumezzough).

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The aim of this study is to establish the spatio-temporal epidemiologic pattern of HVL in Morocco according to many variables (age, gender, locality, urbanization...).

2. Materials and methods

We used clinical and epidemiological data provided by the Moroccan Directorate of Epidemiology and Fight Against Diseases, during 2004–2014 (Moroccan Ministry of Health (MMH), 2015).

A cross-sectional study was done that included all cases of HVL registered in Morocco, from January 2004 to December 2014. A suspected case was defined, according to the surveillance guide of the Moroccan Ministry of Health, before any confirmation by all different diagnosis, as a subject with fever and splenomegaly from an endemic area. Generally, HVL's evolution is very slow, from months to sometimes several years with gradual increase and worsening of clinical and biological symptoms.

The analyzed variables were gender, age, locality, month; statistical analysis was done through the program Epi-Info 6.04 of the Moroccan Directorate of Epidemiology and Fight Against Diseases.

Maps were produced for incidence repartition calculated for the studied area by using ArcMap GIS version 10. All data were analyzed by using SPSS software and results were considered significant when the P-value was less than 0.05 by using a Tukey test.

3. Results

The spatiotemporal analysis shows that in 2011 two areas were exposed to HVL by *L. infantum* in Morocco under a hypo-endemic way in rural foci. The first is mainly along a northeast axis where *L. infantum* is endemic, while the second spread from the center to south, including the Marrakech-Tensift-Al Haouz, Tadla-Azilal and Agadir-Tiznite regions like Marrakech, Chichaoua, Al Haouz, El Kelaâ, Azilal, Taroudannt, Agadir and Tiznite provinces (Table 1) and the South-East area including Zagora, Tinghir and the entire area below the High Atlas Mountains where cases have been recorded (Fig. 1).

According to Moroccan Ministry of Health (Moroccan Ministry of Health, 2014), the epidemiological situation of HVL in Morocco, between 2004 and 2013, is marked by the continued reporting of cases with an average of 137 cases/year. However, some increase since 2006 was noted (Table 1). During the period between January 2003 to December 2013, 1481 cases of VL were registered in Morocco. 171 cases have been observed in 2006 against 111 recorded in 2013 (Fig. 2).

According to locality, Taounate (Lat: 35.249; Long: – 3.940; Alt: 567 m) province is the most affected, with 220 cases (16.09% of all cases), followed by Chefchaouen (Lat: 35.171; Long: – 5.272; Alt: 600 m) with 13.17% and Taza (Lat: 34.228; Long: – 4.021; Alt: 1100 m) with 10.46% of the total cases (Table 1). For this latter province, the number of cases rose, with 1 case in 1990 to reach 26 cases in 2000. The provinces of Alhoceima (Lat: 35,249; Long: – 3,938; Alt: 14 m), Chefchaouen, Taounate and Moulay Yacoub (Lat: 34.088; Long: – 5.181; Alt: 260 m) were unharmed during the years 1990–1991 and 1992, they have become foci of HVL from 2000.

As shown in Fig. 3, Moroccan HVL occurred mainly in children under 5 years old, this category was significantly ($P < 0.05$) affected. It can affect also young and old people, reflecting the beginning of a bimodal pattern of incidence (Fig. 3). Most cases registered were male, except for 2011 as shown in Fig. 4. In fact, this may be due to social behavior of male gender, who are more active out of the houses at night and then more accessible to the vector bites. In general, the difference of gender infection is not statistically significant.

According to register of Ministry of Health, the geographic distribution of HVL showed predominance in rural areas but we noted that it's opening to be urban (Fig. 5). The difference was not statistically significant. Analysis according to urbanization was not possible because of a lack of information pre-2013 concerning type of urbanization.

4. Discussion

In Morocco the eco-epidemiological complex which characterizes HVL is not yet well understood. According to Moroccan Ministry of Health, all human cases are due to *L. infantum* MON 1.

In Morocco, *L. tropica* species may cause the visceral canine leishmaniasis. Several cases of canine leishmaniasis caused by *L. tropica* have been reported in regions where canine leishmaniasis is caused by *L. infantum* MOM 1 (Kahime et al., 2015b). In the provinces of Taounate and Al Hoceima, *L. tropica* was isolated from dogs with VL (Guessouss-Idrissi et al., 1997; Lemrani et al., 2002).

HVL-*L. infantum* is transmitted by sandflies belonging to the subgenus *Larrousius* with domestic dog being the host reservoir (Kahime et al., 2014), as *Canis familiaris* play for this culprit parasite in southwest Europe and northwest Africa, including Morocco. Nevertheless, *P. ariasi*, *P. perniciosus* and *P. longicuspis* are the proven vectors in Mediterranean countries (Amro et al., 2013; Berdjane-Brouk et al., 2012; Kahime et al., 2015b), while in Morocco, only *P. ariasi* vectorial role was confirmed.

Zarrouk et al. (2015) hypothesized the potential involvement of typical (PN) and atypical (PNA) morphs of *P. perniciosus*, *P. longicuspis* sensu stricto (LCss), and *P. longicuspis* (LCx), at least, with *P. ariasi*, in the epidemiological cycle of *L. infantum* in Morocco.

HVL is encountered habitually in children related to their immaturity and immune systems (World Health Organization, 2010); the average age is between 3.5 and 4 years (Hassani et al., 2011). A slight male predominance is noted (Lakhdar Idrissi et al., 2007).

Human visceral leishmaniasis disease is frequent in rural communities of Africa (Hailu et al., 2005). In Morocco, HVL is now spread throughout many provinces. It exists more in rural area, where, the majority of the population live at the poverty level in unsanitary housing, poorly nourished, and possibly with decrease of the immunity. Moreover, HVL is recorded in urban area. One of the major risk factors is the leishmaniasis spread may be urbanization (World Health Organization (WHO), 2002), closely related to

Table 1
HVL cases in Morocco recorded between 2004 and 2013 (Moroccan Ministry of Health (MMH), 2015).

Provinces	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Total	%
Taounate	16	25	25	31	36	21	27	17	9	13	220	16.09
Chefchaouen	18	12	24	28	26	17	18	16	12	9	180	13.17
Taza	23	21	19	13	16	21	7	11	9	3	143	10.46
Moulay Yacoub	19	17	22	9	9	11	8	6	4	8	113	8.27
Al Hoceima	14	5	3	5	14	10	16	6	7	11	91	6.66
Fez	13	12	17	1	8	5	7	4	8	2	77	5.63
Séfrou	6	6	13	6	9	9	13	5	4	4	75	5.49
Sidi Kacem	8	3	5	6	5	4	6	5	2	2	46	3.37
Meknès	4	2	5	9	4	5	2	3	6	1	41	3.00
Tétouan	3		5	3	4	4	1	1	2	5	28	2.05
El Hajeb	1	2	6	6	3	2		1	2	2	25	1.83
Nador	2	2	2	3	1	2	3	3	3	4	25	1.83
Khénifra	2	2		5	10	2	2			1	24	1.76
Kénitra	1			4	2		2	3	7	3	22	1.61
Beni Mellal	4	2	2	4	1	3	2	1	1		20	1.46
Al Haouz	3	2	3	1		1		1	1	4	16	1.17
Larache	3			4	2	2		2	2	1	16	1.17
El Jadida	3		2	3	4		2				14	1.02
Zagora	2		3	3			1	1	2	2	14	1.02
Ouazzane								4	3	5	12	0.88
Azilal						2	4	1		4	11	0.80
Boulemane			2	2			1		4	1	10	0.73
Errachidia	1		3	3						2	9	0.66
Khémisset			2	3			2		2		9	0.66
Tata	1		1				6			1	9	0.66
Berkane			1	1		1		2	2	1	8	0.59
Driouach								2	2	3	7	0.51
Taourirte	1				1	3		1		1	7	0.51
Chichaoua	1	1		1		1	2				6	0.44
Ouarzazate					1	3			1	1	6	0.44
Settat	1				2		1			2	6	0.44
Taroudannt			2		2	1				1	6	0.44
El Kelaâ				1		1				3	5	0.37
Guercif (Taza)								1	2	2	5	0.37
Marrakech			1	1		1	1				5	0.37
Tinghir (Ouarz)								1	1	3	5	0.37
Essaouira				1		1		2			4	0.29
Safi							3			1	4	0.29
Agadir			2							1	3	0.22
Chtouka					1	1	1				3	0.22
Jrada			1	1					1		3	0.22
Khouribga				1	1					1	3	0.22
Mdiq Fnideq							1	1	1		3	0.22
Salé				1				1	1		3	0.22
Sidi Youssef										2	2	0.15
Tiznit	1							1			2	0.15
Assa Zag	1										1	0.07
Fahs Anjra	1										1	0.07
Ifrane								1			1	0.07
Inezgane								1			1	0.07
Oujda					1						1	0.07
Rabat										1	1	0.07
Sidi Slimane										1	1	0.07
Tanger Assilah	1										1	0.07
Temara								1			1	0.07
Other provinces									12		12	0.88
Total	154	114	171	160	163	134	139	107	113	112	1367	100%

the sharp increase in migration rural–rural and/or rural–urban related to socio-economic, demographic, and environmental-climatic factors.

In recent five years “urbanization” of HVL has been observed (Moroccan Ministry of Health (MMH), 2015), like for the ACL incidence increasing (World Health Organization (WHO), 2002; Kahime et al., 2015a).

Dogs (domestic and feral) are the main reservoir of infection. Due to a sizeable feral population and lack of a proven effective vaccine for control of canine leishmaniasis it is practically impossible to control HVL.

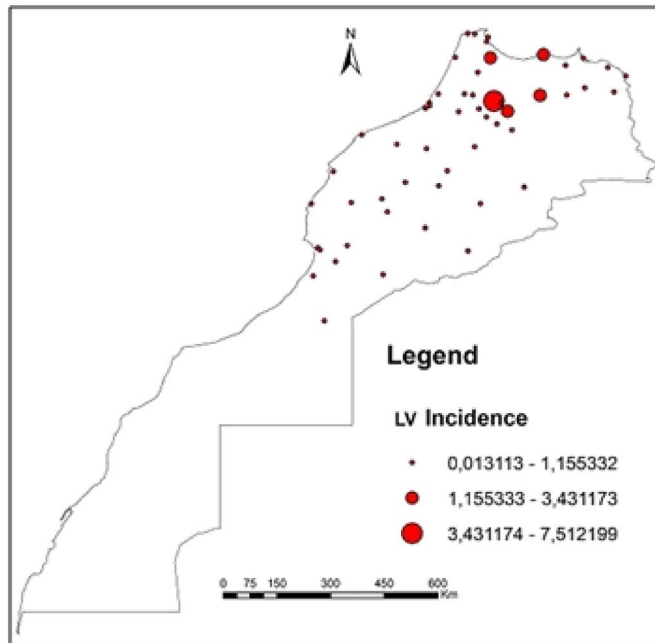


Fig. 1. Geographical distribution of HVL incidence (cases due to *L. infantum*/100,000 population/(2003–2014 period) in Moroccan provinces.

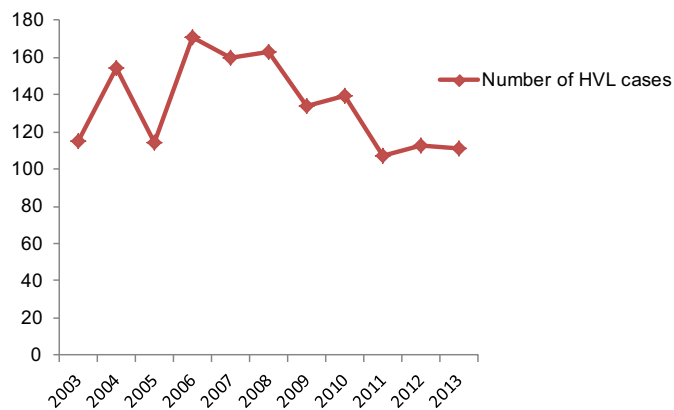


Fig. 2. Confirmed cases of visceral leishmaniasis in Morocco, from January 2003 to December 2013.

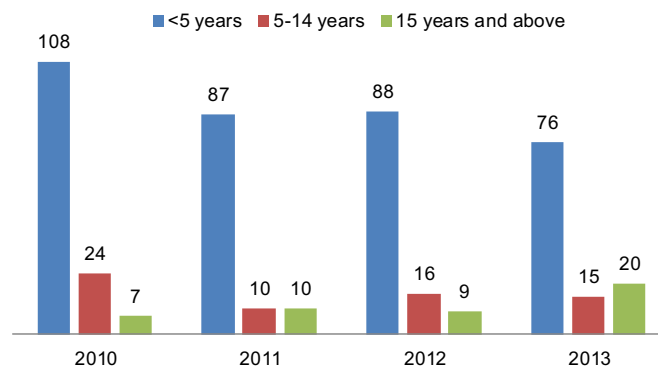


Fig. 3. Age distribution of confirmed cases (y-axis) of human visceral leishmaniasis in Morocco, from January 2010 to December 2014.

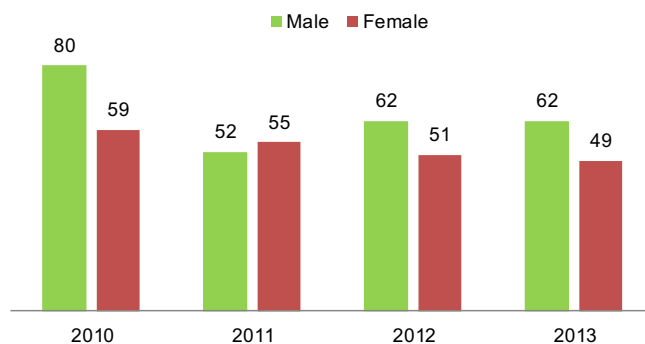


Fig. 4. Gender distribution of confirmed cases (y-axis) of human visceral leishmaniasis, in Morocco, from January 2010 to December 2014.

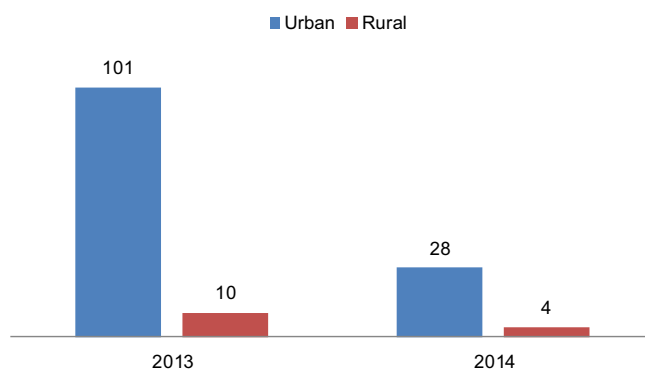


Fig. 5. Confirmed cases (y-axis) of visceral leishmaniasis by living area, of Morocco, from January 2010 to December 2014.

5. Conclusion

This study is an update of the state of HVL to *L. infantum* in Morocco whose geographical position, the coexistence of many potential vectors, the high dog population — as main reservoir of *L. infantum* (Dereure et al., 1986; Boussaa et al., 2014), climate (Ready, 2014), socio-economic condition (Kahime et al., 2012) all contribute to the spread of LVH infection. Continuous epidemiological surveillance is thus required. Furthermore, more investigations of risk factors associated especially with vector-reservoir population densities, urbanization and socio-economic conditions may provide an explanation for the change in geographical distribution of visceral forms of leishmaniasis at the local level.

Conflict of interest

The authors report no conflict of interest.

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