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**Epidemiological investigation about cutaneous leishmaniasis and canine
leishmaniasis in Algeria**

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Dedication

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Abstract

Leishmaniasis is one of the main animal diseases in Algeria. But although it is well known and wide spread.

Due to its gravity and frequency, Leishmaniasis has been widely studied in Algeria, both in humans and in dogs (disease porters). The disease continues to interest doctors, veterinarians, epidemiologists and researchers, as well as national health institutions.

Leishmaniasis is a vector-borne diseases caused by an intracellular protozoan parasite of the genus *Leishmania* common to humans and some animals, and transmitted by a female bite from a small fly called the sand fly found in forests, rural areas and around cities. This parasitic disease is widespread in the world.

This work describes a retrospective epidemiological study of human cutaneous leishmaniasis and canine leishmaniasis in Algeria which is well known as a main reservoir for this disease.

The objectives of this study were to follow the evolution over time and spatial distribution of cases of cutaneous Leishmaniasis and canine leishmaniasis.

A retrospectively study was carried out and reported cases for nine years from 2010 to 2019, collected at the National Institute of Public Health and the Direction of veterinary services .

The results showed that always the highest cases in cutaneous leishmaniasis are reported in hot spots from the country and in total Algeria recorded 93836 cases between the year 2010-2019.

We conclude that Algeria is currently among the most affected in the Mediterranean basin of human and canine leishmaniasis.

Keywords: Canine leishmaniasis , Cutaneous Leishmaniasis ,survey, Algeria

RÉSUMÉ

La leishmaniose est l'une des principales maladies animales en Algérie. Mais bien qu'elle soit bien connue et largement répandue.

En raison de sa gravité et de sa fréquence, la leishmaniose a été largement étudiée en Algérie, tant chez l'homme que chez le chien (porteurs de maladies). La maladie continue d'intéresser les médecins, les vétérinaires, les épidémiologistes et les chercheurs, ainsi que les établissements de santé nationaux.

La leishmaniose est une maladie à transmission vectorielle causée par un parasite protozoaire intracellulaire du genre *Leishmania* commun aux humains et à certains animaux, et transmise par une morsure femelle d'une petite mouche appelée mouche des sables que l'on trouve dans les forêts, les zones rurales et autour des villes. Cette maladie parasitaire est répandue dans le monde.

Ce travail décrit une étude épidémiologique rétrospective de la leishmaniose cutanée humaine et de la leishmaniose canine en Algérie qui est bien connue comme réservoir principal pour cette maladie.

Les objectifs de cette étude étaient de suivre l'évolution au fil du temps et la distribution spatiale des cas de leishmaniose cutanée et de leishmaniose canine.

J'ai analysé rétrospectivement tous les cas signalés pendant neuf ans de 2010 à 2019, recueillis à l'Institut national de santé publique (INSP) et à la Direction des services vétérinaires (DSV).

Les résultats ont montré que toujours les cas les plus élevés de leishmaniose cutanée sont signalés dans les points chauds du pays et au total, l'Algérie a enregistré 93836 cas entre l'année 2010-2019.

Nous concluons que l'Algérie est actuellement parmi les plus touchées dans le bassin méditerranéen de la leishmaniose humaine et canine.

Mots-clés : Leishmaniose canine , Leishmaniose cutanée, enquête, Algérie

الملخص

يعتبر داء الليشمانيا من الامراض الحيوانية الرئيسية في الجزائر. لكن بالرغم من أنه معروف وواسع الانتشار. نظراً لخطورته و تواتره، تمت دراسة داء الليشمانيا على نطاق واسع في الجزائر ، سواء عند البشر او الكلاب (حامل الداء). فالمرض لا يزال يثير اهتمام الاطباء، البيطرة، واخصائي الأوبئة والباحثين، وكذلك المؤسسات الصحية الوطنية. الليشمانيا هي الامراض التي تنتقل عن طريق ناقلات التي تدخلها الى الجسم قابل للتلقيح تسببه طفيليات من جنس الليشمانيا مشتركة بين الانسان وبعض الحيوانات، وتنتقل من قبل لدغة الانثى من ذبابة صغيرة تسمى ذبابة الرمل وجدت في الغابات و المناطق الريفية و حول المدن. ويعتبر هذا المرض الطفيلي منتشر على نطاق واسع في العالم. يصف هذا العمل دراسة وبائية استعادية لداء الليشمانيا الجلدي البشري وداء الليشمانيا الناب في الجزائر، والتي تعرف جيدا بأنها الخزان الرئيسي لهذا المرض.

كانت أهداف هذه الدراسة هي متابعة التطور مع مرور الوقت والتوزيع المكاني لحالات داء الليشمانيا الجلدي وداء الليشمانيا الكلاب.

لقد حللت بأثر رجعي جميع الحالات المبلغ عنها لمدة تسع سنوات من 2010 إلى 2019، التي تم جمعها في المعهد الوطني (DSV) واتجاه الخدمات البيطرية (INSP) للصحة العامة.

وأظهرت النتائج أن أعلى حالات داء الليشمانيا الجلدية يتم الإبلاغ عنها دائما في المناطق الساخنة من البلاد، وفي المجموع سجلت الجزائر 93836 حالة في السنوات ما بين 2010 و2019.

نستنتج أن الجزائر حاليا من بين أكثر المناطق تضررا في حوض البحر الأبيض المتوسط من داء الليشمانيا البشري والكلبي.

الكلمات الدالة: داء الليشمانيا لناب، الليشمانيا الجلدية ، مسح ، الجزائر

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Abbreviation List:

ZVL: Zoonotic Visceral Leishmaniasis

ZCL: Zoonotic Cutaneous Leishmaniasis

ACL: anthroponotic Cutaneous Leishmaniasis

VL: Visceral Leishmaniasis

CL: Cutaneous Leishmaniasis

CanL : Canine leishmaniosis

Ph : Phlebotomine

Introduction

Leishmaniasis is caused by an intracellular parasite transmitted to humans by the bite of a sand fly. It is a disease with a worldwide distribution; it is found in about 89 countries. It is endemic in Asia, Africa, the Americas, and the Mediterranean region transmitted by sand flies mainly of the genera *Phlebotomus* and *Lutzomyia*. Worldwide, 1.5 to 2 million new cases occur each year, 350 million are at risk of acquiring the disease, and leishmaniasis causes 70,000 deaths per year. Clinical features depend on the species of *Leishmania* involved and the immune response of the host. Manifestations range from the localized cutaneous to the visceral form with potentially fatal outcomes (Torres-Guerrero et al., 2017).

Leishmaniasis are vector-borne diseases caused by obligate protozoan parasites from the genus *Leishmania* (Trypanosomatida: Trypanosomatidae), and transmitted by the bite of infected female phlebotomine sandflies (Diptera: Psychodidae), whose hosts/reservoirs are animals such as canids, rodents, marsupials, hyraxes, dogs and humans. Epidemiological cycles of leishmaniasis fall into two broad categories: the zoonotic forms of leishmaniasis (ZL), where the primary reservoirs are wild or domestic mammals, and anthroponotic forms (AL) for which humans are the primary reservoirs. Two clinical presentations are distinguished: visceral (VL) and cutaneous (CL). Leishmaniasis are endemic in large areas of the tropics, subtropics, and the Mediterranean basin (Izri et al., 2021).

Every year, people face several insect pests and Phlebotomine sand flies (Diptera: Psychodidae: Phlebotominae) which they are a group of medically and veterinary important insect vectors of disease by the co-occurrence of a large number of competent vector species in New World endemic transmission foci of leishmaniasis. It is a transmissible parasitic disease caused by a flagellated protozoan belonging to the genus *Leishmania* (Kinetoplastida: Trypanosomatidae) transmitted to vertebrate mammals by the bite of a vector insect. Leishmaniasis is one of the vector-borne diseases that have emerged or re-emerged for a long time (Randa et al., 2017).

In this study we focused to follow the evolution over time and spatial distribution of cases of *cutaneous Leishmaniasis* and *canine leishmaniasis* in Algeria.

Chapter 1 :

Bibliographic part

Generality:

In our country, Leishmaniasis was firstly reported in 1860 Henri Hamel who discovered the disease in Biskra. The first epidemic cases were reported in the military garrisons in Biskra in 1960 where more than 200 cases were recorded. Two types of leishmaniasis are present in Algeria, visceral (VL) and cutaneous (CL) leishmaniasis. The VL caused by *Leishmania infantum*, transmitted by *Phlebotomus perniciosus* sand the reservoir is the dog, was recorded in the north of the country; in a humid bioclimatic stage, but is spreading throughout the all country. Therefore, the CL is observed in 4 clinical forms, where the reservoir and the vector vary from place to another. The first form, zoonotic cutaneous leishmaniasis (ZCL), is due to *Leishmania major* that was identified in semi-arid and arid to Saharan regions and *Phlebotomus papatasi* was the main vector and the *Gerbillidae* was the main reservoir. The second type, sporadic localized CL caused by *Leishmania infantum* was noculated by *Phlebotomus perfiliewi* and the geographic distribution and the reservoir are similar to the previous one. The third form of CL, due to *Leishmania killicki* was identified in in Ghardaïa southern Algeria and the reservoir is mainly the rodent *Massoutiera mzabi* and the vector *Phlebotomus sergenti*. The fourth form is caused by *Leishmania tropica* noticed in urban areas.

Leishmaniasis has become an emergency health problem in some countries, including Algeria; where the annual global incidence of leishmaniasis is estimated at 1.2 million new cases of CL and at 400.000 new cases of VL(Randa et al., 2017) .

1.Main disease:

Leishmaniasis are vector-borne diseases caused by obligate parasites from the genus *Leishmania* (Trypanosomatida: Trypanosomatidae). This genus is subdivided into two major phylogenetic lineages: *Euleishmania* and *Paraleishmania*. There are fifty-four named species of *Leishmania* (without considering synonyms) (fig.1) and approximately twenty species that are pathogenic to humans. These diseases are endemic in large areas of the tropics and subtropics and in the Mediterranean basin, globally spanning more than 98 countries and territories. There are approximately 350 million people at risk for leishmaniasis and approximately 12 million cases worldwide, with an estimated annual incidence of 0.7 ± 1.2 million cases of CL (cutaneous leishmaniasis) and 0.2 ± 0.4 million cases of VL (Visceral leishmaniasis) (Eddaikra et al., 2018).

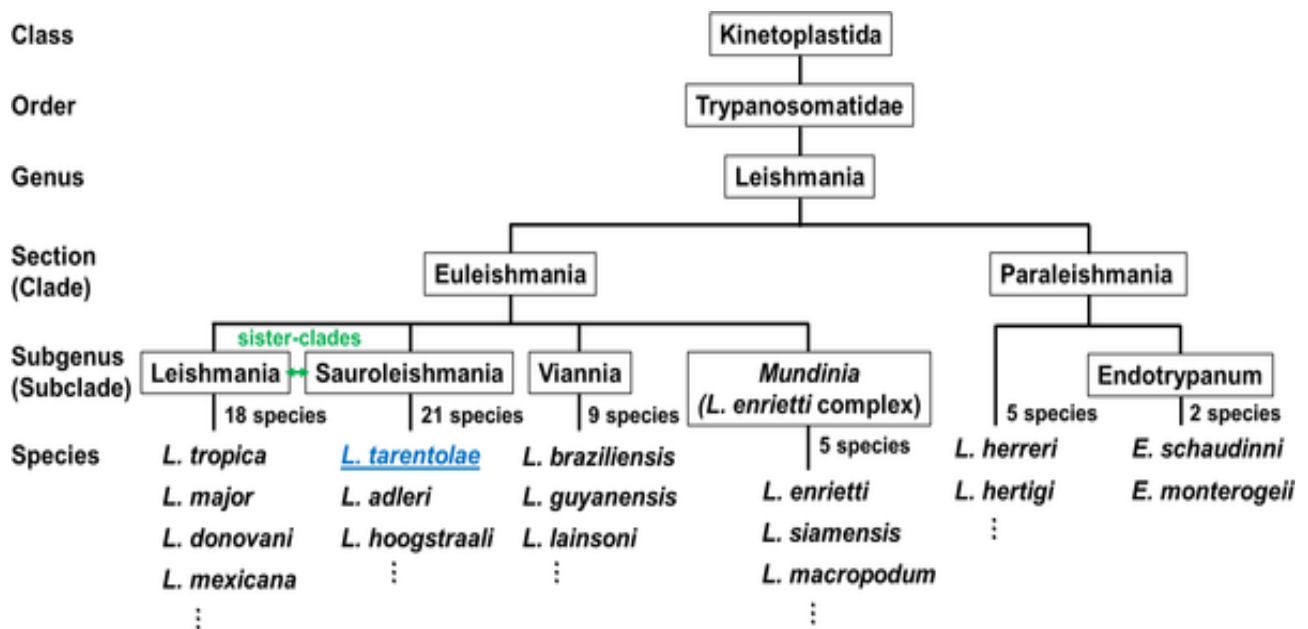


Figure 1: species of *Leishmania* (Salomão et al., 2017)

2.Human Leishmaniasis:

In Algeria, cutaneous and visceral leishmaniosis constitute a public health concern. Algeria ranks second, after Afghanistan, for the incidence of cutaneous leishmaniosis. The visceral form, recorded in humid and sub-humid regions located in the north of the country, is caused by *Leishmania infantum*, with dogs as the main reservoir and *Phlebotomus perniciosus* or *P. longicuspis* acting as vectors. This disease affects mainly children under 5 years of age. *L. major*, *L. infantum* and *L. killicki*(syn *L. tropica*) are the identified causative agents of the cutaneous forms of the disease in Algeria (Eddaikra et al., 2018).

Cases of cutaneous leishmaniosis caused by *L. major* are widely distributed across the arid zones of the southern part of Algeria. The identified mammalian reservoir hosts of *L. major* are wild rodents, including *Psammomys obesus* and *Meriones shawi*. Its proven vector is *Phlebotomus papatasi*. In the northern humid and sub-humid parts of the country, *L. infantum* is responsible for the sporadic form of CL. The main vector is *P. perfiliewi*, and the reservoir hosts are dogs. In addition, an outbreak of cutaneous leishmaniosis caused by *L. killicki* (syn *L. tropica*) and transmitted by *Phlebotomus sergenti* was detected in 2005 in the province of Ghardaia (Eddaikra et al., 2018).

3. Canine leishmaniosis:

Dogs are competent reservoirs/hosts of several protozoan pathogens transmitted by blood-feeding arthropods. Throughout their long history of domestication, they have served as a link for the exchange of parasites among livestock, wildlife, and humans and therefore remain an important source of emerging and re-emerging diseases (Medkour *et al.*, 2020).

Canine leishmaniosis (CanL) caused by *L. infantum* is a zoonotic disease that affects millions of dogs. The clinical features of the disease vary from subclinical, self-limiting infections to fatal disease. The incubation period of CanL ranges from a few months to several years. The clinical features of the disease vary from subclinical self-limiting infection to fatal disease. In Algeria six zymodemes have been found to infect dogs and cause the different damage according to the type of factor, They got from the isolation of the dermo tropic zymodeme MON-24 of *L. infantum* from Ph.perfiliewi suggested that it was one of the main vectors of cutaneous leishmaniasis in the north of the country; the reservoir has not been identified. In addition, other zymodemes of *Leishmania* have been identified in visceral leishmaniasis patients, frequently associated with human immunodeficiency virus but the most frequently recorded is *L. infantum*, belonging to the MON-1 zymodeme (A group of parasites with the same isoenzymes) (Eddaikra *et al.*, 2018; Harrat *et al.*, 1996).

Both diseased and sub-clinically infected dogs are infectious to sand fly vectors, allowing transmission of the parasite to other dogs or humans. That is why prompt diagnosis of infected dogs is essential. Microscopic examination of smears of lymph node and bone marrow aspirates, along with serology and polymerase chain reaction, are the most frequently used diagnostic methods for CanL (Adel *et al.*, 2015).

Chapter 2:

Experimental part

Retrospective study about cutaneous leishmaniasis

1.Introduction:

Algeria ranks second after Afghanistan for the incidence of *cutaneous leishmaniasis* (CL) worldwide. Cutaneous leishmaniasis is one of many dangerous parasitic diseases. It remains a serious public health problem not only in *Souf* oasis, but also in Algeria and all developing countries (Khezzani and Bouchemal, 2017).

The results of nine-year study showed a recording of 93836 confirmed cases of cutaneous leishmaniasis and the details shows that this disease affects all municipalities and all age groups, A parallel, this study showed that the original factors of the studied area, such as climatological, agricultural and environmental factors, was the reason do not apparition this epidemic for a long time, but the changes in these conditions, resulting from various human activities create new environmental conditions, which help with the emergence and spread of leishmaniasis disease(Khezzani and Bouchemal, 2017).

2.Objective of this study:

The objective of this study is to:

- monitor the evolution over time and the distribution in space of cases of cutaneous leishmaniasis of human, archived within the National Institute of Public Health, during the period between 2010 and 2019
- Carry out a retrospective epidemiological analysis of the cases of skin leishmaniasis identified over a period of nine years (2010 to 2019), which is located in all the cities of Algeria
- Evaluate which cities are concerned to be the most one who record cutaneous leishmaniasis and discuss the results

3.Material and methods:

3.1 Study design:

The investigation was conducted from the period of 2010 to 2019 at the level of the National Institute of Public Health in Algeria and Pasteur institute of Algeria.

we addressed to them to collect the number of cases recorded in the last nine years who provided us with:

- Number of cases of LC during the period of (2010-2019)
- Population of every city
- Pasteur institute confirmed that the most method that they use to confirm (CL) is a Cutaneous biopsy, sampled according to Evans's protocol, were smeared on a microscopic slide, air-dried, fixed with absolute methanol, stained by Giemsa 10%, and directly examined under a light microscope at 500_ or 1000_ magnification.

3.2Data analysis

The data were subjected to statistical analyses. The Excel 2010 program was used for the development of the various curves and graphs and also the development of the regression line which analyzed and validated through the use of the techniques provided by IBM SPSS statistic 20 software (Statistical Package for Social Sciences).

4. Results:

❖ Human cases:

Our results were summarized in figure (4, 5, 6, 7, 8, 9,10, 11, 12, 13,14,15)

Those figures showed the evolution of LC cases between 2010 and 2019

➤ In 2010

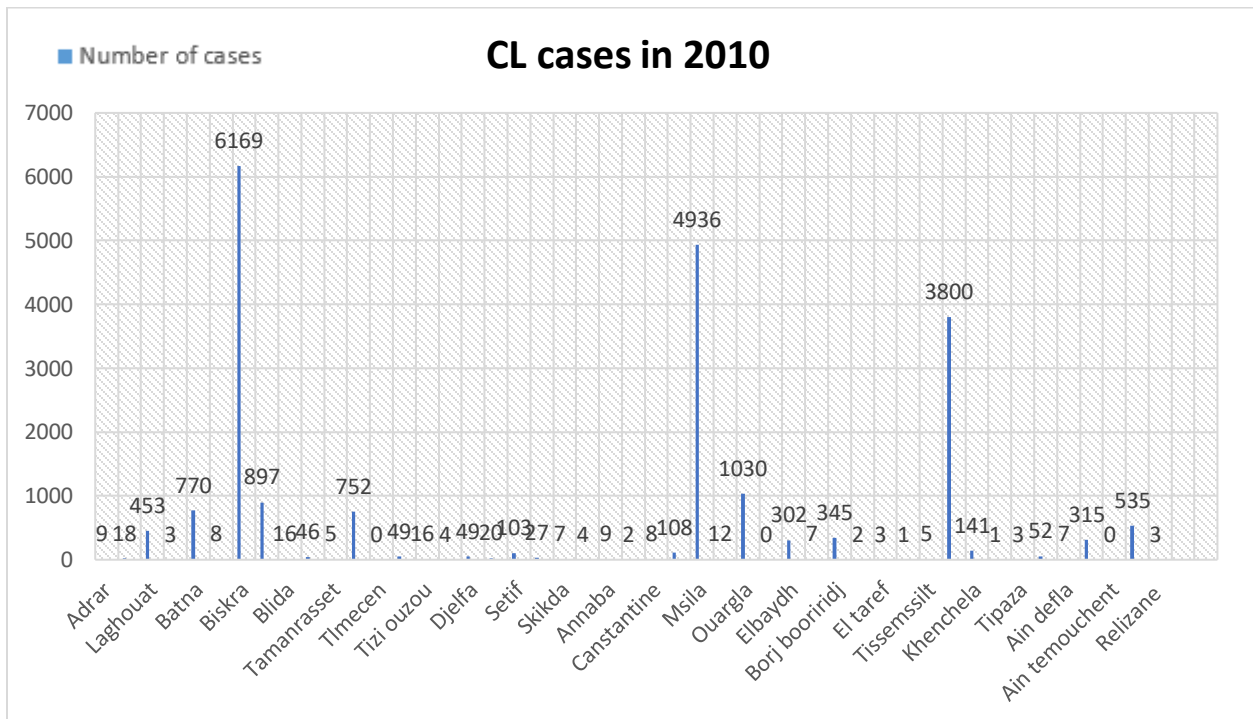


Figure 2: Graphic curve of cutaneous Leishmaniasis cases in 2010

As a result, Biskra showed the highest rate with (6166 cases) of CL in 2010, then M'Sila in the second place with (4936 cases) and El-Oued in the third place with (3800 cases).

➤ **In 2011**

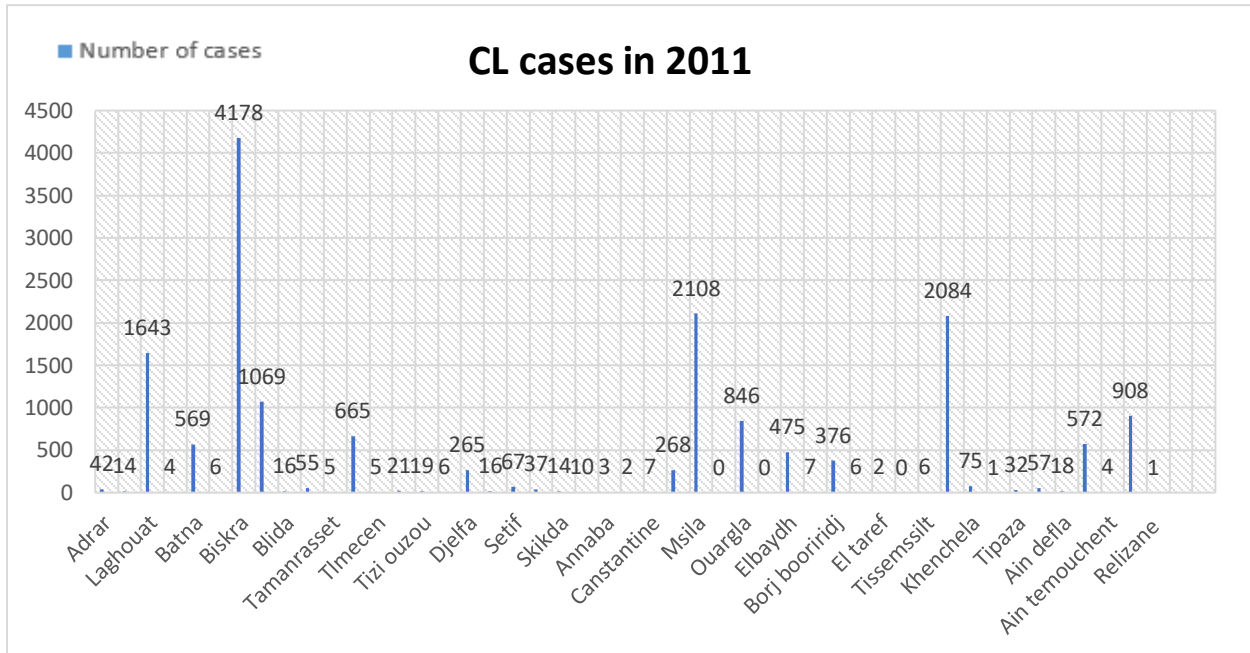


Figure 3 : Graphic curve of cutaneous Leishmaniasis cases in 2011

As a result, Biskra showed the highest rate with (4178c cases) of CL in 2011, then M'Sila in the second place with (2108 cases)and El oued in the third place with (2084 cases).

➤ **In 2012**

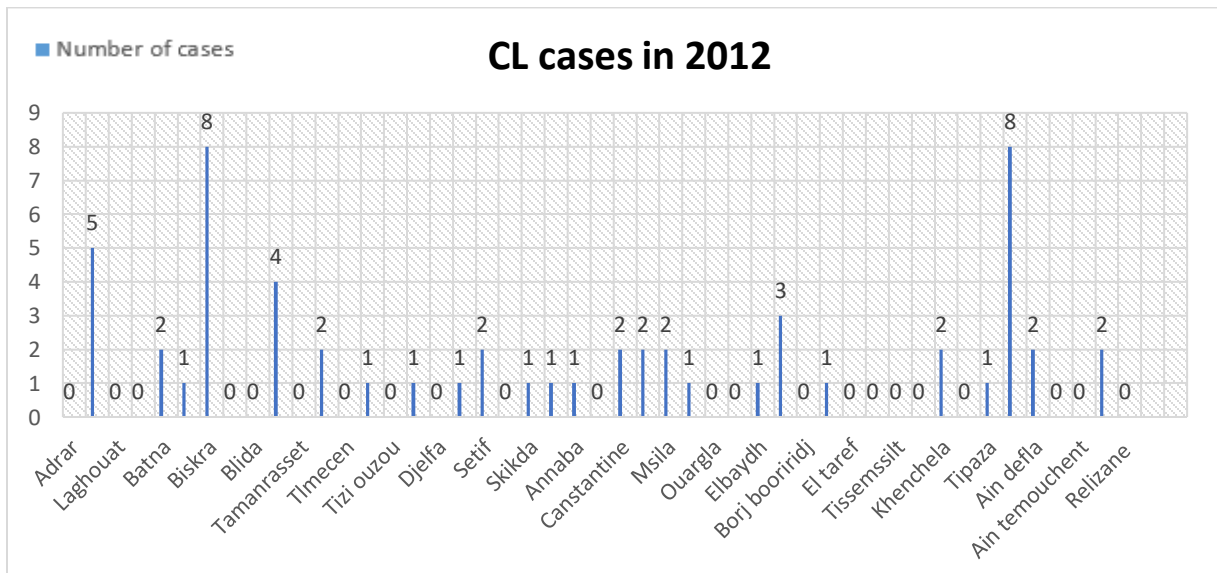


Figure 4 :Graphic curve of cutaneous Leishmaniasis cases in 2012

As a result, Biskra and Mila showed the highest rate with (8cases) of CL in 2012, then chlef in the second place with (5 cases) and bouira in the third place with (4 cases). (No record infos)

➤ **In 2013**

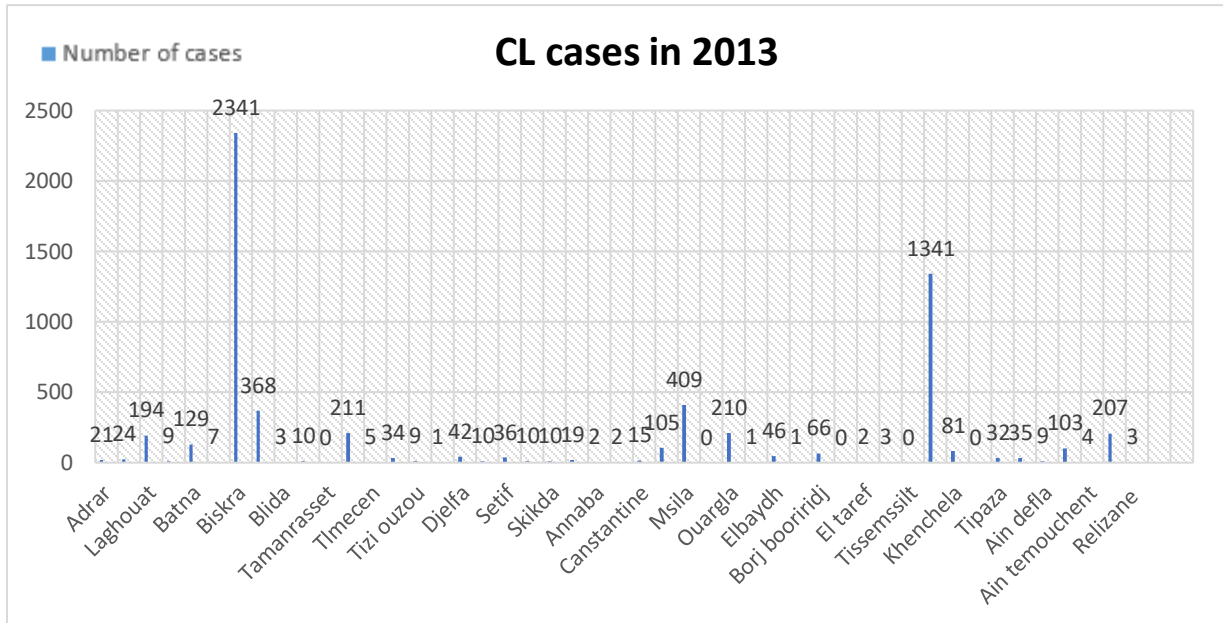


Figure 5 :Graphic curve of cutaneous Leishmaniasis cases in 2013

As a result, Biskra showed the highest rate with (2341 cases) of CL in 2013, then EL-Oued in the second place with (1342cases) and M'Sila in the third place with (409 cases).

➤ **In 2014**

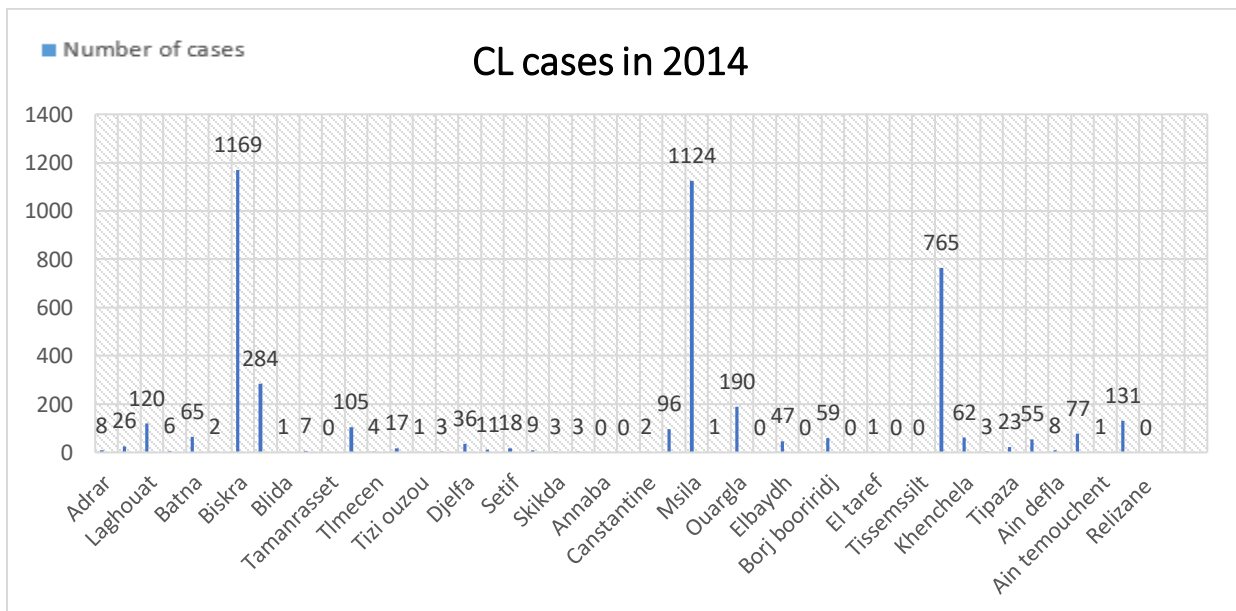


Figure 6 :Graphic curve of cutaneous Leishmaniasis cases in 2014

As a result, Biskra showed the highest rate with (1169) of CL in 2014, then M'Sila in the second place and EL-Oued in the third place with (765 cases).

➤ **In 2015**

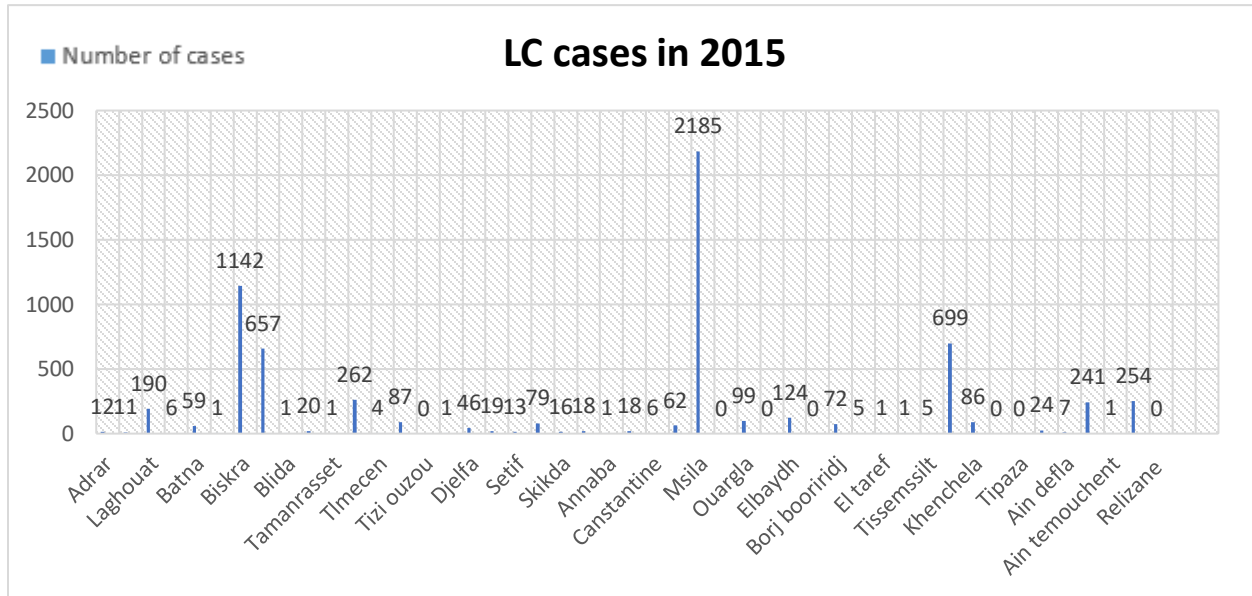


Figure 7 : Graphic curve of cutaneous Leishmaniasis cases in 2015

As a result, M’sila showed the highest rate with (2185 cases) of CL in 2015, then Biskra in the second place with (1142 cases)and El-Oued in the third place with (699 cases).

➤ **In 2016**

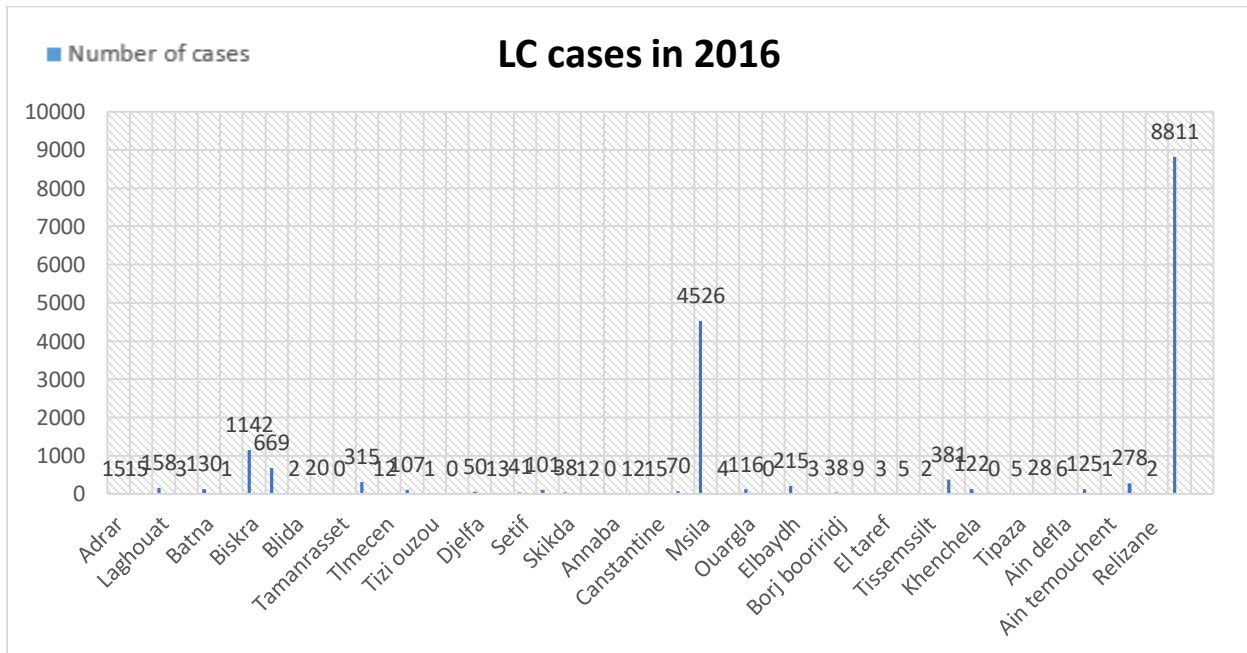


Figure 8: Graphic curve of cutaneous Leishmaniasis cases in 2016

As a result, M’sila showed the highest rate with (4526 cases) of CL in 2016, then Biskra in the second place with (1142 cases) and El-Oued in the third place with (381 cases).

➤ **In 2017**

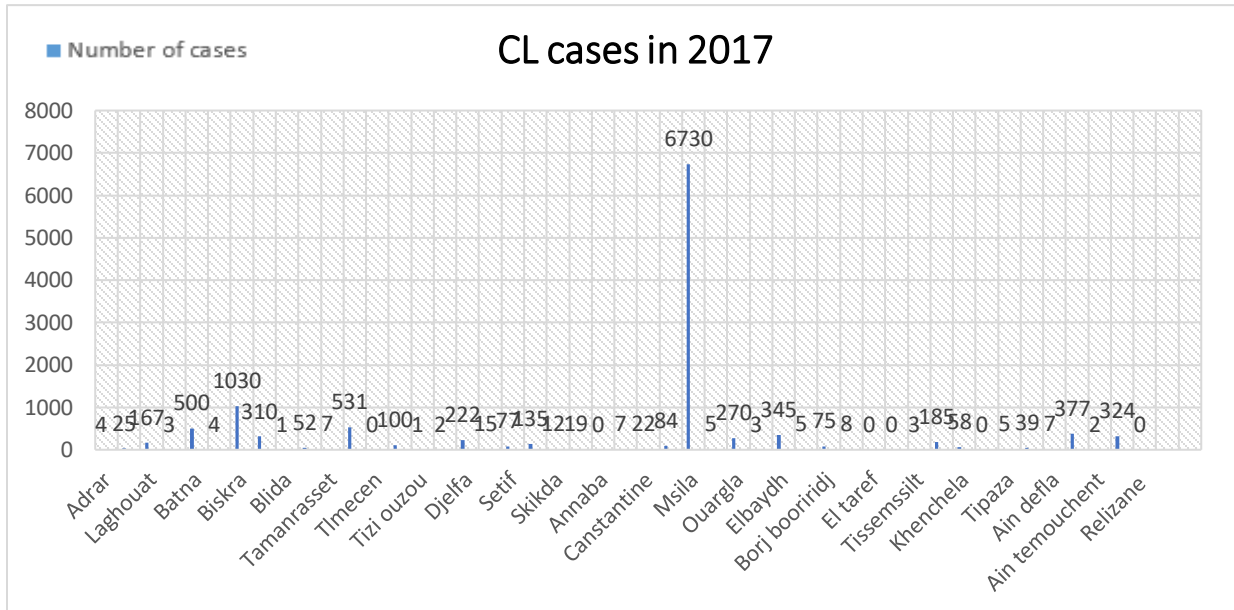


Figure 9 : Graphic curve of cutaneous Leishmaniasis cases in 2017

As a result, M’Sila showed the highest rate with(6730 cases)of CL in 2017, then Biskra in the second place with (1030) and Batna in the third place with (500 cases).

➤ **In 2018**

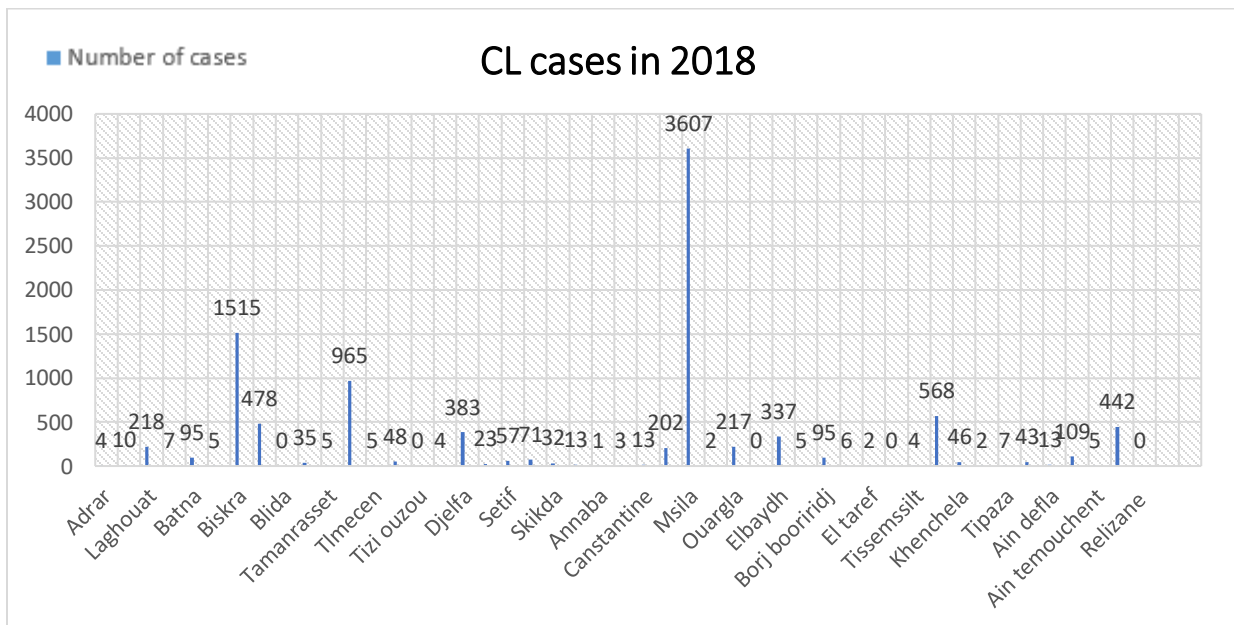


Figure 10 : Graphic curve of cutaneous Leishmaniasis cases in 2018

As a result, M’Sila showed the highest rate with(3607 cases)of CL in 2018, then Biskra in the second place with (1515 cases)and Timecen in the third place with (965 cases).

➤ In 2019

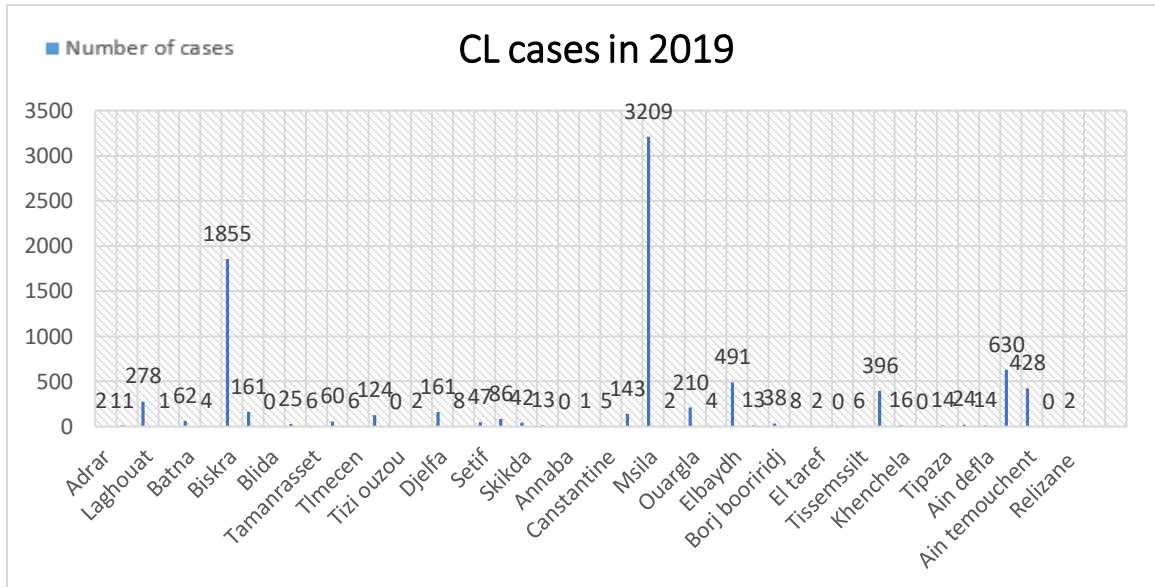


Figure 11 : Graphic curve of cutaneous Leishmaniasis cases in 2019

As a result, M'Sila showed the highest rate with (3209 cases) of CL in 2019, then Biskra in the second place with (1855 cases) and Naama in the third place with (630 cases).

This graph represents the cases of leishmaniasis in the 48 Cities during the period 2010-2019.

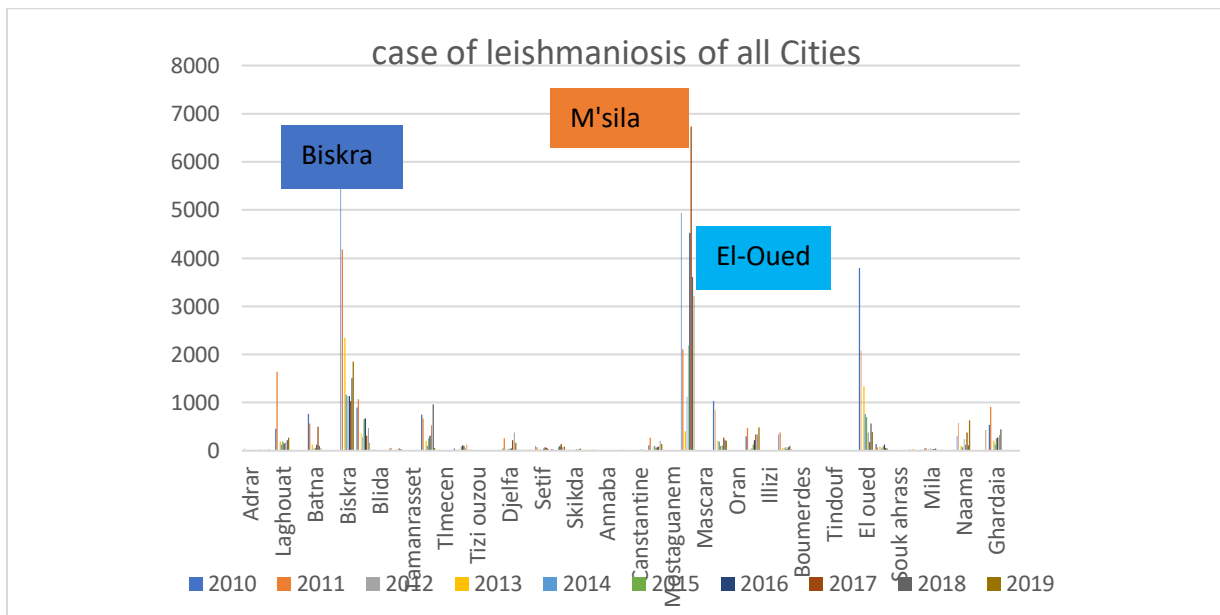


Figure 12: Cases of cutaneous Leishmaniasis of all the Cities between 2010-2019 in Algeria

We can see clearly that the most affected areas are: M'sila, Biskra and El oued

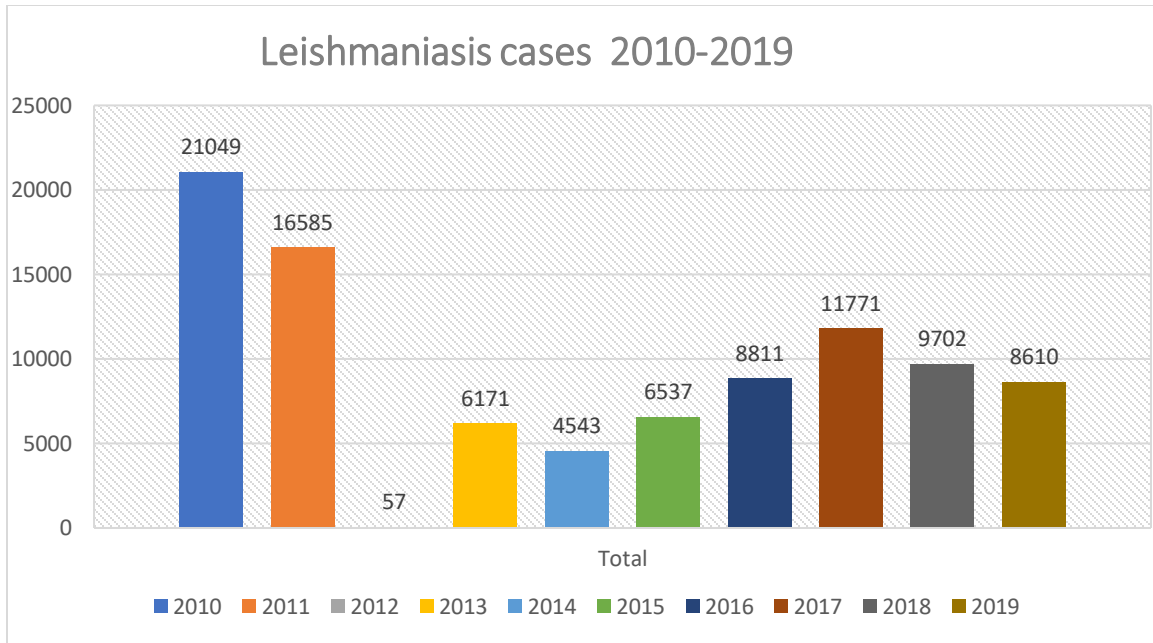


Figure 13: Global cases of cutaneous Leishmaniasis between 2010 – 2019 in Algeria

The results show that the year when we reported the highest cases of CL was 2010 and the lowest cases was reported in 2012.

5. Discussion:

In a period of nine years (between 2010 to 2019), our results show that Algeria recorded 93836 cases of cutaneous leishmaniasis which is a huge number, and we can notice that mostly every year the three cities who are classified in the top of list in the terms of cases are (Biskra , M'Sila and El-Oued) and this results explain that those region are main reservoir of this disease .

The results showed that always the highest cases in cutaneous leishmaniasis are reported in hot spots from the country.

In our country, cutaneous leishmaniasis (CL) caused by *L. major*, *L. infantum*, and *L. tropica* has a 30-fold higher incidence than the visceral form. Zoonotic cutaneous leishmaniasis (ZCL) is caused by *L. major*, in which the proven vector and reservoir are *Phlebotomus papatasi* and *Psammomys obesus*, respectively. The disease is prevalent in 41 out of Algeria's 48 districts, spanning the North Saharan fringe, and the arid and semi-arid bioclimatic areas, including Biskra, Bordj Bouarreridj, Batna, Djelfa, Saida, Sétif, M'sila, and Abadla. More recently, a spread of the disease has taken place towards M'sila, Ksar Chellala, Djelfa, and Bou-Saada foci, and the Northern part of the Tell Atlas, in the Soummam basin.

Leishmania tropica causes anthroponotic cutaneous leishmaniasis (ACL), a chronic form with less than 100 cases per year that commonly occurs in sympatry with *L. major*. It is restricted to Constantine, Annaba, Ghardaia, and Tipaza. *Phlebotomus sergenti* is considered the proven vector of *L. tropica*, with humans as the primary reservoir. Nevertheless, some animals like *Massoutiera mzabi* (the Mzab gundi from the family Ctenodactylidae) are additional suspected reservoirs. Sporadic cutaneous leishmaniasis caused by *L. infantum*. The parasitological, epidemiological, and clinical characteristics were individualized by (Belazzoug et al., 1985) .

In the north of the country *P. perfiliewi* is reported as a vector of leishmania and can be responsible of sporadic cutaneous infections all over regions in northwestern Algeria (Mostghanem ,Oran, Tlemcen) and Tell Atlas (Tizi-Ouzou, Bouira, Bordj Menail, Tipaza,Blida, and Algiers) (Izri et al., 2021).

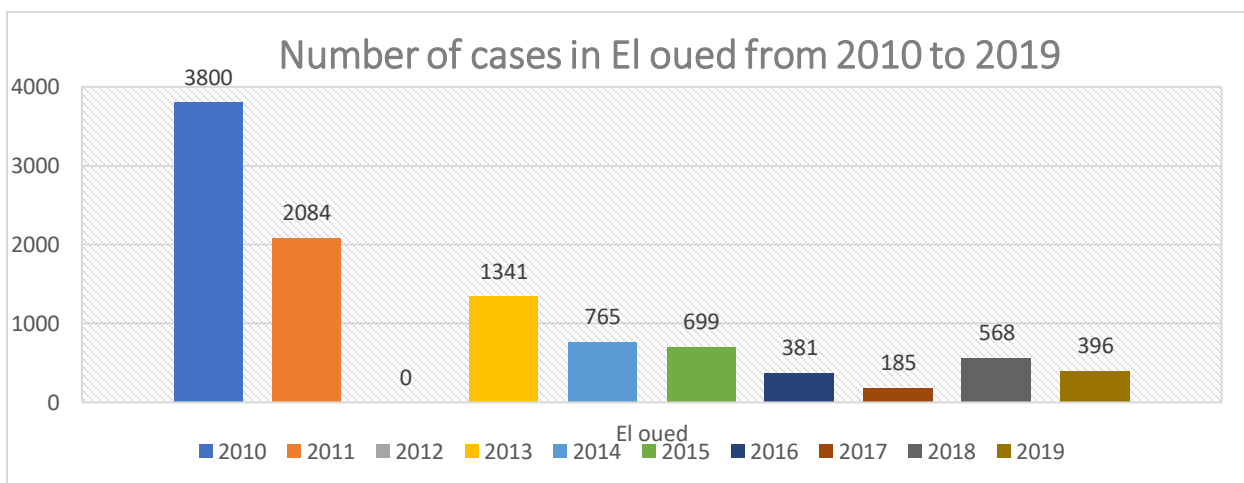
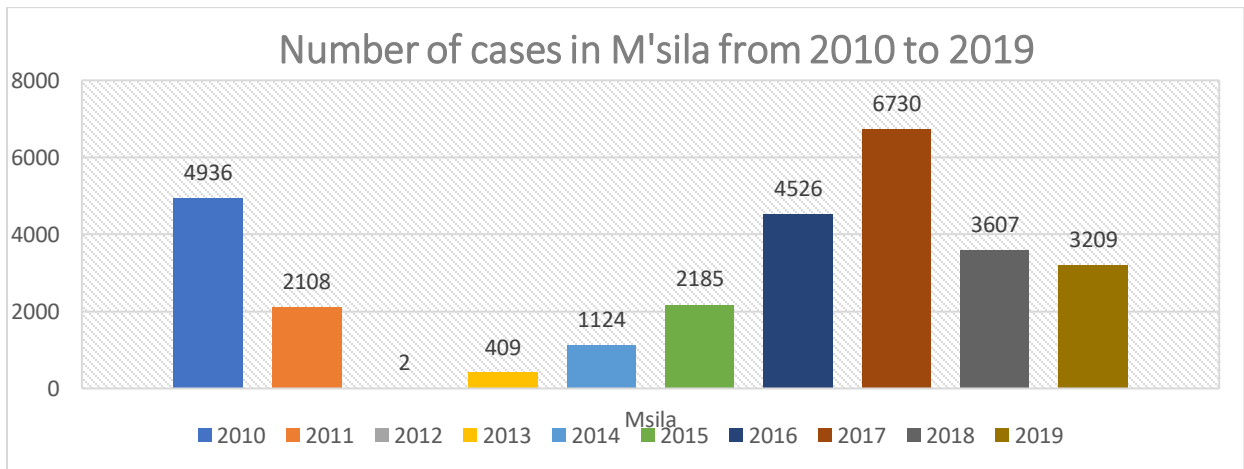
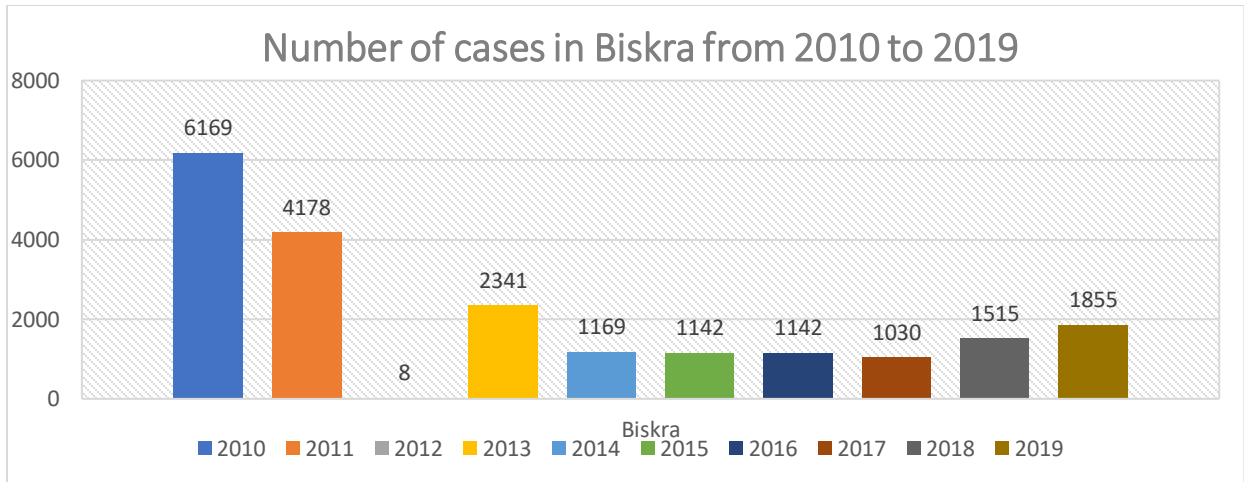


Figure 14 : Graphs show the number of cases during the period of 2010 – 2019 in the most affected cities Biskra- M'sila - El oued

6.Conclusion:

This study highlights the spread of *Leishmaniasis* from the arid zones towards the semi-arid areas. Climate changes and desertification observed in the steppe area northern Sahara could play a role in the extension of the disease like Biskra , M'Sila and EL oued .

Leishmaniasis presents a real public health problem throughout the Algerian territory, especially in Biskra and M'Sila district.

The predominance of the cutaneous form in that area is clearly in relation with the environment which is favorable for the vector development.

The development of leishmaniasis in Algeria has been marked by a considerable increase in the number of cases of cutaneous leishmaniasis in the period of 2010-2019 (more than 2000 cases per year). The results showed that always the highest cases in cutaneous leishmaniasis are reported in hot spots from the country.

Cutaneous leishmaniasis (CL) is endemic in Algeria where two forms have been previously described, in the north, the cutaneous form caused by *L. infantum*, and *L. tropical* in the southern parts of the country.

Recommendation:

First, we recommend to be aware with the area risk specially in the season when they can be active, so people can take their way to prevent leishmaniasis so they can avoid getting bitten ny using anti insect product or at least do the necessary by visiting the doctors when they get a bite.

Secondly we should limit the spread of the parasite by taking the necessary measures in the season when they can be active by indoor Residual Spraying of an antiparasitic in the street and the regions that can be home-town for the parasite.

Retrospective study about canine leishmaniasis

1.Objectives of this study:

The objectives of this study are to:

- monitor the evolution over time and the distribution in space of cases of canine leishmaniasis (CanL) in Algeria archived within the Minister of Agriculture and rural Development (MADR), during the period between 2010 and 2019
- Carry out a retrospective epidemiological analysis of the cases of canine leishmaniasis identified over a period of nine years (2010 to 2019), which is located in some cities of Algeria where they declare the disease
- Carry a survey investigation between the veterinary doctors to see how they deal with the situation of this disease.

2.Material and methods:

2.1Study design:

The investigation was conducted from the period of 2010 to 2019 at Direction of veterinary services (DSV) and some private veterinary clinics.

We addressed to them to collect the number of cases of (CanL) recorded in the last nine years who provided me with:

- Number of cases of LC during the period of (2010-2019) in some cities

3.Results:

❖ Canine cases:

Our results were summarized in figure (17,18,19,20,21,22,23)

Those figures showed the evolution of CanL cases between 2010 and 2019

➤ In 2010

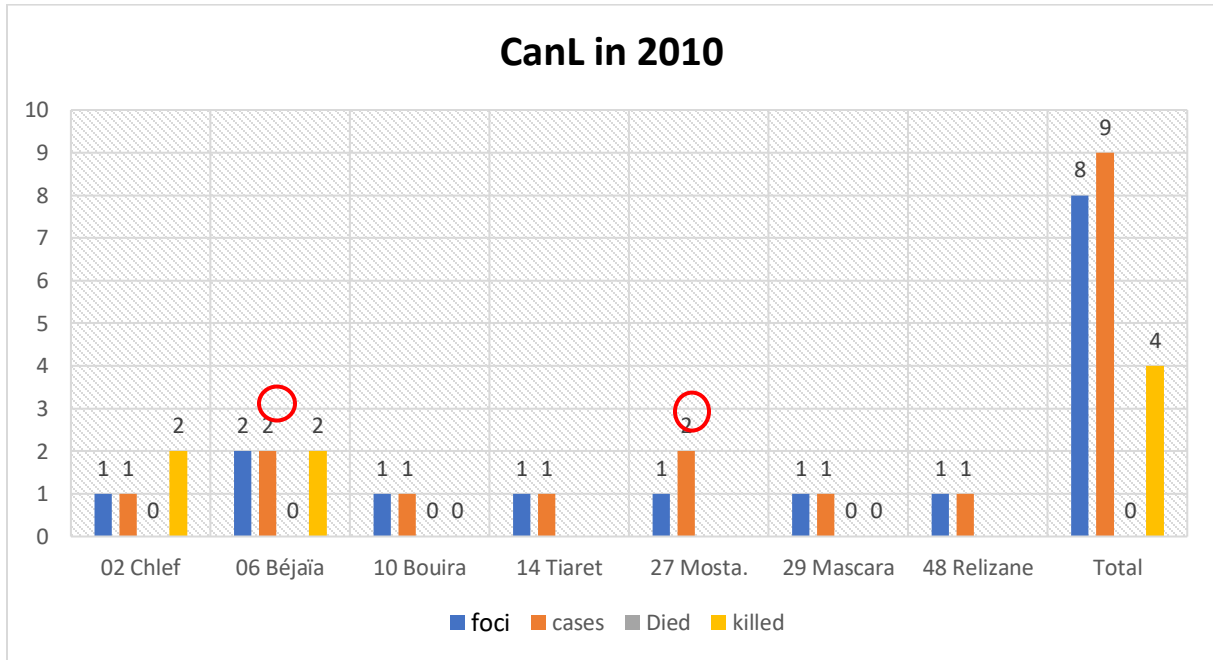


Figure 15 : Graphic curve of Canine leishmaniasis cases in 2010 in Algeria

Tow provinces Bejaia and Mostaganem recorded the highest numbers of cases

➤ In 2011

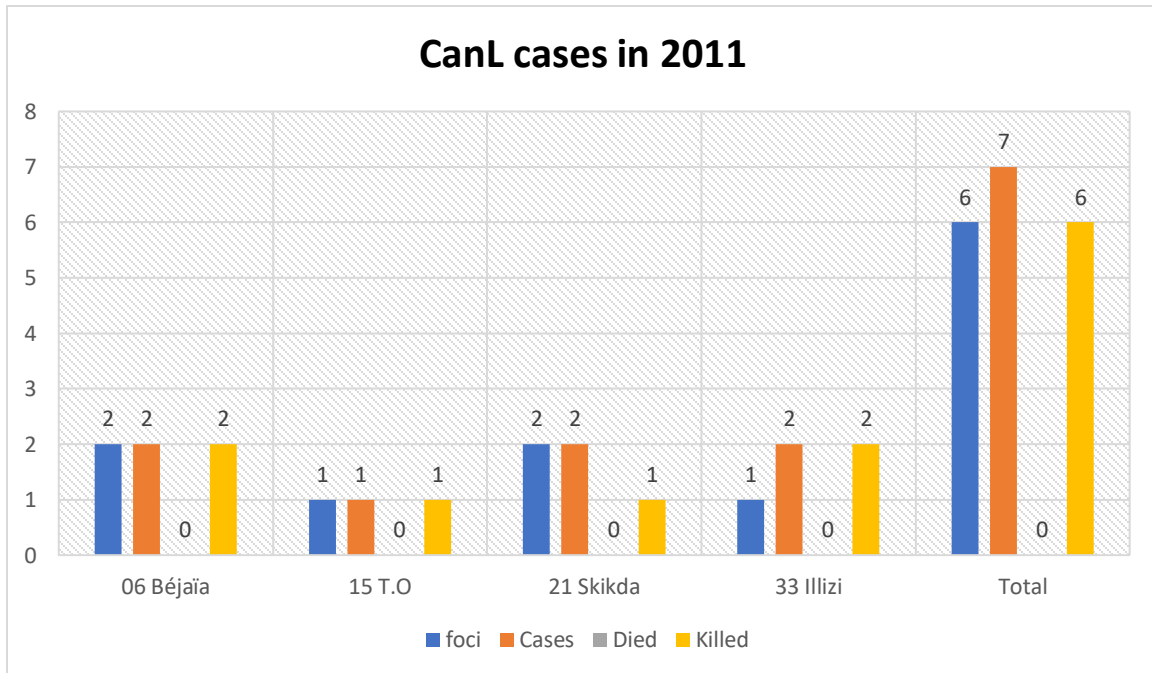


Figure 16: Graphic curve of Canine leishmaniasis cases in 2011 in Algeria

The number of cases and the outbreaks are almost the same in all the provinces.

➤ In 2012

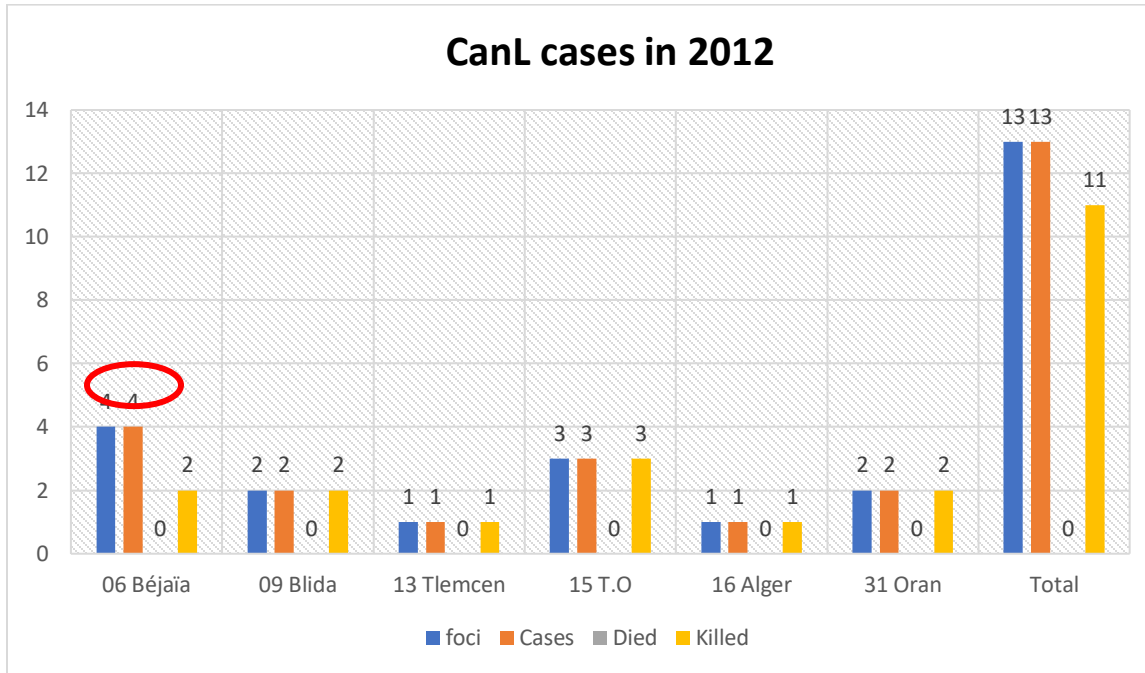


Figure 17: Graphic curve of Canine leishmaniasis cases in 2012 in Algeria

Bejaia is the Mediterranean province most affected by the number of cases and focus

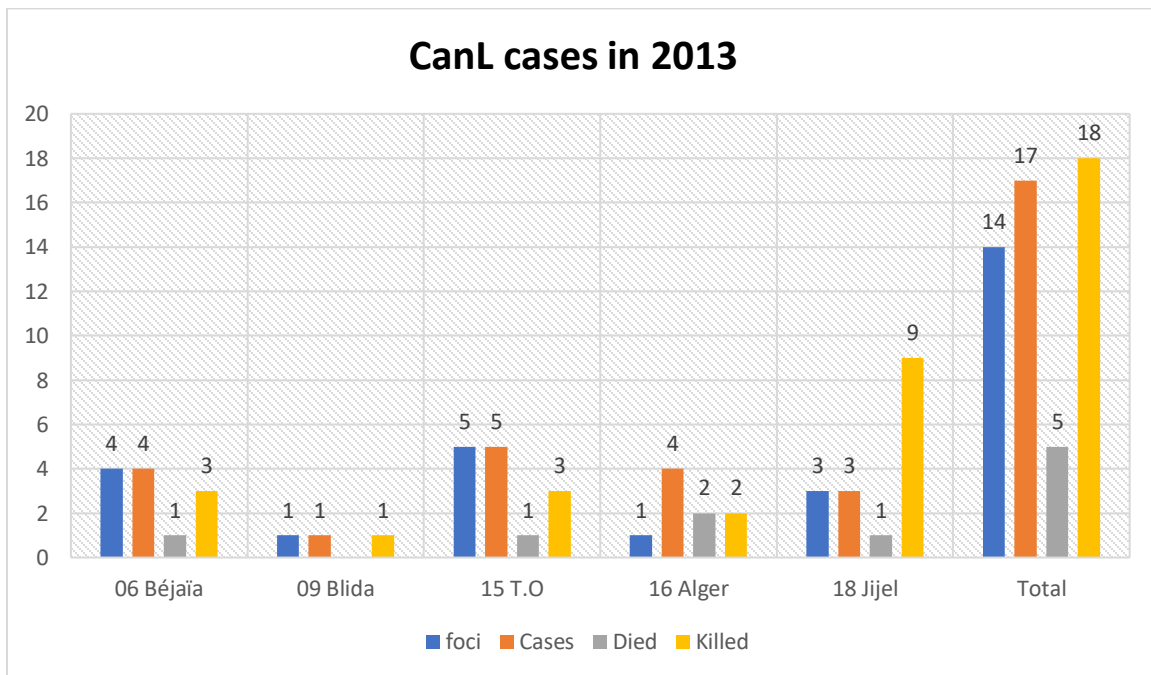


Figure 18: Graphic curve of Canine leishmaniasis cases in 2013 in Algeria

Jijel is the most province of the number of dogs killed result of a suspecting of CanL

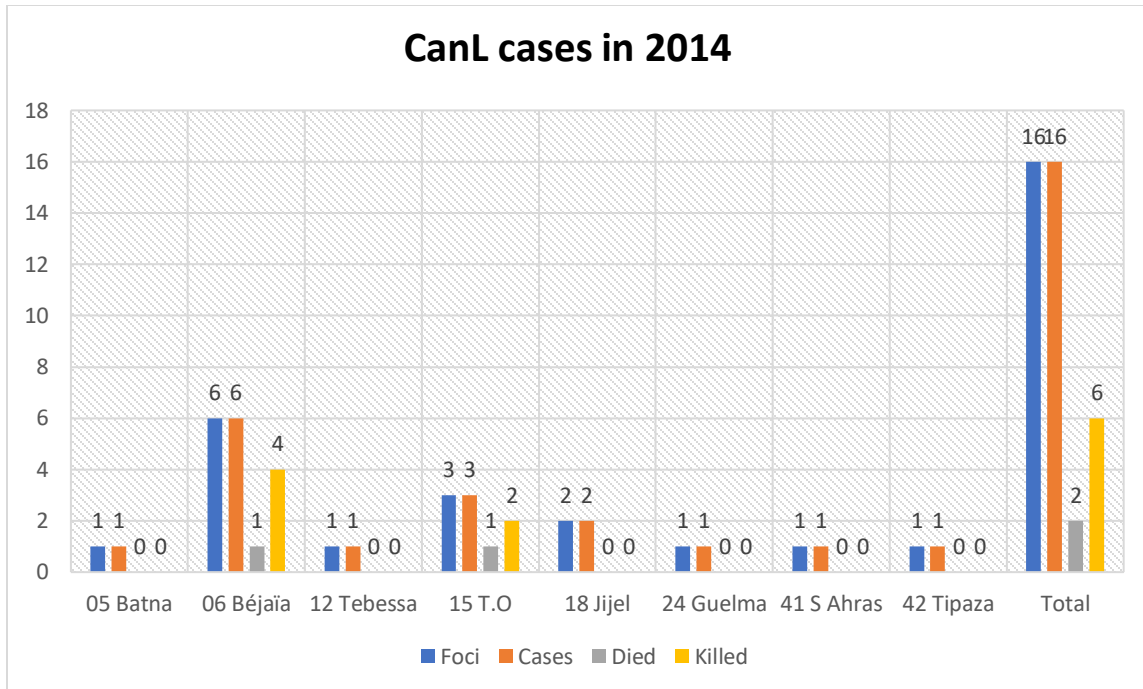


Figure 19: Graphic curve of Canine leishmaniasis cases in 2014 in Algeria

In 2014 Bejaia reported the highest cases

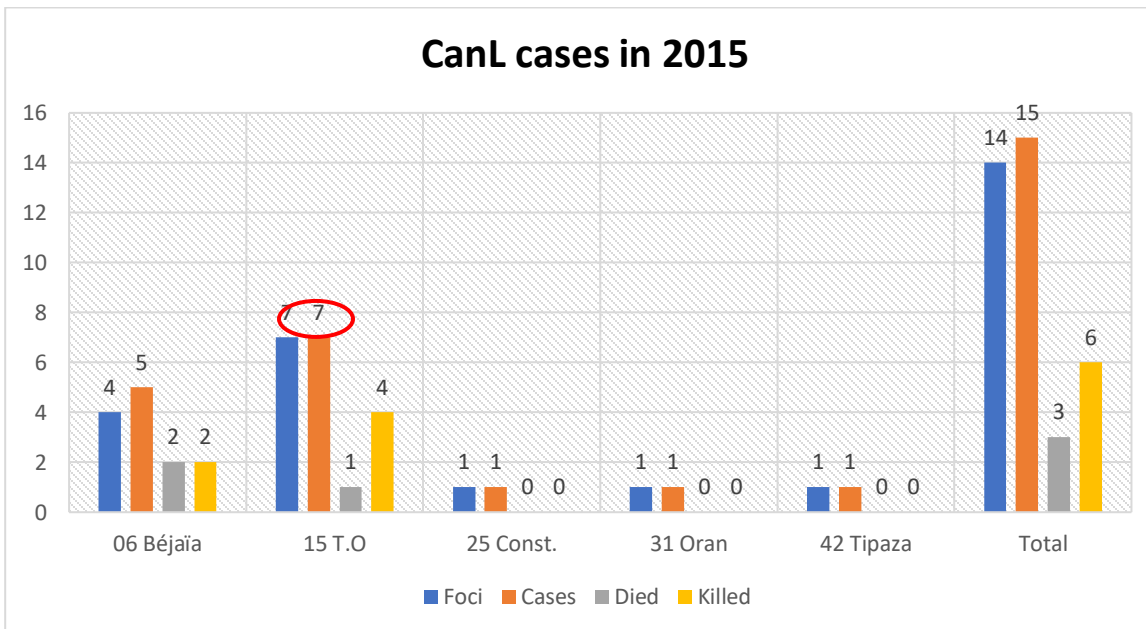


Figure 20: Graphic curve of Canine leishmaniasis cases in 2015 in Algeria

In 2015 Tizi ousou reported the highest number of cases

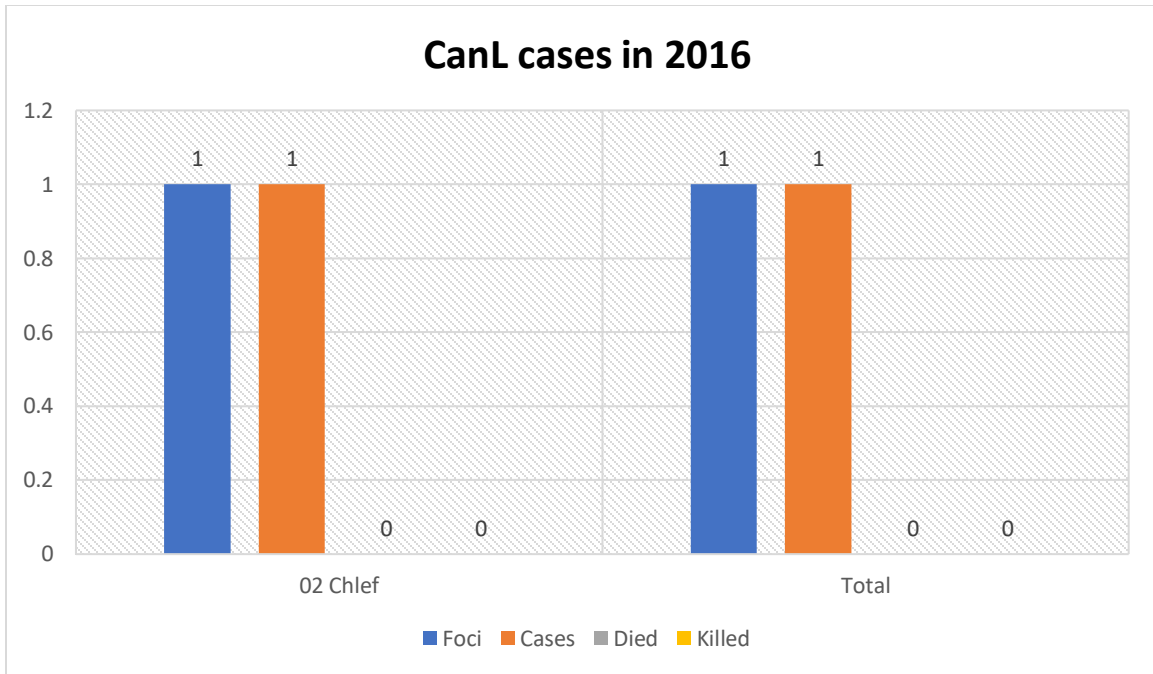


Figure 21: Graphic curve of Canine leishmaniasis cases in 2016 in Algeria

In 2016 Chlef was the only province who recorded a case

In 2017 and 2019 there is no information but it doesn't mean there's no cases .

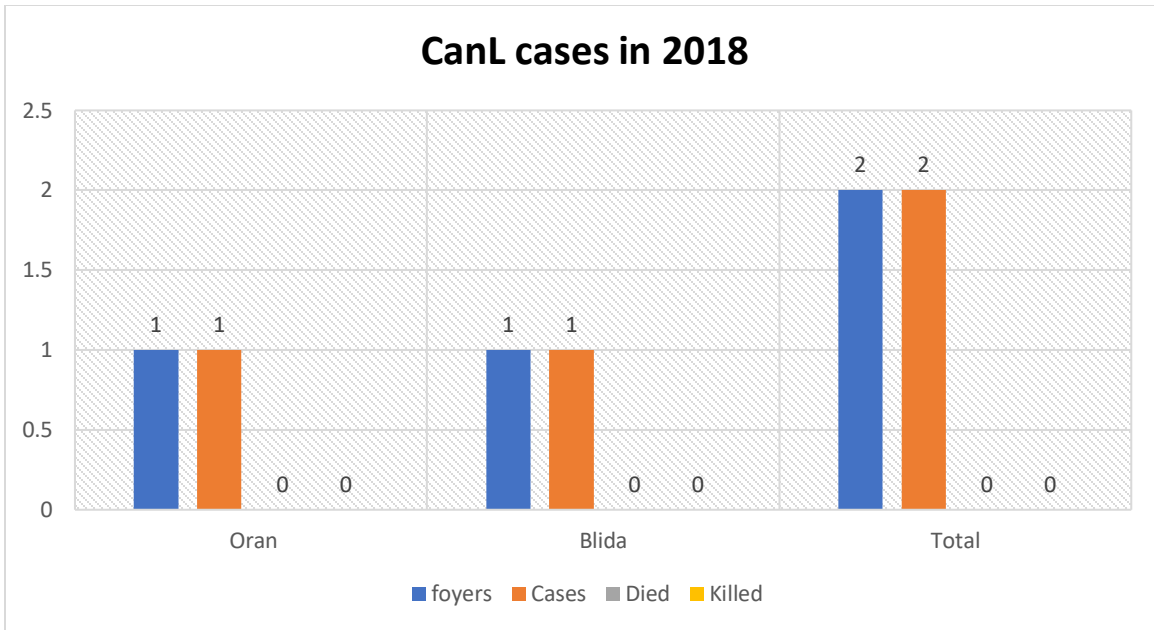


Figure 22: Graphic curve of Canine leishmaniasis cases in 2018 in Algeria

The number of cases and the outbreaks is the same in the 2 provinces Blida and Oran

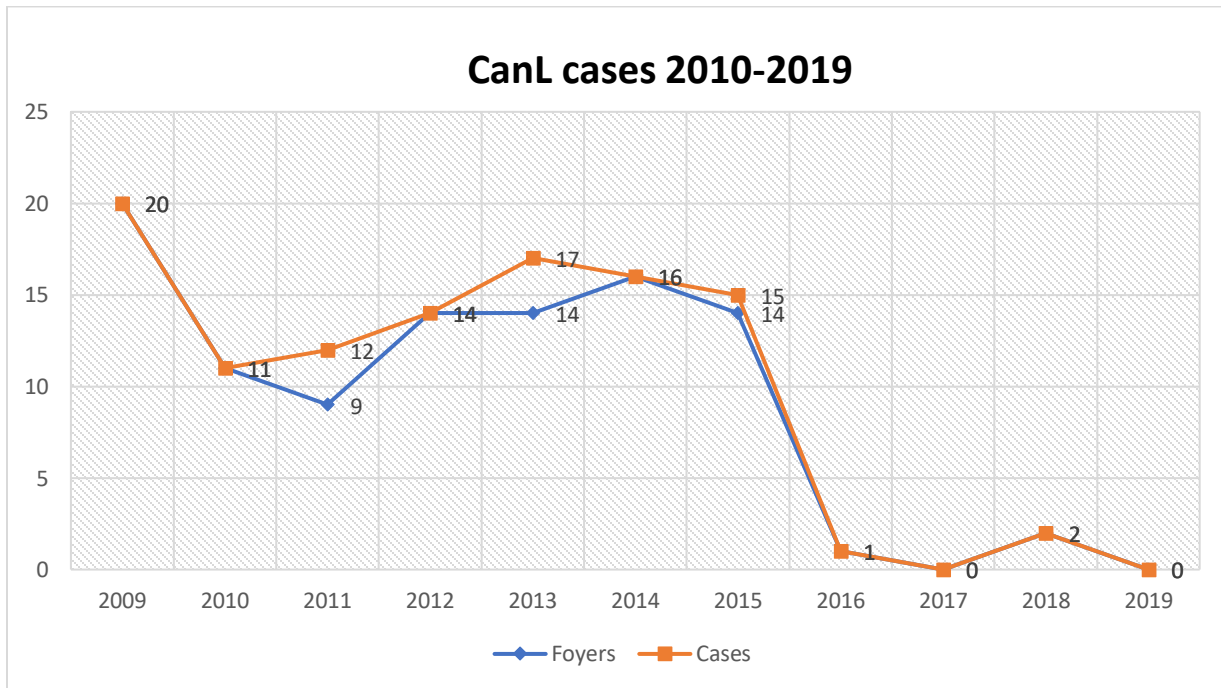


Figure 23: Graphic curve of Canine leishmaniasis cases between 2010 and 2019 in Algeria

We notice that there's a true concordance between number of cases and foyers and in the last years the cases reduce.

4. Investigation survey part (for veterinary Doctors):

The survey was developed leaning on the research how usually our colleagues deal with this disease.

The questions asked was about:

- General information (cabinet name, Doctor name, city)
- Epidemiological information (number of cases, number of suspicious cases, season, evolution of the disease)
- Methodology of the diagnosis (clinical signs, tests used to confirm the disease)
- Lead to hold with the case (Treatment or euthanasia, declaration of the disease for the government)

4.1 Collect of Answers:

All veterinary clinics who helped me in this work and doctors were contacted in social media to see first if they would like to participate in this epidemiological survey (see appendices) (. And most of them accepted to help me with pleasure. In total they're (30 doctor).

4.2 Results:

The answers collected have been treated by excel system and it showed:

▪ Saison of the disease:

The results are illustrated in the figure below

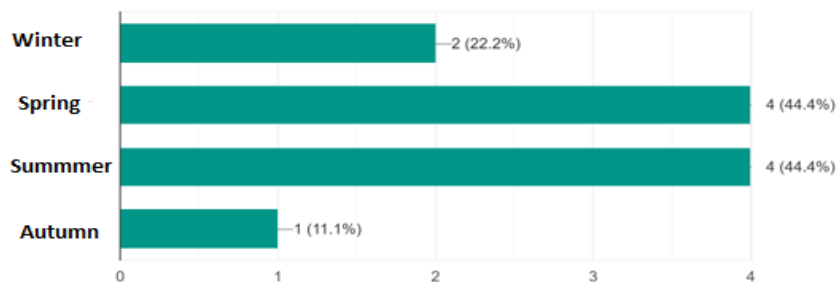


Figure 24: season of disease

We notice that in the spring and summer, veterinary doctors recorded the highest rate.

- **Symptoms:**

The results are illustrated in the figure below

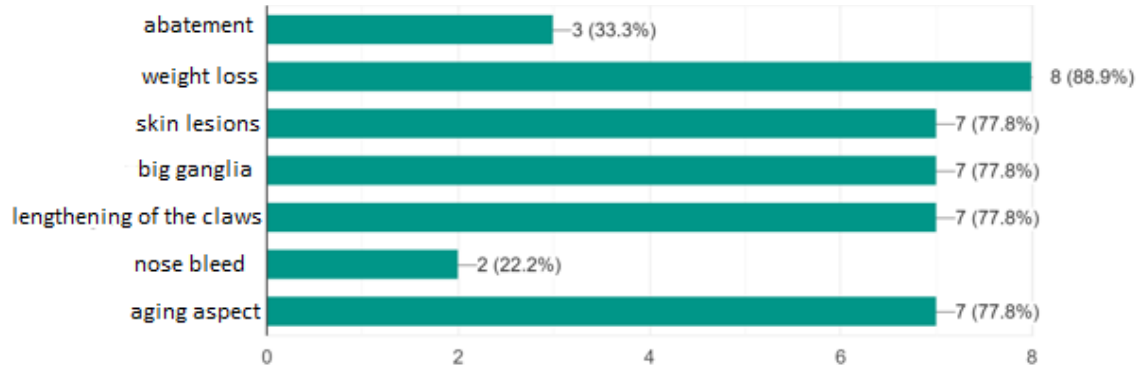


Figure 25: Clinicals signs observed

The most noted Clinical signs are weight loss with 88.9%.

- **Did the doctors use to confirm the disease or no?**

The results are illustrated in the figure below

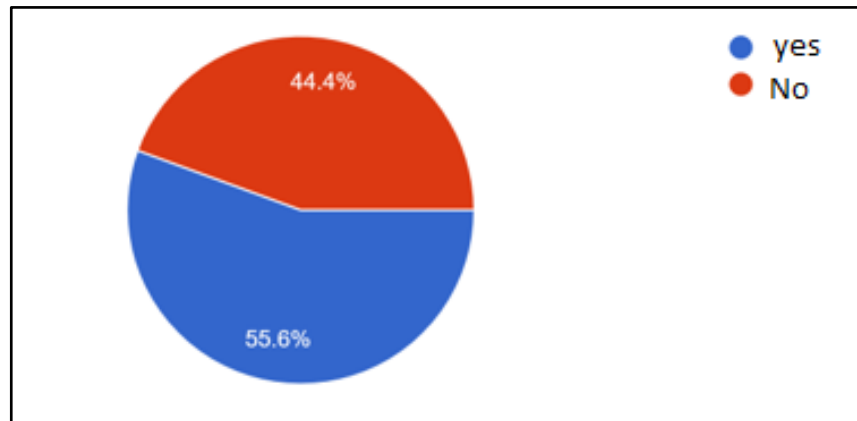


Figure 26: Experimentation use answers

We notice clearly that 55.6% of the doctors confirm the leishmaniasis disease.

- **Test of sample used:**

The results are illustrated in the figure below

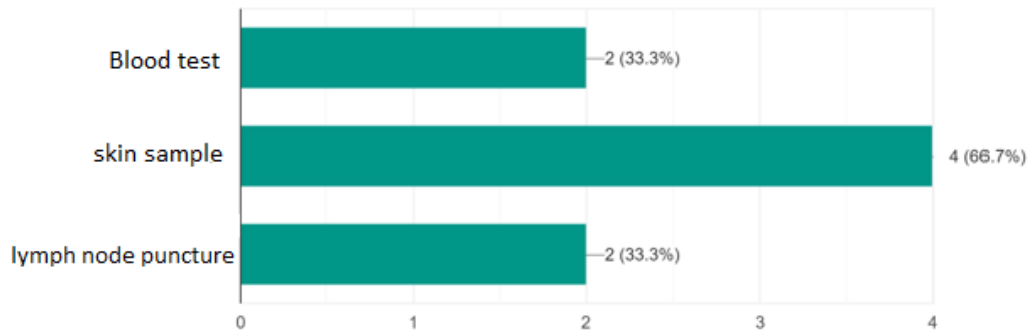


Figure 27: Test used to confirm the disease

We find that the skin samples test are the most used with a rate of 66.7%

5. Discussion:

Our results clearly showed the difference in the geographical distribution between cutaneous leishmaniasis and canine leishmaniasis during the period 2010-2019, what differs with the results of (HARRAT *et al* ,2011) (Aït-Oudhia *et al.*, 2011),so the canine leishmaniasis are distributed throughout the northern part of the country and the geographic distribution of the leishmaniasis sporadic skin are sprayed in the south areas .

The prevalence estimated for the two westernmost localities (Tlemcen and Mostaganem) does not exceed 15% and the highest values are found for Bejaia. The latter lies in the area of Kabylie, which is one of the main agricultural areas of the country because of its higher rainfall. Sandflies (*Phlebotomus* spp.), the vectors of *L. infantum* in the mediterranean basin, are active during the warmer months of the year(Adel *et al.*, 2015).

6.Conclusion:

Canine leishmaniasis is a serious disease, often fatal in dogs, and has a zoonotic character, the dog being the main reservoir of this disease in humans. The control of canine leishmaniasis is important both to control the disease between dogs and for the reduction of the spread for the humans.

Three confirmed clinical and fatal cases of leishmaniasis in dogs of unidentified origin have been reported by the laboratory and the state veterinarians. We conclude that Algeria is currently among the most affected by canine leishmaniasis especially Bejaia and Jijel, this disease requires increased monitoring of the course of these zoonoses and the application adequate control measures.

The need to combat canine leishmaniasis has greatly stimulated research into the immunological processes involved in dogs infected with leishmania. Elucidating the mechanisms involved in the immune responses of canine leishmaniasis is the key to improving anti-Leishmania therapy and vaccine development.

Despite recent advances in disease research, canine leishmaniasis continues to be a danger zoonosis that is spreading around the world and need a real step to limit the spread of the vector .

Recommendation:

Although several strategies exist, the best control measure to prevent canine Leishmania infantum is to treat dogs using **biocidal topical formulations based on legal insecticides** or **repellents** (as collars, spot-ons or sprays) during the period when the vectors are active.

Or we can chose euthanasia for stray dogs to limit the contamination between dogs .

GLOBAL CONCLUSION

Leishmaniasis has been widely studied in Algeria, Leishmaniasis is considered to be an endemic disease both in humans and in dogs (disease porters). The disease continues to interest doctors, veterinarians, epidemiologists and researchers, as well as national health institutions.

A lot of doctors among us confirm that these 2 kinds of leishmaniasis CL and CanI have a link in the number of cases specially in the northern part and arid and semi-arid region. where we can find the L.infantum which is responsible of the sporadic form in the CL and also VL and the canine form at the same time .

Permanent solution for the leishmaniasis in terms of successful human vaccination is still a major challenge. However, there are different vaccinations currently being tested in mouse model which still far away to be officially useful so the only things that we can do is to limit the spreading of the vector and take the measures in the area risk.

Appendix:

Number of cases of *cutaneous Leishmaniasis* in 2010

<i>Wilaya</i>	<i>Population</i>	<i>Numbers of cases</i>
ADRAR	404129	9
CHLEF	1047099	18
LAGHOUAT	415300	453
OUM EL BOUAGHI	626501	3
BATNA	1192232	770
BEJAIA	1020445	8
BISKRA	744413	6169
BECHAR	277644	897
BLIDA	952121	16
BOUIRA	758214	46
TAMANRASSET	187586	5
TEBESSA	682091	752
TLEMCEM	1017368	0
TIARET	902542	49
TIZI OUZOU	1308623	16
ALGER	3068728	4
DJELFA	1069533	49
JIJEL	697945	20
SETIF	1608810	103
SAIDA	341833	27
SKIKDA	951786	7
SIDI BEL ABBES	636154	4
ANNABA	661527	9
GUELMA	511254	2
CONSTANTINE	976125	8
MEDEA	965871	108
MOSTAGANEM	763062	0
M'SILA	1023595	4936
MASCARA	812997	12
OUARGLA	590710	1030
ORAN	1480966	0
EL BAYADH	218082	302
ILLIZI	46995	7
BORDJ BOU ARRERIDJ	688488	345
BOUMERDES	777690	2
EL TARF	439147	3
TINDOUF	35534	1
TISSEMSILT	328056	5
EL OUED	677026	3800
KHENCHELA	405874	141
SOUK AHRAS	439651	1
TIPAZA	610643	3
MILA	823268	52
AIN DEFLA	810188	7
NAAMA	156782	315
AIN TEMOUCHENT	393226	0
GHARDAIA	393767	535
RELIZANE	774346	3
TOTAL ALGERIE	35715878	21049

Number of cases of *cutaneous Leishmaniasis* in 2011

<i>Wilaya</i>	<i>Population</i>	<i>Numbers of cases</i>
ADRAR	438638	42
CHLEF	1068026	14
LAGHOUAT	518210	1643
OUM EL BOUAGHI	668074	4
BATNA	1193250	569
BEJAIA	950013	6
BISKRA	787358	4178
BECHAR	290415	1069
BLIDA	1098922	16
BOUIRA	729965	55
TAMANRASSET	193830	5
TEBESSA	694131	665
TLEMCEEN	1000615	5
TIARET	902899	21
TIZI OUZOU	1157943	19
ALGER	3235056	6
DJELFA	1227926	265
JIJEL	669770	16
SETIF	1580873	67
SAIDA	353651	37
SKIKDA	952692	14
SIDI BEL ABBES	626885	10
ANNABA	636378	3
GUELMA	508525	2
CONSTANTINE	1009470	7
MEDEA	846706	268
MOSTAGANEM	785361	1
M'SILA	1073910	2108
MASCARA	833567	0
OUARGLA	607960	846
ORAN	1590261	0
EL BAYADH	255517	475
ILLIZI	60605	7
BORDJ BOU ARRERIDJ	666572	376
BOUMERDES	871700	6
EL TARF	434000	2
TINDOUF	59888	0
TISSEMSILT	309576	6
EL OUED	710155	2084
KHENCHELA	413806	75
SOUK AHRAS	472262	1
TIPAZA	629707	32
MILA	811195	57
AIN DEFLA	834342	18
NAAMA	223606	572
AIN TEMOUCHENT	392104	4
GHARDAIA	391944	908
RELIZANE	767781	1
TOTAL ALGERIE	36536041	16585

Number of cases of *cutaneous Leishmaniasis* in 2012

<i>Wilaya</i>	<i>Population</i>	<i>Numbers of cases</i>
ADRAR	452957	0
CHLEF	1096778	5
LAGHOUAT	540745	0
OUM EL BOUAGHI	688467	0
BATNA	1224882	2
BEJAIA	965875	1
BISKRA	808738	8
BECHAR	300230	0
BLIDA	1140408	0
BOUIRA	746533	4
TAMANRASSET	200726	0
TEBESSA	711319	2
TLEMCEN	1031176	0
TIARET	927796	1
TIZI OUZOU	1179279	0
ALGER	3303021	1
DJELFA	1269872	0
JIJEL	683102	1
SETIF	1614286	2
SAIDA	365239	0
SKIKDA	978476	1
SIDI BEL ABBES	628978	1
ANNABA	655075	1
GUELMA	522886	0
CONSTANTINE	1027804	2
MEDEA	853461	2
MOSTAGANEM	809063	0
M'SILA	1102712	2
MASCARA	859910	1
OUARGLA	626112	0
ORAN	1621439	0
EL BAYADH	264814	1
ILLIZI	63962	3
BORDJ BOU ARRERIDJ	680236	0
BOUMERDES	903058	1
EL TARF	447763	0
TINDOUF	63912	0
TISSEMSILT	315851	0
EL OUED	733035	0
KHENCHELA	424920	2
SOUK AHRAS	485052	0
TIPAZA	650124	1
MILA	828849	8
AIN DEFLA	863184	2
NAAMA	233886	0
AIN TEMOUCHENT	405481	0
GHARDAIA	404753	2
RELIZANE	787093	0
TOTAL ALGERIE	37493316	57

Number of cases of *cutaneous Leishmaniasis* in 2013

<i>Wilaya</i>	<i>Population</i>	<i>Numbers of cases</i>
ADRAR	463803	21
CHLEF	1122101	24
LAGHOUAT	552835	194
OUM EL BOUAGHI	704038	9
BATNA	1253535	129
BEJAIA	986553	7
BISKRA	828023	2341
BECHAR	306440	368
BLIDA	1163554	3
BOUIRA	762838	10
TAMANRASSET	205245	0
TEBESSA	728207	211
TLEMCEEN	1051105	5
TIARET	948721	34
TIZI OUZOU	1202787	9
ALGER	3362370	1
DJELFA	1300014	42
JIJEL	699578	10
SETIF	1650871	36
SAIDA	372618	10
SIKIDA	999993	10
SIDI BEL ABBES	640923	19
ANNABA	667655	2
GUELMA	533630	2
CONSTANTINE	1049238	15
MEDEA	872593	105
MOSTAGANEM	826556	0
M'SILA	1128926	409
MASCARA	877235	0
OUARGLA	641110	210
ORAN	1652419	1
EL BAYADH	270626	46
ILLIZI	65250	1
BORDJ BOU ARRERIDJ	695998	66
BOUMERDES	920910	0
EL TARF	456859	2
TINDOUF	65250	3
TISSEMSILT	323453	0
EL OUED	750990	1341
KHENCHELA	434653	81
SOUK AHRAS	495202	0
TIPAZA	663437	32
MILA	848678	35
AIN DEFLA	882948	9
NAAMA	238688	103
AIN TEMOUCHENT	412973	4
GHARDAIA	413613	207
RELIZANE	804759	3
TOTAL ALGERIE	38300000	6171

Number of cases of *cutaneous Leishmaniasis* in 2014

<i>Wilaya</i>	<i>Population</i>	<i>Numbers of cases</i>
ADRAR	474569	8
CHLEF	1147252	26
LAGHOUAT	564809	120
OUM EL BOUAGHI	719494	6
BATNA	1282004	65
BEJAIA	1007111	2
BISKRA	847180	1169
BECHAR	312585	284
BLIDA	1186454	1
BOUIRA	779028	7
TAMANRASSET	209715	0
TEBESSA	745393	105
TLEMCEEN	1070830	4
TIARET	969494	17
TIZI OUZOU	1226155	1
ALGER	3421010	3
DJELFA	1329895	36
JIJEL	715982	11
SETIF	1687194	18
SAIDA	379923	9
SKIKDA	1021364	3
SIDI BEL ABBES	652740	3
ANNABA	680111	0
GUELMA	544285	0
CONSTANTINE	1070503	2
MEDEA	891590	96
MOSTAGANEM	843897	0
M'SILA	1154951	1124
MASCARA	894379	1
OUARGLA	655986	190
ORAN	1683042	0
EL BAYADH	276386	47
ILLIZI	66518	0
BORDJ BOU ARRERIDJ	711659	59
BOUMERDES	938573	0
EL TARF	465871	1
TINDOUF	66570	0
TISSEMSILT	331015	0
EL OUED	768815	765
KHENCHELA	444318	62
SOUK AHRAS	505270	3
TIPAZA	676624	23
MILA	868392	55
AIN DEFLA	902569	8
NAAMA	243437	77
AIN TEMOUCHENT	420376	1
GHARDAIA	422386	131
RELIZANE	822297	0
TOTAL ALGERIE	39100000	4543

Number of cases of *cutaneous Leishmaniasis* in 2015

<i>Wilaya</i>	<i>Population</i>	<i>Numbers of cases</i>
ADRAR	484858	12
CHLEF	1172192	11
LAGHOUAT	577088	190
OUM EL BOUAGHI	735135	6
BATNA	1309874	59
BEJAIA	1029005	1
BISKRA	865597	1142
BECHAR	319380	657
BLIDA	1212246	1
BOUIRA	795963	20
TAMANRASSET	214274	1
TEBESSA	761597	262
TLEMCEEN	1094109	4
TIARET	990570	87
TIZI OUZOU	1252810	0
ALGER	3495380	1
DJELFA	1358806	46
JIJEL	731547	19
SETIF	1723872	13
SAIDA	388182	79
SKIKDA	1043567	16
SIDI BEL ABBES	666930	18
ANNABA	694896	1
GUELMA	556118	18
CONSTANTINE	1093774	6
MEDEA	910973	62
MOSTAGANEM	862243	1
M'SILA	1180059	2185
MASCARA	913822	0
OUARGLA	670246	99
ORAN	1719630	0
EL BAYADH	282395	124
ILLIZI	67964	0
BORDJ BOU ARRERIDJ	727130	72
BOUMERDES	958977	5
EL TARF	475998	1
TINDOUF	68017	1
TISSEMSILT	338211	5
EL OUED	785528	699
KHENCHELA	453977	86
SOUK AHRAS	516254	0
TIPAZA	691333	0
MILA	887270	24
AIN DEFLA	922190	7
NAAMA	248729	241
AIN TEMOUCHENT	429514	1
GHARDAIA	431569	254
RELIZANE	840173	0
TOTAL ALGERIE	39950000	6537

Number of cases of *cutaneous Leishmaniasis* in 2016

<i>Wilaya</i>	<i>Population</i>	<i>Numbers of cases</i>
ADRAR	514599	15
CHLEF	1191972	15
LAGHOUAT	645609	158
OUM EL BOUAGHI	755445	3
BATNA	1328075	130
BEJAIA	1005592	1
BISKRA	910444	1142
BECHAR	328217	669
BLIDA	1287901	2
BOUIRA	790379	20
TAMANRASSET	228140	0
TEBESSA	779627	315
TLEMCEEN	1096670	12
TIARET	1006413	107
TIZI OUZOU	1194662	1
ALGER	3550082	0
DJELFA	1480959	50
JIJEL	727219	13
SETIF	1733059	41
SAIDA	397766	101
SKIKDA	1050661	38
SIDI BEL ABBES	710832	12
ANNABA	686153	0
GUELMA	555253	12
CONSTANTINE	1108556	15
MEDEA	873032	70
MOSTAGANEM	877474	0
M'SILA	1231090	4526
MASCARA	927667	4
OUARGLA	705348	116
ORAN	1765825	0
EL BAYADH	308058	215
ILLIZI	78270	3
BORDJ BOU ARRERIDJ	728531	38
BOUMERDES	1000718	9
EL TARF	482883	3
TINDOUF	84663	5
TISSEMSILT	337027	2
EL OUED	834246	381
KHENCHELA	463983	122
SOUK AHRAS	530600	0
TIPAZA	703453	5
MILA	892550	28
AIN DEFLA	906611	6
NAAMA	285466	125
AIN TEMOUCHENT	431164	1
GHARDAIA	445766	278
RELIZANE	841290	2
TOTAL ALGERIE	40800000	8811

Number of cases of *cutaneous Leishmaniasis* LC in 2017

<i>Wilaya</i>	<i>Population</i>	<i>Numbers of cases</i>
ADRAR	531122	4
CHLEF	1218446	25
LAGHOUAT	674123	167
OUM EL BOUAGHI	774247	3
BATNA	1357111	500
BEJAIA	1018396	4
BISKRA	937411	1030
BECHAR	336387	310
BLIDA	1328843	1
BOUIRA	803442	52
TAMANRASSET	235558	7
TEBESSA	797946	531
TLEMCEEN	1117069	0
TIARET	1028700	100
TIZI OUZOU	1204151	1
ALGER	3628548	2
DJELFA	1538476	222
JIJEL	739669	15
SETIF	1766724	77
SAIDA	407162	135
SKIKDA	1071739	12
SIDI BEL ABBES	725569	19
ANNABA	696704	0
GUELMA	565313	7
CONSTANTINE	1132218	22
MEDEA	880459	84
MOSTAGANEM	897048	0
M'SILA	1265170	6730
MASCARA	947653	5
OUARGLA	726286	270
ORAN	1809750	3
EL BAYADH	319720	345
ILLIZI	82272	5
BORDJ BOU ARRERIDJ	742376	75
BOUMERDES	1029071	8
EL TARF	493240	0
TINDOUF	90535	0
TISSEMSILT	342898	3
EL OUED	861107	185
KHENCHELA	474792	58
SOUK AHRAS	543575	0
TIPAZA	719134	5
MILA	909957	39
AIN DEFLA	926182	7
NAAMA	299676	377
AIN TEMOUCHENT	439460	2
GHARDAIA	457347	324
RELIZANE	857216	0
TOTAL ALGERIE	41750000	11771

Number of cases of *cutaneous Leishmaniasis* in 2018

<i>Wilaya</i>	<i>Population</i>	<i>Numbers of cases</i>
ADRAR	546579	4
CHLEF	1241881	10
LAGHOUAT	701846	218
OUM EL BOUAGHI	791204	7
BATNA	1382743	95
BEJAIA	1028358	5
BISKRA	962364	1515
BECHAR	343757	478
BLIDA	1367093	0
BOUIRA	814342	35
TAMANRASSET	242508	5
TEBESSA	814315	965
TLEMCEEN	1134534	5
TIARET	1048418	48
TIZI OUZOU	1210180	0
ALGER	3697946	4
DJELFA	1593569	383
JIJEL	750140	23
SETIF	1795797	57
SAIDA	415565	71
SKIKDA	1090056	32
SIDI BEL ABBES	738454	13
ANNABA	705357	1
GUELMA	573878	3
CONSTANTINE	1153015	13
MEDEA	885362	202
MOSTAGANEM	914388	0
M'SILA	1296407	3607
MASCARA	965250	2
OUARGLA	745667	217
ORAN	1849365	0
EL BAYADH	330856	337
ILLIZI	86226	5
BORDJ BOU ARRERIDJ	754280	95
BOUMERDES	1055145	6
EL TARF	502351	2
TINDOUF	96533	0
TISSEMSILT	347855	4
EL OUED	886243	568
KHENCHELA	484438	46
SOUK AHRAS	555245	2
TIPAZA	733023	7
MILA	925001	43
AIN DEFLA	943419	13
NAAMA	313676	109
AIN TEMOUCHENT	446611	5
GHARDAIA	467862	442
RELIZANE	870898	0
TOTAL ALGERIE	42600000	9702

Number of cases of *cutaneous Leishmaniasis* in 2019

<i>Wilaya</i>	<i>Population</i>	<i>Numbers of cases</i>
ADRAR	562231	2
CHLEF	1265191	11
LAGHOUAT	730377	278
OUM EL BOUAGHI	808167	1
BATNA	1408219	62
BEJAIA	1037947	4
BISKRA	987533	1855
BECHAR	351128	161
BLIDA	1405805	0
BOUIRA	825016	25
TAMANRASSET	249551	6
TEBESSA	830644	60
TLEMCEEN	1151748	6
TIARET	1068030	124
TIZI OUZOU	1215688	0
ALGER	3766961	2
DJELFA	1649888	161
JIJEL	760415	8
SETIF	1824520	47
SAIDA	423950	86
SKIKDA	1108183	42
SIDI BEL ABBES	751226	13
ANNABA	713793	0
GUELMA	582309	1
CONSTANTINE	1173663	5
MEDEA	889888	143
MOSTAGANEM	931640	0
M'SILA	1327812	3209
MASCARA	982728	2
OUARGLA	765218	210
ORAN	1888990	4
EL BAYADH	342225	491
ILLIZI	90329	13
BORDJ BOU ARRERIDJ	766028	38
BOUMERDES	1081389	8
EL TARF	511399	2
TINDOUF	102881	0
TISSEMSILT	352723	6
EL OUED	911699	396
KHENCHELA	494056	16
SOUK AHRAS	566908	0
TIPAZA	746842	14
MILA	939866	24
AIN DEFLA	960542	14
NAAMA	328182	630
AIN TEMOUCHENT	453673	428
GHARDAIA	478402	0
RELIZANE	884398	2
TOTAL ALGERIE	43450000	8610

Number of cases of *canine Leishmaniasis* in 2010

City	Foci	Cases	Died	Killed	
02 Chlef		1	1	0	2
06 Béjaïa		2	2	0	2
10 Bouira		1	1	0	0
14 Tiaret		1	1	0	0
27 Mosta.		1	2	0	0
29 Mascara		1	1	0	0
48 Relizane		1	1		
Total		8	9	0	4

Number of cases of *canine Leishmaniasis* in 2011

City	Foci	Cases	Died	killed	
06 Béjaïa		2	2	0	2
15 T.O		1	1	0	1
21 Skikda		2	2	0	1
33 Illizi		1	2	0	2
Total		6	7	0	6

Number of cases of *canine Leishmaniasis* in 2012

City	Foci	Cases	Died	Killed	
06 Béjaïa		4	4	0	2
09 Blida		2	2	0	2
13 Tlemcen		1	1	0	1
15 T.O		3	3	0	3
16 Alger		1	1	0	1
31 Oran		2	2	0	2
Total		13	13	0	11

Number of cases of *canine Leishmaniasis* in 2013

City	Foci	Cases	Died	Killed	
06 Béjaïa		4	4	1	3
09 Blida		1	1		1
15 T.O		5	5	1	3
16 Alger		1	4	2	2
18 Jijel		3	3	1	9
Total		14	17	5	18

Number of cases of *canine Leishmaniasis* in 2014

City	Foci	Cases	Died	killed
05 Batna	1	1	0	0
06 Béjaïa	6	6	1	4
12 Tebessa	1	1	0	0
15 T.O	3	3	1	2
18 Jijel	2	2	0	0
24 Guelma	1	1	0	0
41 S Ahras	1	1	0	0
42 Tipaza	1	1	0	0
Total	16	16	2	6

Number of cases of *canine Leishmaniasis* in 2015

City	Foci	Cases	Died	killed
06 Béjaïa	4	5	2	2
15 T.O	7	7	1	4
25 Const.	1	1	0	0
31 Oran	1	1	0	0
42 Tipaza	1	1	0	0
Total	14	15	3	6

Number of cases of *canine Leishmaniasis* in 2016

City	Foci	Cases	Died	Killed
02 Chlef	1	1	0	0
Total	1	1	0	0

Number of cases of *canine Leishmaniasis* in 2018

City	Foci	Cases	Died	Killed
31 Oran	1	1	0	0
09 Blida	1	1	0	0
Total	2	2	0	0

In 2017 and 2019 no information was recorded.

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