



Epidemiology of Human Leptospirosis in the Central Region of Veracruz, Mexico

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Authors' contributions

This work was carried out in collaboration between all authors. Author JAVC designed the study, performed the statistical analysis and wrote the first draft of the manuscript. Author DIMH managed the literature search. Author LAOS retrieved the data base. All authors read and approved the final manuscript.

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ABSTRACT

Aims: To epidemiologically characterize patients confirmed as cases of leptospirosis in Central Veracruz, Mexico based on official records.

Study Design: Descriptive retrospective study.

Place and Duration of Study: Sanitary District No. VIII, Health Ministry in central Veracruz, Mexico from January 2007 to December 2011.

Methodology: Data analysis was performed on official records of clinical cases suggestive of human leptospirosis and confirmed by microscopic agglutination test plate within the study period. Variables considered for analysis included filing date, patient's socio-demographic characteristics, care center, test result and identified serovars. Incidence rate was calculated as the number of cases per 100000 inhabitants. Chi-square was used to compare categories in Minitab v. 13 and a

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significance level of $P = .05$ was defined.

Results: There were 1403 suspected cases of leptospirosis from 14 municipalities in central Veracruz, of which 42.4% (595) resulted positive for leptospirosis. The municipalities with the highest number of confirmed cases in the period were: Veracruz (56%, 333 cases), La Antigua (14%, 83 cases) and Boca del Río (7.7%, 46 cases). La Antigua showed an unusually high incidence rate (65.1). Years with the highest number of cases were 2010 (257 cases) and 2011 (94 cases). Months with the highest number of cases were October (156 cases, 26.2%), and to a lesser extent February (57, 9.6%), August (55, 9.2%), January (53, 8.9%) and September (53, 8.9%) detecting a highly significant statistical difference between months ($P = .01$). The single month with the highest number of cases in the study period was October 2010, in which 120 positive cases of leptospirosis were recorded, which is coincidental with the aftermath of Hurricane Karl that hit the region in September 2010. Most affected age groups were 21-30 years (125 cases, 21.1%), 11-20 (104, 17.5%) and 31-40 (92, 15.5%), but no statistically significant difference between these groups was identified ($P = .4$). Male subjects (727 cases, 51.82%) were more affected than females (676, 48.18%), but this difference was not significant ($P = .05$).

Conclusion: We conclude that leptospirosis has a strong presence in the human population in central Veracruz, Mexico.

Keywords: Zoonoses; socio-demographics; epidemiology; descriptive study; humid tropics.

1. INTRODUCTION

Leptospirosis is a worldwide disease that is considered the greatest international impact zoonosis and the one causing major impact from the economic and social standpoints. Today is a re-emerging disease for which few countries have a notification system [1]. The disease occurs throughout the year, although it predominates in the rainy season, and can take place as isolated cases or manifest itself in outbreaks in both rural and urban areas [2]. Leptospire are microorganisms that depend for their survival on soil pH and environmental conditions such as temperature and relative humidity. They are very sensitive to drying, direct sunlight, and pH both acid and alkali, since a pH lower than 6 or greater than 8 has an inhibitory effect on the microorganisms, and a temperature below 13°C or greater than 35°C kills them quickly [3].

The epidemiology of leptospirosis has been modified by changes in animal husbandry, climate and human behavior [4-6]. The resurgent interest in leptospirosis has resulted from large outbreaks occurring in several places around the world which have received significant publicity [7-10]. Mexico has a climate conducive to outbreaks of leptospirosis. Additionally, increases of severe weather events in recent years have contributed to higher leptospirosis incidence. Incidence rate of leptospirosis in the state of Tabasco is 31 cases per 100000 inhabitants; in turn, Veracruz incidence rate is 22 cases per 100000 inhabitants [11]. The state of Veracruz in Mexico meets environmental and geographical

conditions necessary for the occurrence of leptospirosis in animals and humans; therefore it is important to obtain statistical data to characterize epidemiological performance in the region and make decision for improving related health services. Hence, the objective of this study was to carry out a retrospective research to determine some epidemiological patterns and provide a socio-demographic characterization of human leptospirosis in the central region of Veracruz, Mexico.

2. METHODOLOGY

2.1 Area Description and Population Study

The state of Veracruz is a narrow strip of land slightly curved stretching from northwest to southeast along the eastern coast of Mexico. It has an area of 71,820 km². Altitude varies from 0 to 5747 meters. Average annual rainfall of 1597mm is twice the national average of 772 mm. According to the results of 2010 Census, the state had a population of 7'643,194 inhabitants (51.58% female), with a density of 106 inhabitants per km². Veracruz population represents 6.8% of the national, ranking as third.

There are 20828 villages in the state; of these, 20513 have less than 2500 inhabitants, accounting for 98.5% of all communities. In these areas -considered rural-, dwell 3'064856 inhabitants (39% of the total population). The remaining lives in towns bigger than 2500 inhabitants, and is considered urban. It is noteworthy that the national population

composition is only 22% rural. The predominant rurality and dispersion of the population demand a greater effort of the health sector institutions to provide health services for everybody.

For administering health services, the Health ministry divides the state into 11 Sanitary Districts, each of which comprises several municipalities. The study area lies on the geographic responsibility of the Sanitary District No. VIII which includes 14 municipalities: Alvarado, Boca del Rio, Cotaxtla, Ignacio de la Llave, Jamapa, La Antigua, Manlio Fabio Altamirano, Medellín, Paso de Ovejas, Puente Nacional, Soledad, Tlalixcoyan, Úrsulo Galván and Veracruz, and comprising a population in excess of one million inhabitants. Predominant climate in the tropical areas where the study took place is warm wet. Average annual temperature ranges from 22 to 26°C with a yearly rainfall varying from 900 to 2100 mm.

2.2 Data Collection and Analysis

A retrospective analysis using official records from 2007 to 2011 of the VIII Sanitary District, Ministry of Health, was performed. Case ascertainment mechanisms were based on passive surveillance. Official personnel at the different Health Care Centers diagnosed clinically cases suspected of leptospirosis. According to Mexican legislation notification is mandatory [12]. Blood samples were taken from suspected patients and sent to the laboratory for confirmation. Data were obtained from clinical records files containing filing date, location of occurrence, Care Center, sex and age of patient and result to micro-agglutination test, performed as recommended by national and international standards [12,13]. All testing were conducted in the Veracruz's Public Health Laboratory, the only organism that provides official testing for leptospirosis in the state of Veracruz. So this study was performed with official results issued by the State Public Health Laboratory of Veracruz Mexico on patients clinically suspected of Leptospirosis and serologically tested. Occurrence of leptospirosis confirmed cases was classified by external variables such as Care Center, month, year, and municipality. Age and sex of the patient was also considered. A suspect case is a case where the patient shows several clinical signs consistent with leptospirosis, in turn, a confirmed case refers to a patient which resulted positive to leptospirosis after testing by the micro-agglutination test.

Incidence rate was calculated as cumulative incidence, that is the number of cases cases per 100000 inhabitants. Descriptive statistics were estimated for all the variables and the chi-square test was performed with the use of Minitab v. 14 defining a significance level of $P = .05$.

3. RESULTS AND DISCUSSION

In the study period 2007 to 2011 were received by the Sanitary District No. VIII of the Health Ministry, 1,403 suspected cases of leptospirosis from 14 municipalities located in the central region of the state of Veracruz, of which 42.41% (595) were positive for leptospirosis. This number of cases seems high when compared to other studies. For instance, in a study encompassing 10 years in Manaus, State of Amazonas, Brazil, there were 665 cases of leptospirosis reported, but only 339 were confirmed [14]. Also, in the Netherlands, in a 84-year period study (1925-2008), only 2,553 severe leptospirosis cases were diagnosed [2]. In Israel, a 15-year period study (1985 to 1999) found only 59 cases [4].

Noteworthy, almost 60% of suspected leptospirosis cases submitted for serological confirmation were negative. From the records, apparently there is no follow-up of leptospirosis suspected cases that resulted negative to serological testing, or at least the data is not entered in the clinical cases sheets. There is a wide range of diseases whose clinical manifestations can be similar to leptospirosis, including influenza, dengue and dengue hemorrhagic fever, yellow fever and other viral haemorrhagic fevers, rickettsial diseases, Lyme disease, Legionnaires' disease, toxoplasmosis, malaria, typhoid and other enteric fevers, viral hepatitis, fever of unknown origin, pyelonephritis, aseptic meningitis, chemical poisoning, food poisoning, primary HIV seroconversion, and infectious mononucleosis, among others [15].

The municipalities with the highest number of cases of leptospirosis occurred are those with the biggest urban concentration: Veracruz (333 cases, 56% of the total), La Antigua (83 cases, 14%), and Boca del Rio (46 cases, 7.7%). Municipalities were not statistically compared, but the three aforementioned municipalities accounted for more than 75% of cases. Even though authors did not expected spatial correlation in the data, incidence rate in La Antigua was surprisingly higher than expected, and the reason remains obscure (Table 1). Years with the highest number of cases were 2010 (257) and 2011 (94).

Table 1. Confirmed cases of leptospirosis in Central Veracruz, Mexico from January 2007 to December 2011 by municipality and month

Variables	Population	Total cases	Mean	Standard error mean	95% Confidence interval	Incidence rate
Municipality						
Alvarado	51 955	32	6.4	2.5	(-0.55, 13.35)	12.3
Boca del Río	138 058	46	9.2	2.6	(2.1, 6.3)	6.7
Cotaxtla	19 710	11	2.2	1.5	(-1.9, 6.4)	11.2
Ignacio de la Llave	17 121	15	3.0	1.7	(-1.7, 7.7)	17.5
Jamapa	10 376	7	1.4	0.9	(-1.3, 4.1)	13.5
La Antigua	25 500	83	16.4	11.9	(-16.5, 49.7)	65.1
Manlio F. Altamirano	22 585	3	0.6	4.0	(-0.5, 1.7)	2.7
Medellín	59 126	8	1.6	1.1	(-1.5, 4.7)	2.7
Paso de Ovejas	32 576	14	2.8	1.9	(-2.4, 7.9)	8.6
Puente Nacional	21 603	14	2.8	1.9	(-2.4, 7.9)	12.9
Soledad de Doblado	27 008	3	0.6	0.4	(-0.5, 1.7)	2.2
Tlaxiucoyan	37 037	11	2.2	1.3	(-1.4, 5.8)	5.9
Úrsulo Galván	29 005	15	3.0	2.3	(-3.3, 9.3)	10.3
Veracruz	552 156	333	67	12.8	(31.0, 102.2)	12.1
Month						
January	1043816	53	10.6	2.59	(3.49, 20.01)	5.1
February	1043816	57	11.4	4.27	(-1.80, 27.30)	5.5
March	1043816	31	6.2	1.49	(1.50, 11.00)	3.0
April	1043816	30	5.75	1.55	(0.82, 10.68)	2.9
May	1043816	27	5.25	1.97	(-1.03, 11.53)	2.6
June	1043816	39	8.25	4.03	(-4.57, 21.07)	3.7
July	1043816	32	6.25	1.89	(0.24, 12.26)	3.1
August	1043816	55	12.25	4.27	(-1.34, 25.84)	5.3
September	1043816	53	11.5	2.63	(3.13, 19.87)	5.1
October	1043816	156	37.5	27.5	(-50.1, 125.1)	15.0
November	1043816	33	6.75	2.39	(-0.87, 14.37)	3.1
December	1043816	29	5.5	2.1	(-1.19, 12.19)	2.8

The total number of cases in this study is higher than those found in similar studies in the country, which may be due to climatic conditions in the study area that encourage the growth of bacteria [3,15]. Vado et al. [16] analyzed 439 sera from patients with serology suggestive of leptospirosis in the period 1998 to 2000 in Yucatan, Mexico and found only 61 cases (13.9%). In the same region, Zavala et al. [17], in a previous study found a similar value of human seropositivity (14.2%). In turn, Navarrete-Espinosa et al. [18] in a cross-sectional study of 550 serum samples from inhabitants of Jaltipan, Veracruz, found a prevalence of 4%.

The months with the highest number of cases in the study period were October (156, 26.2%), and to a lesser extent February (57, 9.6%), August (55, 9.2%), January (53, 8.9%) and September (53, 8.9%) (Table 1). Overall, most cases

(44.4%) were recorded from August to October coinciding with the season in which highest annual rainfall in the region occurs. A highly significant statistical difference between months was recorded ($P = .01$). In the study of Vado-Solís et al. [16] in Yucatan, 74% of human cases occurred during the rainy season. In Manaus, the largest number of cases also occurred during the period of intense rainfall [14]; however, in Hawaii, the highest occurrence of cases occurred from October to February [10].

The single month with the highest number of cases in the study period was October 2010, with 120 positive cases of leptospirosis. The cases in this month represented 46.7% of all positive cases in 2010 and 20.2% of the cases detected in the study period. The reason for this anomaly can be found in the aftermath of Hurricane Karl, which severely hit and affected the study area by

mid-September 2010 [19]. Natural disasters have been recognized as a factor associated with the subsequent presentation of outbreaks of leptospirosis in Mexico and elsewhere [20-22].

Most affected age groups were 21-30 years (125 cases, 21.1%), 11-20 years (104 cases, 17.5%) and 31-40 years (92 cases, 15.5%) but no statistically significant difference between age groups was identified ($P=.05$). Overall, 54.0% of leptospirosis cases corresponded to individuals between 11 and 30 years, decreasing with age (Table 2). This is similar to what was found in Jaltipan, Veracruz, where the most affected age group was 15 to 24 years, followed by 5 to 14 years [18]. In the study done in the City of Manaus, Brazil, the largest number of cases, including deaths, occurred in the age group from 14 to 44.9 years (74%) [14]. In Hawaii, the age range that appeared most cases was from 20 to 29 years, while the lower frequency range was from 0 to 9 years [10]. However, when compared by incidence rate, the number increased by age group. In a study in Yucatan, Mexico the highest seropositivity was found in people over 56 years of age [17]. More cases were identified as positive in male (310, 52.1%) than in female subjects (285, 47.9%), but no statistical difference was observed ($P=.05$) and incidence rate was identical for both sex groups (Table 2). In Jaltipan, Mexico and in Yucatan, Mexico a slight predominance of males over females was obtained [17,18]. In contrast, in the Netherlands,

in Hawaii and in Manaus, Brazil, more than 85% of the cases occurred in male persons [2,10,14].

Data records analyzed in this study did not included information on cohabitation, contact or exposure of persons to animals. Also, occupational data of patients was not entered. This information may be useful for epidemiological purposes but there are not enough elements to attempt an explanation, so the study remains mainly descriptive as a socio-demographic characterization of leptospirosis in the area. Also, from the information available for this study, no evidence of an epidemiological follow-up of leptospirosis cases was identified. This is important to identify other possible non-specific clinical cases, common sources of exposure and risk factors, in order to take more specific measures for prevention and control [15,23].

4. CONCLUSION

We conclude that leptospirosis has a strong presence in the human population in central Veracruz, Mexico. Out of 1,403 suspected cases of leptospirosis from 14 municipalities in central Veracruz, 42.4% (595) were positive. Most cases occur in the rainy season and male patients in productive age brackets (21-40 years old) accounted for the majority of the cases.

Table 2. Confirmed cases of leptospirosis in Central Veracruz, Mexico from January 2007 to December 2011 by age group and sex of patients

Variables	Population	Total cases	Mean	Standard error mean	95% confidence interval	Incidence rate
Age group, years						
Lessthan 10	238597	37	6.2	0.9	(4.0, 9.5)	15.5
11-20	232580	104	22.4	7.5	(-0.0, 47.5)	44.7
21-30	209720	125	26.6	10.0	(-2.9, 60.9)	59.6
31-40	136742	92	19.2	7.9	(-4.6, 46.1)	67.3
41-50	93629	80	16.6	6.2	(-1.9, 37.4)	85.4
51-60	61880	74	14.8	2.5	(8.1, 23.9)	119.6
61-70	23327	44	7.2	4.6	(-6.2, 23.2)	188.6
71+	47341	39	6.0	3.6	(-4.3, 18.8)	83.4
Sex						
Male	543837	310	62.0	16.1	(17.2, 106.8)	57.0
Female	499979	285	57.0	18.5	(5.5, 108.5)	57.0

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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