

## Epidemiology of leptospirosis in the department of Huila, Colombia. 2011 - 2017

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DOI: <https://doi.org/10.22517/25395203.24549>

### Abstract:

**Objective:** Describe the epidemiology of Leptospirosis in the department of Huila during the years 2011 to 2017.

**Materials and methods:** This article is a descriptive, cross-sectional, retrospective study. The population analyzed were patients from the different municipalities of the department of Huila who were reported as probable or confirmed cases for leptospirosis, structuring records for each year in databases compiled by the epidemiology area of the department's health secretary, based on the public health surveillance notification sheets for leptospirosis, and generated by each Primary Data Generating Unit (UPGD) in the presence of the event; The data were discriminated according to the variables of interest for the study in a new database in Excel; tabulated with the statistical program R - Studio 3.3.3 and Epidat 4.2, to later be processed with descriptive statistics and finally expressed in percentages and incidence rates.

**Results:** 268 cases were reported, which 61 (23%) were confirmed by laboratory and 207 (77%) suspicious or probable. 69% of the patients presented fever, myalgia and headache as representative symptoms. The most affected group range in ages from 27 and 59 (44%). The population was characterized for being part of the urban area (65%), and the cases were more frequent in men (72%). Regarding to employment, it was found that farmers (20%) and the cleaning staff (17%) were the most common cases. The risk factors identified were the presence of domestic animals in 67% of the cases, as well as the presence of rats at home (51%) and the possible poor water management.

**Conclusions:** The increase in the number of cases of Leptospirosis is probably associated with the poor water management and the presence of animals at home.

**Key words:** Leptospirosis, Epidemiology, Colombia

**Epidemiología de la Leptospirosis en el departamento del Huila, Colombia. 2011- 2017**

### Resumen

**Objetivo:** Describir la epidemiología de la Leptospirosis en el departamento del Huila durante el período 2011-2017.

**Materiales y métodos:** Estudio descriptivo de corte transversal, retrospectivo. La población analizada fueron pacientes de los diferentes municipios del departamento del Huila que se reportaron como casos probables o confirmados de leptospirosis. Se estructuraron registros por cada año en bases de datos recopiladas por el área de epidemiología de la Secretaría de Salud del Huila, basadas en las fichas de notificación de vigilancia en salud pública para leptospirosis y generadas por cada Unidad Primaria Generadora de Datos (UPGD) ante la presencia del evento. Los datos fueron discriminados de acuerdo a las variables de interés para el estudio en una nueva base de datos en Excel; tabuladas con el programa estadístico R – Studio 3.3.3 y Epidat 4.2, para luego ser procesados con estadísticos descriptivos y finalmente ser expresados en porcentajes y en tasas de incidencia.

**Resultados:** Se reportaron 268 casos, de los cuales 61 (23%) fueron confirmados por laboratorio y 207 (77%) sospechosos o probables. El 69% de los pacientes presentaron fiebre, mialgias y cefalea como síntomas representativos. El grupo etario más afectado tenía entre 27 y 59 años de edad (44%). La población se caracterizó por ser del área urbana (65%), con mayor frecuencia en hombres (72%). En relación a la ocupación laboral, se encontró mayor frecuencia en agricultores (20%) y en el personal de aseo (17%). Los factores de riesgo evi-

denciados fueron la presencia de animales domésticos en un 67% de los casos, así como la presencia de ratas en el hogar (51%) y el posible mal manejo del agua.

**Conclusiones:** El incremento en el número de casos de Leptospirosis probablemente está asociado a la mala manipulación del agua y a la presencia de animales en el domicilio.

**Palabras clave:** Leptospirosis, epidemiología, Colombia.

## Introduction

Leptospirosis is a worldwide infectious disease that is transmitted from animals to humans, being considered a zoonosis with a high epidemic potential, mainly in tropical regions (1). The main form of transmission occurs through direct human contact with the urine of infected rodents, dogs, cows, pigs and wild animals, as well as contaminated waters or environments (2).

*Leptospira interrogans*, is the pathogen responsible for the disease, more than 200 species have been described that can infect man (3). According to the World Health Organization (WHO), Leptospirosis can potentially constitute a serious disease (although it can be treated) since its clinical picture is similar to other unrelated infections, such as influenza, meningitis, hepatitis, dengue or viral hemorrhagic fevers, and can be fatal if not treated in time (4). According to the Panamerican Health Organization (PAHO), it is estimated that 1.03 million cases of leptospirosis are recorded worldwide each year, causing approximately 58,900 deaths (5). In the Region of the Americas, the annual morbidity rate fluctuates between a minimum of 3.9 cases per 100,000 inhabitants, with the highest incidence in South Latin America; and a maximum of 50.7 cases in the Caribbean (5).

During 2014, 10,702 human cases were reported worldwide, of which 95.5% were registered in Latin America, with a higher number of cases in Brazil (3,974), Peru (2,329) and Colombia (867). In the Caribbean, the highest rates were in Trinidad and Tobago with 363 cases, Saint Vincent and the Grenadines with 17 cases, and the Dominican Republic with 10 cases (5).

In Colombia, the prevalence of the disease varies according to the region, for example, in an indigenous community in the department of Córdoba, a study showed that the seroprevalence was 18.1%; in the region of Urabá, Antioquia, the prevalence was 12.5%; thus confirming the circulation of *Leptospira* spp in various regions of

the country (6). According to Carreño et al, in Colombia, mainly on the Atlantic Coast, Urabá Antioqueño and Eje Cafetero, the highest rates of the disease are presented (7).

The department of Huila has shown a growing curve of notified cases, finding 73 cases during 2013, while in 2014 and 2015 95 and 85 cases were reported respectively. For 2016 there was a significant increase in the number of cases (118), although for 2017 the figure decreased to 46 reported cases (8).

In this context, the Ten-Year Public Health Plan (PDSP) Colombia 2012 - 2021 and the Ministry of Health and Social Protection designed, in 2015, the Integrated Management Strategy of zoonoses for 100% of the Territorial Health Directorates, with the aim of supporting the prevention of Leptospirosis. With this, it is expected that by 2021, the incidence rate of this infection throughout Colombia will be known globally and by department (9), as well as epidemiological surveillance studies contemplated in the PDSP, which are required to establish the determinants of infection and its frequency, in order to know the real impact of the disease and its relevance in rural or urban settings of the country (10).

To achieve a better knowledge of the disease, it is important to have both local and national epidemiological studies that allow us to know in more detail the behavior of this pathology, facilitating the relevant entities design public health strategies in intervention and prevention. Taking into account the above, the objective of this study was to describe the epidemiology of Leptospirosis in the department of Huila during the years 2011 to 2017.

## Materials and methods:

The registered cases were taken from the databases of the Department of Epidemiological Surveillance of the Department of Health in Huila, which were reported as probable cases and confirmed by laboratory during the years 2011-2017.

A descriptive, retrospective, cross-sectional study was carried out. The database included sociodemographic information, clinical data, epidemiological link and laboratory results (IgM against *Leptospira* in paired samples by microagglutination (MAT), culture of *Leptospira* spp in any body fluid or by detection of DNA by Polymerase Chain Reaction); there was no discrimination based on age, sex, or race.

Data processing and analysis was performed with the R Commander statistical program. Continuous variables

were expressed as mean  $\pm$  standard deviation, discrete variables were expressed as frequencies and proportions. Subsequently, a statistical analysis was performed using the chi-square test ( $\chi^2$ ) for the comparison of proportions. The standardized incidence rate of each of the municipalities per 100,000 inhabitants was graphed on a map of the department of Huila.

## Results

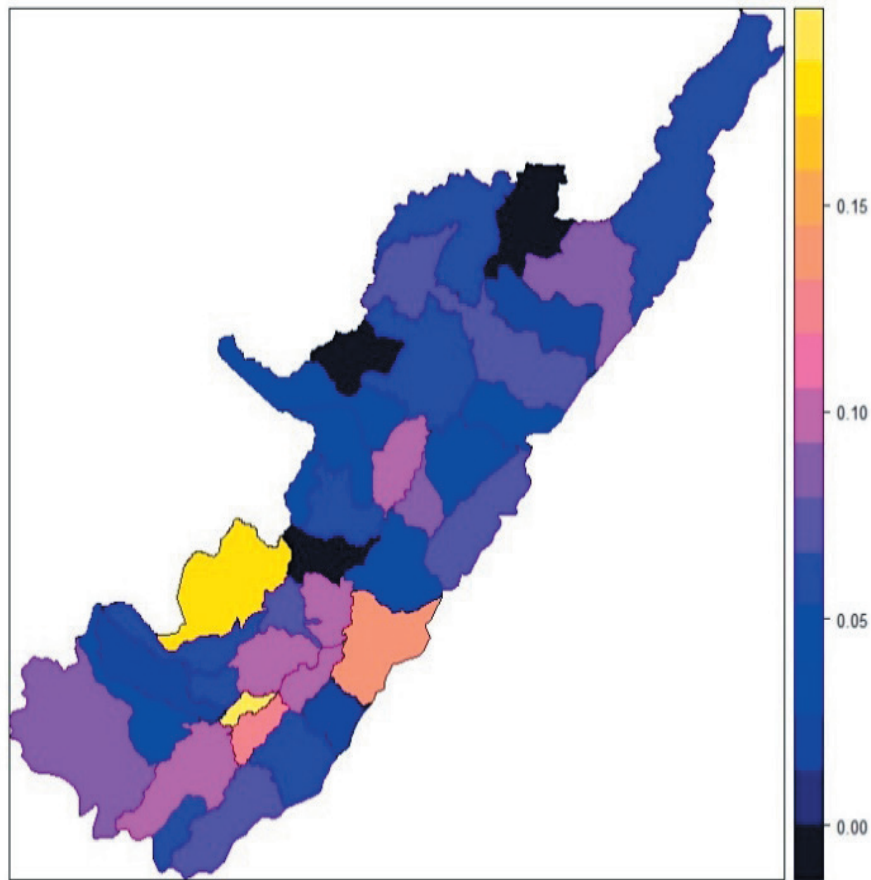
A total of 268 cases of Leptospirosis were reported during the study period. Table 1 indicates the sociodemographic characteristics of the population. The mean age of the patients was  $34.11 \pm 19.24$ . 44% of the study population were adults, 72% were male, and most of them came from the urban area (65%); The municipality with the highest incidence rate of reported cases was Elías with 7 cases per 100,000 inhabitants, followed by La Plata, with 6 cases per 100,000 inhabitants. (Figure 1). The work activities associated with risk for Infection, present in 39% of the cases, were agriculture and personnel who work in cleaning activities. The most frequent symptoms were fever, headache or myalgia, found in 69% of the cases. The data are recorded in Table 1:

**Table 1.** Sociodemographic characterization of the study population

CHARACTERISTICS		POPULATION N (%)
<b>TOTAL</b>		268 (100%)
<b>Age group</b>	<b>MEAN <math>\pm</math> DS</b>	34,11 $\pm$ 19,24
	Early Childhood	10 (4)
	Childhood	13 (5)
	Adolescence	51 (19)
	Youth	44 (16)
	Adulthood	118 (44)
	Elderly	32 (12)
<b>Gender</b>	Masculine	194 (72)
	Femenine	74 (28)
<b>Residence</b>	Urban	175 (65)
	Rural	93 (35)
<b>Occupation</b>	Occupation with risk for infection	105 (39)
	Occupation without risk for infection	163 (61)
<b>Symptoms</b>	Asymptomatic	0 (0)
	Constitutional symptoms (Fever, Myalgia or headache)	186 (69)
	Specific symptoms (Splenomegaly or jaundice)	10 (4)
	2 or more or	72 (27)

The municipality with the highest incidence rate of reported cases was Elías with 7 cases per 100,000 inhabitants, followed by La Plata, with 6 cases per 100,000 inhabitants (Figure 1).

**Figure 1.** Incidence rates per 100,000 inhabitants, broken down by municipalities according to the cases reported during the period 2011 - 2017.



Elías and La Plata were the 2 municipalities in the department of Huila with the highest incidence rate: 7 and 6 cases per 100,000 inhabitants respectively

As indicated in Table 2, the study population was discriminated according to the operational definitions of the types of cases described in the public health surveillance protocol for Leptospirosis. In which a total of 268 patients were included, of which 61 cases were laboratory confirmed (23%) and 207 (77%) identified as probable or suspected. The years with the highest number of reported cases were 2014 and 2015 with a total of 56 cases for the year 2014 (21% of the total cases of the period under study) and 50 cases for the year 2015 (19% of the total cases of the period under study).

**Table 2.** Distribution of the population according to the type of case reported in relation to the risk factors associated with Leptospirosis infection

Characteristics	Probable or suspected case N (%)	Laboratory confirmed case N (%)	P
<b>Total</b>	207 (77)	61 (23)	N.A
<b>Notification year</b>			
2011	12 (4)	5 (2)	
2012	28 (10)	16 (6)	
2013	29 (11)	2 (1)	
2014	42 (16)	14 (5)	
2015	37 (14)	13 (5)	
2016	42 (16)	3 (1)	
2017	17 (6)	8 (3)	0,006 <sup>a</sup>
<b>Water sources</b>			
Not reported	8 (3)	1 (0,5)	
Aqueduct	150 (56)	47 (17,5)	
River	19 (7)	6 (2)	
Community well	17 (6,5)	6 (2)	
Storage tank	6 (2)	1 (0,5)	
More than 2 water sources	7 (3)	0 (0)	0,647 <sup>a</sup>
<b>Presence of rats</b>			
Yes	106 (39)	32 (12)	
Not	101 (38)	29 (11)	0,864 <sup>a</sup>
<b>Uncovered sewers</b>			
Yes	59 (22)	11 (4)	
Not	148 (55)	50 (19)	0,102 <sup>a</sup>
<b>Poultry presence</b>			
Yes	10 (4)	2 (1)	
Not	197 (73)	59 (22)	0,606 <sup>a</sup>
<b>Presence of cattle and pigs</b>			
Yes	25 (9)	6 (2)	
Not	182 (68)	55 (21)	0,631 <sup>a</sup>
<b>Presence of domestic animals</b>			
Yes	134 (50)	46 (17)	
Not	73 (27)	15 (6)	0,119 <sup>a</sup>
<b>Contact with sick animals</b>			
Yes	18 (7)	5 (2)	
Not	189 (70)	56 (21)	0,903 <sup>a</sup>
<b>Floods in housing area</b>			
Yes	12 (5)	4 (1)	
Not	195 (73)	57 (21)	0,826 <sup>a</sup>
<b>Contact with stagnant water</b>			
Yes	45 (17)	12 (5)	
Not	162 (60)	49 (18)	0,729 <sup>a</sup>
<b>Solid waste disposal</b>			
Garbage collection	134 (50)	38 (14)	
Peridomiciliary garbage disposal	73 (27)	23 (9)	0,727 <sup>a</sup>
<b>Garbage storage time</b>			
1 - 3 Days	142 (53)	41 (15)	
4 - 7 Days	60 (23)	17 (6)	
More than 7 days	5 (2)	3 (1)	0,600 <sup>a</sup>
<b>Sports activities background</b>			
Yes	70 (26)	19 (7)	
Not	137(51)	42 (16)	0,697 <sup>a</sup>

DS = Standard deviation, P: probability



One of the main findings focuses on the sources of water for household activities since 9% of the reported cases showed the use of river water for drinking and household chores. Regarding the presence of domestic animals in the home, it was found that 26% of the cases were exposed to this risk factor. On the other hand, the presence of rats in the home or workplace was identified in 51% of the patients.

Predisposing situations classically described in the literature, such as exposure to stagnant water sources and peridomiliary presence of uncovered sewers, were not identified in the studied population. However, the socio-sanitary conditions did have relevance in the reported cases, since 24% of the patients confirmed with Leptospirosis had solid waste (garbage) at the household and peridomiliary level; With regard to work occupations, only 39% of the patients had a trade that is associated with the risk of acquiring the disease. (Jobs in agriculture, livestock, veterinarians, fishermen, cleaning personnel, army and police).

## Discussion

Generally, zoonoses go unnoticed, either because the animals themselves do not develop the disease or because symptoms begin to manifest in humans after a long period of time (12). The cases of leptospirosis registered during the years of study, in the department of Huila, indicate that there is a direct or indirect transmission of the etiological agent from animals to man through contact with contaminated environments (13). According to Macías Herrera et al., Leptospirosis can occur in all stages of life, reaching higher incidence rates in economically productive life ages, being consistent with this study, where the highest number of cases occurred in adults (14). This research showed agriculture as the most predominant occupation in the recorded cases. Sethi et al. Indicate that agrarian life is a risk factor due to intimate contact with animals and flooded fields, which are suitable conditions for the survival and transmission of leptospira (15). According to the regional information system of Huila, rice harvest is the most frequent agricultural activity (16). A study carried out in farmers dedicated to rice cultivation in Peru, revealed that the practice of working barefoot and handling rodents in crop fields predisposes to the disease (17).

Different studies have shown that the prevalence of leptospirosis is higher in men than in women and is directly related to the roles played in productive agricultural work, being more susceptible to the risk of the disease; the above coincides with data reported in this study, where the male sex has a higher percentage of confirmed

cases (18). A fact to highlight in this research is the fact of having the highest number of cases in the urban area, which may be associated with the fact that urban agriculture emerges as a process of territorial expansion that serves as a mechanism to house rural families that come to cities seeking a better quality of life (19). This migration promotes agricultural practices in urban and peri-urban spaces, and generates modifications in ecosystems, increasing the presence of diseases such as leptospira (15).

The expansion of urban slums has created conditions conducive to the transmission of infection by rats (20). According to the scientific literature, rodents are the main reservoirs of *Leptospira* spp, since they move freely and can have contact with other species of animals, facilitating the spread of the infection to susceptible hosts; diagnosis in these animals is difficult and their infection does not induce symptoms, which makes the control of these reservoirs even more difficult (21). In this study, the presence of rats and domestic animals was evidenced in workplaces or homes, which predisposes them to infection.

It should be remembered that natural reservoirs among domestic animals include cattle, pigs, sheep, and dogs, which vary with serovar and geographic region (22). In rural areas, cattle live in close contact with agricultural workers; a relatively high prevalence of leptospirosis in the urine of bovines, becoming an important route of transmission through contaminated urine (13).

The geographical, climatological, economic and social conditions of Colombia generate a favorable environment for the re-emergence of leptospirosis; its tropical location, with warm thermal floors in most of the national territory, unsuitable social conditions, work without labor protection, deficient sanitary services and population settlements, favor the appearance of the disease (23).

It is important to note that various investigations have suggested an association between climatic changes and the presentation of a greater number of cases of the disease (24). A study carried out in Thailand reports a higher number of cases after the rainy season and floods in tropical areas (25). In this research, the years that reported the highest number of cases of leptospirosis were in 2011 and 2016. According to IDEAM, the climatic changes reported in those years arose drastically as a consequence of the phenomenon of "La Niña" in some regions of Colombia, including the department of Huila, enhancing this risk factor for the transmission of *Leptospira* (26)

In this study, it was identified that the municipalities with the highest incidence rate were Elías and La Plata, where work activity is mainly focused on agricultural and livestock activities (27) (28). According to the Health Situation Analysis (ASIS), these municipalities present precarious social determinants of health, deficiency in the coverage of the sewage system, the aqueduct, in the quality of the water and unfavorable sanitary conditions, making diseases such as Leptospirosis more easily affected to this population (28) (27).

The frequency of reported cases worldwide is variable and depends on the social and climatological characteristics of the population, and the number of human cases is not precisely known, due to underdiagnosis or misdiagnosis of the disease (3). National and international studies indicate that the presence of clinical manifestations such as fever, headache, myalgia, general malaise, abdominal pain, diarrhea and arthralgia are part of the initial symptoms of leptospirosis but that at the same time creates confusion due to the similarity of the symptoms generated by other microorganisms (29); These investigations are consistent with what was found in this study, since the symptoms that were most evident in the reported cases were fever, headache and myalgia.

Finally, due to the fact that the symptoms are variable and that the clinical picture is similar to other endemic diseases of the Huila department (such as Dengue), the diagnosis of Leptospirosis is not easy and requires a high clinical and epidemiological suspicion to detect them in time. It is important to control the vectors (control of rodents, livestock) and an improvement of the socio-sanitary conditions by the competent entities to reduce the number of cases of the disease and by means of a timely diagnosis to avoid the impact on the quality of life of the population.

### Acknowledgments:

Department of Health of Huila

### Referencias

1. Caino H, Scaglia J, Crucio F, Siquirot G. Leptospirosis. Rev Fac Ciencias médicas. 2006;1(3):30–6.
2. Rodríguez R. Evaluation of the behavior of human leptospirosis by means of a mathematical model using climatic variables as predictors. [Internet] 2010 [cited 2018 December 19]. Available from: [http://www.veterinaria.org/revistas/redvet/n030310B/0310B\\_DS27.pdf](http://www.veterinaria.org/revistas/redvet/n030310B/0310B_DS27.pdf)
3. World Health Organization. Leptospirosis.[Internet]

2021[cited 2020 Dec 15]. Available from:

[https://www.paho.org/hq/index.php?option=com\\_content&view=article&id=7821:2012-informacion-general-leptospirosis&Itemid=0&lang=es](https://www.paho.org/hq/index.php?option=com_content&view=article&id=7821:2012-informacion-general-leptospirosis&Itemid=0&lang=es)

4. Terpstra WJ. Human Leptospirosis: Guide for Diagnosis, Surveillance and Control [Internet] 2008 [cited 2019 Dec 19]. Available from:

Disponible en: <http://www.med.monash.edu.au/microbiology/staff/adler/guia-esp.pdf>

5. World Health Organization. The control of neglected zoonotic diseases: From advocacy to action: Report of the fourth international meeting held at WHO headquarters, Geneva, Switzerland, 19-20 November 2014. [Internet] 2014 [citado el 19 de diciembre de 2019]. Available from: [https://www.paho.org/salud-en-las-americas-2017/?post\\_type=zoonosis](https://www.paho.org/salud-en-las-americas-2017/?post_type=zoonosis)
6. Flores P. Human leptospirosis in Colombia: the experience of the Colombian Institute of Tropical Medicine - CES. CES Med [Internet] 2008[cited 2019 Dec 19];21(1). Disponible en: <http://revistas.ces.edu.co/index.php/medicina/article/view/118>
7. Buitrago L. Informe nacional de zoonosis 2014. [Internet] 2014 [citado el 15 de diciembre de 2019]. Disponible en: <https://www.slideshare.net/LuisAlbertoCarreoBui/informe-nacional-de-zoonosis-2014>
8. Secretaría de Salud Departamental del Huila. Boletines Epidemiológicos año 2017 [Internet] 2017 [citado el 19 de diciembre de 2019] Disponible en: <https://www.huila.gov.co/salud/publicaciones/7191/boletines-epidemiologicos-ano-2017/>
9. Ministerio de Salud y Protección Social. Plan Decenal de Salud Pública Colombia 2012 – 2021. Sistema de seguimiento. [Internet] 2021 [citado el 10 de enero de 2021]. Disponible en: [https://www.minsalud.gov.co/Documentos\\_y\\_Publicaciones/Sistema\\_de\\_Seguimiento\\_y\\_Evaluación\\_del\\_Plan\\_Decenal\\_De\\_Salud\\_Pública\\_-\\_PDSP\\_Colombia\\_2012\\_-\\_2021.pdf](https://www.minsalud.gov.co/Documentos_y_Publicaciones/Sistema_de_Seguimiento_y_Evaluación_del_Plan_Decenal_De_Salud_Pública_-_PDSP_Colombia_2012_-_2021.pdf)
10. Ministerio de Salud y Protección Social. Plan decenal de salud pública 2012 - 2021 [Internet] 2013 [citado el 19 de diciembre de 2019]. Disponible en: [https://www.minsalud.gov.co/Documentos\\_y\\_Publicaciones/Plan\\_Decenal\\_-\\_Documento\\_en\\_consulta\\_para\\_aprobación.pdf](https://www.minsalud.gov.co/Documentos_y_Publicaciones/Plan_Decenal_-_Documento_en_consulta_para_aprobación.pdf)

11. Gobernación del Huila. Análisis de Situación en Salud del Departamento del Huila - Neiva 2016 [Internet] 2016 [citado el 19 de diciembre de 2019]. Disponible en: [http://huila.gov.co/documentos/2017/saludpublica/ASIS/asis\\_departamental-2016-huila.pdf](http://huila.gov.co/documentos/2017/saludpublica/ASIS/asis_departamental-2016-huila.pdf)
12. Katz AR, Ansdell VE, Effler P V, Middleton CR, Sasaki DM. Leptospirosis in Hawaii, 1974-1998: epidemiologic analysis of 353 laboratory-confirmed cases. *Am J Trop Med Hyg* [Internet] 2002 [cited 2018 Dec 19];66(1):61-70. Disponible en: <http://www.ncbi.nlm.nih.gov/pubmed/12135270>
13. Haake DA, Levett PN. Leptospirosis in Humans. In: *Current topics in microbiology and immunology* [Internet] 2015 [cited 2018 Dec 19]. p. 65-97. Disponible en: <http://www.ncbi.nlm.nih.gov/pubmed/25388133>
14. Agudelo-Flórez P, Restrepo-Jaramillo BN, Arboleda-Naranjo M. Situación de la leptospirosis en el Urabá antioqueño colombiano: estudio seroepidemiológico y factores de riesgo en población general urbana. *Cad Saude Publica* [Internet] 2007 [citado el 19 de diciembre de 2019];23(9):2094-102. Disponible en: [http://www.scielo.br/scielo.php?script=sci\\_arttext&pid=S0102-311X2007000900017&lng=es&tlng=es](http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0102-311X2007000900017&lng=es&tlng=es)
15. Sethi S, Sharma N, Kakkar N, Taneja J, Chatterjee SS, Banga SS, et al. Increasing trends of leptospirosis in northern India: a clinico-epidemiological study. *Martins EAL, editor. PLoS Negl Trop Dis* [Internet] 2010 [cited 2018 Dec 19];4(1):e579. Available from: <https://dx.plos.org/10.1371/journal.pntd.0000579>
16. Gobernación del Huila. Economía [Internet] 2017 [citado el 19 de diciembre de 2019]. Disponible en: <https://www.huila.gov.co/publicaciones/148/economia/>
17. Tejada Caminiti R, Romaní Romaní F, Wong P, Alarcón Villaverde J. Prácticas laborales de riesgo en cultivadores de arroz del valle del Alto Mayo, Región San Martín, Perú. *Rev Peru Epidemiol* [Internet] 2011 [citado el 19 de diciembre de 2019];15(1):7. Disponible en: <https://dialnet.unirioja.es/servlet/articulo?codigo=3750053>
18. Centro Provincial de Información de Ciencias Médicas, Cuba. Caracterización clinicoepidemiológica de pacientes con leptospirosis. *MEDISAN* [Internet] 2009 [citado el 19 de diciembre de 2019];13(1). Disponible en: [http://scielo.sld.cu/scielo.php?script=sci\\_arttext&pid=S1029-30192009000100004](http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=S1029-30192009000100004)
19. Lacerda HG, Monteiro GR, Oliveira CCG, Suassuna FB, Queiroz JW, Barbosa JDA, et al. Leptospirosis in a subsistence farming community in Brazil. *Trans R Soc Trop Med Hyg* [Internet] 2008 [cited 2018 Dec 19];102(12):1233-8. Available from: <https://academic.oup.com/trstmh/article-lookup/doi/10.1016/j.trstmh.2008.05.010>
20. Costa F, Ribeiro GS, Felzemburgh RDM, Santos N, Reis RB, Santos AC, et al. Influence of household rat infestation on leptospira transmission in the urban slum environment. *Small PLC, editor. PLoS Negl Trop Dis* [Internet] 2014 [cited 2018 Dec 19];8(12):e3338. Available from: <http://dx.plos.org/10.1371/journal.pntd.0003338>
21. Mori M, Bourhy P, Le Guyader M, Van Esbroeck M, Djelouadji Z, Septfons A, et al. Pet rodents as possible risk for leptospirosis, Belgium and France, 2009 to 2016. *Euro Surveill* [Internet] 2017 [cited 2018 Dec 19];22(43). Available from: <http://www.eurosurveillance.org/content/10.2807/1560-7917.ES.2017.22.43.16-00792>
22. Acha PNSB. Zoonoses And Communicable Diseases Common To Man And Animals [Internet] 2003 [cited 2018 Dec 19]. Available from: <https://www.paho.org/hq/dmdocuments/2012/Acha-Zoonoses-Eng.pdf>
23. D. Esobar, W. Garcia, L.A Sandoval, L.E. Tibaquirá HG. Epidemiología de la Leptospirosis en el Departamento del Tolima, Colombia, 2009 - 2011. *Rev Fac Nac Salud Pública* [Internet] 2013 [citado el 19 de diciembre de 2019];31(1):48-57. Disponible en: [http://www.scielo.org.co/scielo.php?script=sci\\_arttext&pid=S0120-386X2013000100006](http://www.scielo.org.co/scielo.php?script=sci_arttext&pid=S0120-386X2013000100006)
24. Petrakovsky J, Bianchi A, Fisun H, Nájera-Aguilar P, Pereira MM. Animal leptospirosis in Latin America and the Caribbean countries: reported outbreaks and literature review (2002-2014). *Int J Environ Res Public Health* [Internet] 2014 [cited 2018 Dec 19];11(10):10770-89. Available from: <http://www.mdpi.com/1660-4601/11/10/10770>
25. Kawaguchi L, Sengkeopraseuth B, Tsuyuoka R, Koizumi N, Akashi H, Vongphrachanh P, et al.



Seroprevalence of leptospirosis and risk factor analysis in flood-prone rural areas in Lao PDR. *Am J Trop Med Hyg* [Internet] 2008 J [cited 2018 Dec 19];78(6):957–61. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/18541776>

26. Instituto de Hidrología, Meteorología y Estudios Ambientales. IDEAM. Tiempo y Clima. [Internet] 2014 [cited 2018 Dec 19]. Available from: <http://www.ideam.gov.co/web/tiempo-y-clima>
27. Gobernación del Huila. Análisis de Situación en Salud del Municipio de La Plata, Huila 2017. [Internet] 2017 [cited 2018 Dec 19]. Available from: <https://www.huila.gov.co/salud/loader.php?lServicio=Tools2&lTipo=descargas&lFuncion=descargar&idFile=26450>
28. Gobernación del Huila. Análisis de Situación en Salud del Municipio de Elías, Huila 2017 [Internet] 2017 [cited 2018 Dec 19]. Available from: <https://www.huila.gov.co/salud/loader.php?lServicio=Tools2&lTipo=descargas&lFuncion=descargar&idFile=26442>
29. Arroyave E, Londoño AF, Quintero JC, Agudelo-Flórez P, Arboleda M, Díaz FJ, et al. Etiology and epidemiological characterization of non-malarial febrile syndrome in three municipalities of Urabá (Antioquia), Colombia. *Biomédica* [Internet] 2013 [citado el 19 de diciembre de 2019];33,1:99–107. Available from <http://www.ncbi.nlm.nih.gov/pubmed/24652254>