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ARTICLE
DOI: http://dx.doi.org/10.18561/2179-5746/biotaamazonia.v6n4p94-99

Epidemiology of leptospirosis: cases from 2011 to 2015 in the Brazilian northern region

Rafaela Segatti Rezende[1*], *Yuri Barcelos*[1], *Thiago Vinicius Fróes Laurindo*[1], *Claudio Alberto Gellis de Mattos Dias*[2], *Euzébio de Oliveira*[3], *Ingrid Lara de Araújo Utzig*, *Amanda Alves Fecury*

1. Acadêmico(a) de Medicina (Universidade Federal do Amapá).
2. Biólogo (Universidade do Sagrado Coração). Doutor em Teoria e Pesquisa do Comportamento (Universidade Federal do Pará). Professor do Instituto Federal do Amapá, Brasil.
3. Biólogo (Universidade Comunitária da Região de Chapecó). Doutor em Doenças Tropicais (Universidade Federal do Pará). Professor da Universidade Federal do Pará, Brasil.
4. Licenciada em Letras (Universidade Federal do Amapá). Especialização em Língua Inglesa (Instituto de Ensino Superior do Amapá, Brasil).
5. Biomédica e Doutora em Doenças Tropicais (Universidade Federal do Pará). Professora da Universidade Federal do Amapá, Brasil.
**Autor para correspondência: rezgatti@hotmail.com*

ABSTRACT. Leptospirosis is an emerging multisystem infectious zoonosis caused by the pathogenic bacteria characterized by a large spectrum of clinical manifestations. Human infection. To analyze the epidemiology of leptospirosis (listed cases between 2011 and 2015) in the cities and states of the brazilian northern region by: age, gender and education. Cross-sectional, descriptive and retrospective study with secondary data from 2011 to 2015 obtained in DATASUS, by gender, education and age. Data were organized and tabulated in Microsoft Excel® 2007 spreadsheets. The project was included in the Platform Brazil and submitted to the Ethics Committee of the Federal University of Amapá with a favorable opinion, CAAE 56180616.1.0000.0003. It was found 4813 notifications predominantly in male gender at Acre, Rio Branco; the age group was between 15 and 39 years old, with elementary education. The reported cases are still considerable, demonstrating the need for public health measures to improve disease prevention in educational, structural and even occupational levels.

Keywords: Epidemiology; Leptospirosis; Public Health.

Epidemiologia da leptospirose: casos de 2011 a 2015 na região Norte Brasileira

RESUMO. A leptospirose é uma zoonose infecciosa, multissistêmica e emergente, causada por bactérias patogênicas constituídas por um grande espectro de manifestações clínicas. Infecção humana. O objetivo do esteudo foi analisar a epidemiologia da leptospirose (casos listados entre 2011 e 2015) nas cidades e estados da Região Norte do Brasil por idade, gênero e educação. Estudo transversal, descritivo e retrospectivo com dados secundários de 2011 a 2015 obtidos no DATASUS, por gênero, escolaridade e idade. Os dados foram organizados e tabulados em planilhas do Microsoft Excel® 2007. O projeto foi incluído na Plataforma Brasil e submetido ao Comitê de Ética da Universidade Federal do Amapá com parecer favorável, CAAE 56180616.1.0000.0003. Foram encontradas 4813 notificações, predominantemente masculinas no Acre e Rio Branco. A faixa etária foi entre 15 e 39 anos, com ensino fundamental. Os casos relatados são ainda consideráveis, demonstrando a necessidade de medidas de saúde pública para melhorar a prevenção de doenças em nível educacional, estrutural e até mesmo ocupacional.

Palavras-chave: Epidemiologia, Leptospirose, saúde pública.

1. Introduction

Leptospirosis is an emerging multisystem infectious zoonosis caused by the pathogenic bacteria *Leptospira*, characterized by a large spectrum of clinical manifestations. Human infection can occur directly (urine of infected animals), or indirectly (contaminated water or soil) (SOUZA et al., 2013).

It is a feverish infectious disease of sudden onset, whose clinical spectrum can range from mildly symptomatic, mild and benign to serious evolution. Weil syndrome, commonly described as jaundice, renal insufficiency and bleeding is the classic manifestation of severe leptospirosis (ELKHOURY et al., 2009).

Leptospirosis is a major public health problem in Brazil, due to the high incidence in populations living in urban areas without adequate infrastructure and with high rodent infestations. These factors, associated to rainy seasons and floods, provide the spread and persistence of leptospires in the environment, predisposing human contact with contaminated water and facilitating outbreaks (ELKHOURY et al., 2009).

According to the Brazil Ministry of Health, the main affected age group is from 15 to 59 years and the most affected region is the Southeast (37.4%), followed by South (31.7%) and Northeast (19.1%) (ELKHOURY et al., 2009). Eight six percent (86%) of the cases are from urban areas, while only 11% come from rural areas (ELKHOURY et al., 2009; SOUZA et al., 2013). Despite the lack of accurate data, the World Health Organization (WHO) estimates lethality in 10% of cases (FIOCRUZ, 2008).

Population growth not accompanied by urban planning contributes to the emergence of diseases and epidemics caused by poor hygiene and sanitation, making more vulnerable people to the negative impacts of social and environmental order. According to the authors, it happens because there are industrialization and disorganized urbanization, lack of economic and political resources, lack of planning and development of cities, favoring the increase and migration vector of epidemics and diseases, thus exposing entire communities to serious health risks, such as leptospirosis (LESSA-AQUINO et al., 2013; SOARES et al., 2014.

Epidemiologically, it is a worldwide spread disease, estimated at 1.03 million cases per year, concentrated in times of high rainfall, especially in the regions of tropical and subtropical climates (COSTA et al., 2015).

With obvious occupational character, leptospirosis affects more constantly men between the third and sixth decades, often working in agriculture (rice fields, sugarcane, livestock, mining, garbage collection, among other professions that involve individual contact with the transmitters animals) (BOURHY et al., 2012; VASCONCELOS et al., 2012; TILAHUN et al., 2013; SILVA et al., 2015).

In Latin America, Asia and Africa, we see the same infectious pattern, affecting least developed countries and reducing their cases when resources are allocated to the implementation of extensive sanitary measures, infrastructure improvement, showing a significantly socioeconomic aspect

combined with the ineffectiveness of preventive health policies (DE OLIVEIRA et al., 2013; MELO et al., 2013; COSTA et al., 2015).

Brazil is the 17th country in the world ranking of infection by leptospirosis, with 12.8 cases per million, providing favorable conditions for its spread, facilitated by the Brazilian weather pattern (hot and rainy), also responsible for the floods over 100 million people (BOURHY et al., 2012; BIGGS et al., 2013; COSTA et al., 2015).

Seven states make up the Northern region of Brazil: Rondônia, Acre, Amazonas, Roraima, Pará, Amapá and Tocantins. They have almost the same national and global epidemiological characteristics of the disease. Between 2007 and 2011, they were second in incidence of cases, and Amapá presented the highest annual average of these states (IBGE, 2015).

In this context, this research quantified and described the epidemiology of leptospirosis reported cases in the period from 2011 to 2015 in the capital cities and states of the North region, assessing the gender, age and education.

2. Method

This article was based on the monograph entitled "Epidemiology of leptospirosis: cases from 2011 to 2015 in the northern region", presented to the bachelor's program in Medicine, Federal University of Amapá/UNIFAP - Macapá/AP, Brazil, in 2016. It refers to a descriptive, cross-sectional retrospective study using secondary data collected from the DATASUS website (www2.datasus.gov.br), which were selected "Health Information (TABNET), Epidemiology and Morbidity" and "Diseases and Notifiable diseases - from 2007 until now (SINAN - SYSTEM DISORDERS NOTIFICATION OF INFORMATION). Then there is the option Leptospirosis, selected and analyzed data from 2011 to 2015 in the states of the northern region, considering gender, education and age.

Data were organized and tabulated in Microsoft Excel 2007 spreadsheet program in order to create figures and tables.

This study was the project contained in the Platform Brazil and sent to the UNIFAP's (Federal University of Amapá) Ethics Committee for consideration and exemption, since the present study used secondary data from government database. It was approved and registered under CAAE 56180616.1.0000.0003.

3. Results

It was reported the total of 4810 leptospirosis cases in the Northern region of Brazil between 2011 and 2015. In 2011, there were 492 cases (343 in men and 149 in women); in 2012 there was an increase to 532 (346 men and 186 women); 2013 had 933 notifications (602 in men and 331 in women); while in 2014 it represented sizable growth with 1725 cases (1123 men and 602 women); there was a decline in 2015, with a total of 1131 records (768 in men and 363 in women). There has been a distribution of 66.11% (3,182 cases) in males and yet, it is noteworthy that in 2014 accounted for over one third of cases, totaling 1,725.

Regarding the distribution of cases among states in the region analyzed, Acre was responsible for the largest number, totaling 3,023 cases in five years, which represented 62.80% of the regional registries. Also in relation to Acre, stood out the years 2014 and 2015, which together represented 69.70% of local notifications. The State of Pará was the second with 11.96% (576 / 4,813) of the cases. Amapá, in turn, occupied the fourth position with 357 notifications, surpassed by Rondônia - 470 records - and overlaying the Amazonas - 346 cases - in the same period. Tocantins contributed 0,51% (25/4.813) notifications. It is worth to note that Roraima is the state with the lowest number of records, less than 3 cases/year (Figure 1).

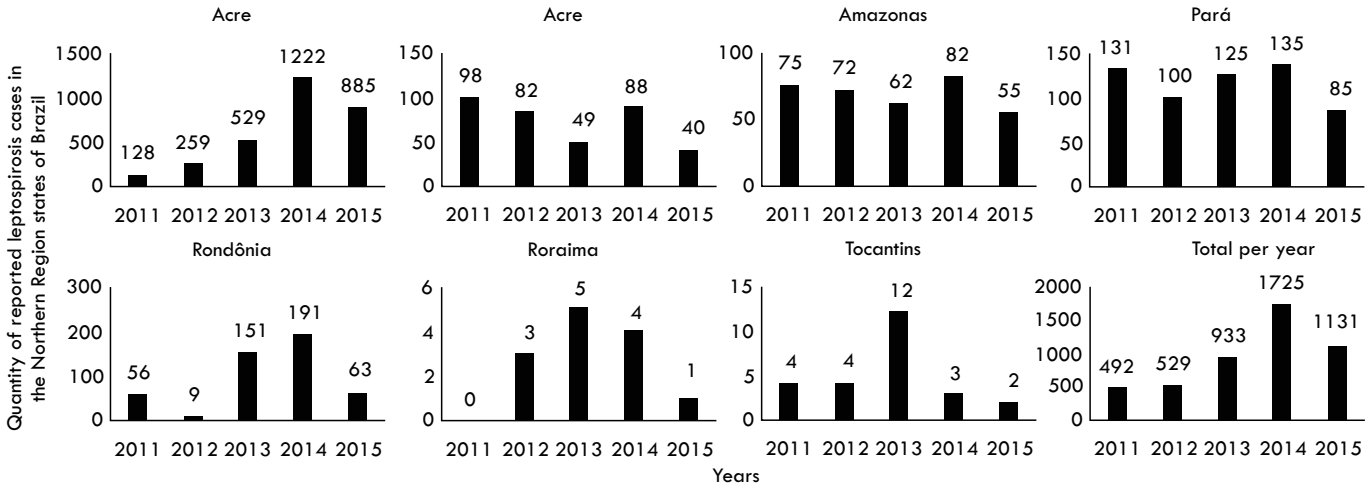

Figure 1. Annual distribution (between 2011 and 2015) leptospirosis among the northern region states of Brazil. / **Figura 1.** Distribuição anual (entre 2011 e 2015) da leptospirose entre os estados da região norte do Brasil.

Figure 2 shows the cases of the seven northern region capitals. There were 3,644 records between the capital, corresponding to 75.71% (3,644/4,813) of the notifications in the region. Again, males predominated (66.57% or 2,426/3,644) between records in capitals. Highlight for 2014 and 2015, which together, reached 2,169 records, more than half of the cases of these same capitals. In contrast, in 2011 there were 341 records.

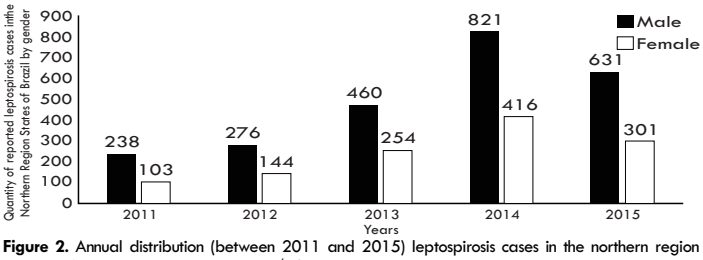

Figure 2. Annual distribution (between 2011 and 2015) leptospirosis cases in the northern region capitals of Brazil by gender, per year. / **Figura 2.** Distribuição anual (entre 2011 e 2015) casos de leptospirose nas capitais do norte da região do Brasil por gênero, por ano.

By analyzing Table 1, it was observed that Rio Branco contributed with the largest share of notifications, 69.26% (2,524/3,644). Palmas had the lowest percentage of notifications, 0.24% (9/3644), the lowest annual rate during the study period. Macapá demonstrated a successive fall: in 2011 71 registered cases and in 2015 less than half (34 cases).

Table 1. Annual distribution (between 2011 and 2015) leptospirosis cases among the northern region capitals of Brazil. / **Tabela 1.** Distribuição anual (entre 2011 e 2015) casos de leptospirose entre as capitais da região norte do Brasil

Northern Region Capitals of Brazil	2011	%	2012	%	2013	%	2014	%	2015	%
Rio Branco	100	29.32	248	59.04	443	62.04	957	77.36	776	83.26
Macapá	73	21.40	61	14.52	39	5.46	58	4.68	34	3.64
Manaus	68	19.94	66	15.71	61	8.54	69	5.57	51	5.47
Belém	79	23.16	35	8.33	66	9.24	68	5.49	45	4.82
Porto Velho	19	5.57	5	1.19	96	13.44	80	6.46	17	1.82
Boa Vista	0	0.00	3	0.71	4	0.56	4	0.32	1	0.1
Palmas	2	0.58	2	0.47	2	0.70	1	0.08	2	0.21
Total	**341**	**100**	**420**	**100**	**711**	**100**	**1237**	**100**	**926**	**100**

Table 2 represents the distributed cases according to age in the five years analyzed, among the seven northern region capitals. For the analyzes, the ages were grouped according to the following age groups: first group (0-14), second group (15-39), third group (40-64), and finally, the fourth group (65 years or more).

Table 2. Leptospirosis cases in the northern region capitals by age group. / **Tabela 2.** Casos de leptospirose nas capitais da região norte, por faixa etária.

Northern region states of Brazil	< 1 to 14	%	15 to 39	%	40 to 64	%	65 or +	%
Acre	520	57.65	1664	65.67	734	61.58	104	55.91
Amapá	181	20.07	118	4.66	52	4.36	6	3.23
Amazonas	78	8.65	171	6.75	91	7.63	11	5.91
Pará	58	6.43	290	11.44	189	15.86	39	20.97
Rondônia	62	6.87	266	10.50	120	10.07	22	11.83
Roraima	0	0.00	10	0.39	3	0.25	0	0.00
Tocantins	3	0.33	15	0.59	3	0.25	4	2.15
Total	**902**	**100**	**2534**	**100**	**1192**	**100**	**186**	**100**
Northern region capitals of Brazil	**<1 to 14**	**%**	**15 to 39**	**%**	**40 to 64**	**%**	**65 or +**	**%**
Acre	427	66.72	1381	70.78	622	68.43	99	69.72
Amapá	126	19.69	90	4.61	46	5.06	3	2.11
Amazonas	41	6.41	172	8.82	92	10.12	9	6
Pará	18	2.82	166	8.51	90	9.90	19	6.34
Rondônia	27	4.22	126	6.46	54	5.94	10	13.38
Roraima	0	0.00	9	0.46	3	0.33	0	7.04
Tocantins	1	0.26	7	0.36	2	0.22	2	0.00
Total	**640**	**100**	**1951**	**100**	**909**	**100**	**142**	**100**

Still analyzing Table 2, considering age by state, Acre had a higher number of records, with 520 children up to 14 years, 1,664 between 15 and 39 years, 734 between 40 and 64, 104 in the population aged 65 or older; however, at Amapá, there was a different result, with 181 to 14, 118 in those between 15 and 39, 52 between 40 and 64 years and 6 to 65 or more. In Amazonas, the population with higher number of cases was the age group between 15 and 39 years, with 171 cases, while in Pará - for the same age group - 290 cases. Roraima and Tocantins were the states with the lowest number of records in general, with no notifications in some age groups.

The most affected age group among the capital was young adults (15-39 years) with 1,951 cases (53.57% of total cases), and Rio Branco had 70.78% (1,381/1,951) notifications in this same age group. The second age group was 40-64 years with 909 notifications, representing 24.96% of cases. People aged 65 or more, together, reached 142 notifications (3.90%), and Boa Vista did not have any case both under 14 and in people aged 65 or older (Table 2).

It is observed in Table 3 a higher occurrence among the population with elementary education, corresponding 2109 records (43.92%). A considerable number, 1,242 cases (25.86%), is grouped into "ignored, in blank or not applicable." A smaller quantity of notifications comprises the illiterate and the group with graduation, representing 164 notifications (3.41%) and 186 records (3.87%), respectively.

Table 3. Leptospirosis cases in the northern region capitals by education level. / **Table 3.** Casos de leptospirose nas capitais da região Norte por nível de educação.

Northern region states of Brazil	Notless/Not applicable	%	Illiterate	%	Elementary Education	%	High School	%	Graduate	%
Acre	520	41.86	135	82.31	1402	66.47	822	74.72	144	77.41
Amapá	149	11.99	5	3.04	145	6.87	443	3.90	6	3.22
Amazonas	202	16.26	4	2.43	95	4.50	37	3.36	8	4.30
Pará	201	16.18	6	3.65	241	11.42	119	10.81	9	4.83
Rondônia	157	12.64	13	7.92	216	10.24	70	6.36	14	7.52
Roraima	5	0.40	0	0.00	2	0.09	3	0.27	3	1.61
Tocantins	8	0.64	1	0.60	8	0.37	6	0.54	2	1.07
Total	**1242**	**100**	**164**	**100**	**2109**	**100**	**1100**	**100**	**186**	**100**
Northern region capitals of Brazil	**Notless/Not applicable**	**%**	**Illiterate**	**%**	**Elementary Education**	**%**	**High School**	**%**	**Graduate**	**%**
Rio Branco	314	38.95	109	87.90	1221	74.58	758	81.14	128	85.33
Macapá	106	13.15	3	2.41	112	6.84	38	4.08	6	4.00
Manaus	189	23.44	4	3.22	82	5.00	31	3.42	8	5.33
Belém	99	12.28	2	1.61	123	7.51	68	7.30	1	0.66
Porto Velho	83	10.29	4	3.22	96	5.86	30	3.22	3	2.00
Boa Vista	9	1.11	1	0.80	1	0.06	4	0.42	2	1.33
Palmas	6	0.74	1	0.80	2	0.12	1	0.10	2	1.33
Total	**806**	**100**	**124**	**100**	**1637**	**100**	**931**	**100**	**150**	**100**

Analyzing the cases in the northern region capitals, Rio Branco had the highest incidence in the reported cases, with 2,530 records (70.31%). Palmas represented 12 notifications (0.33%), and therefore the capital with fewer cases in relation to the other northern capital cities. According to Table 3, the group "elementary school" stood out with 1,637 notifications (45.49%). The illiterate population reached 124 cases (3.44%), representing less significant data if compared to the other education levels.

4. Discussion

There were 4,813 cases in the brazilian northern region from 2011 to 2015. Studies have found 4,015 notifications only in São Paulo between 2007 and 2011(BUZZAR, 2012). This increase may be related to population density difference found in the country regions (IBGE, 2015).

The male gender was the most affected by the infection, and other research has found similar results (LIMA et al., 2012). This predominance in male gender may have connection with occupational exposure factors corroborated by the data of the Regional Coordination of Health (CRS) (CRS, 2016).

Leptospirosis was traditionally considered an occupational disease risk (HARTSKEERL et al., 2011). However, the epidemiology of this disease has undergone important changes after 1970, from labor infection to home space acquired disease. In this context, although the home environment constitutes the main source of infection, cases proportion among children was low. This situation raises the suspicion of underreporting of children's cases, as in the home environment they present likelihood of exposure and hence risk of infection similar to adults, which corroborates the data of this study (Table 2).

Although it has been pointed out this change in epidemiology, leptospirosis remains important employment relationship and may reach a large number of professionals. This relationship is confirmed by a study, which determines the prevalence of infection among workers at five categories of environmental sanitation services - water, sewers, drains galleries, garbage collection and street cleaning - found that of 386 tested serum samples, 40 samples were reagents (10.4%), thus proving that the risk of contracting the disease is related to the workplace, showing the results shown in this article (ALMEIDA et al., 1994), reinforcing the idea that men are more exposed to the disease, as are the more inserted in mentioned occupational activities (MUSSO; LA SCOLA, 2013).

Another study found that in Belo Horizonte, people with elementary education are much more exposed to the disease, presenting the largest leptospirosis notification rates - 73.7% of the confirmed cases - by lack of prevention and poor access to health services (FIGUEIREDO et al., 2001). Acre had the highest number of records of the disease (Figure 1), and is among the worst northern infrastructure indexes, in line with the analysis.

So, Acre predominated, in parallel to Roraima, which had the lowest number of records, less than 3 cases/year (Figure 1). According to a study, the north of the country concentrated 10.6% of cases, Pará leading indexes, contradicting data here presented (PAPPAS et al., 2008).

The total number of cases among the studied capital amounted to more than 75% of the records in the region, and again the predominance of male gender (Figure 2). It should be noted that the pathology predominated in the capital, concentrating larger population (IBGE, 2015).

The pattern of cases followed the regional characteristics. In Table 1, it was observed that Rio Branco had the largest share of notifications, with 69.26% (2,524/3,644), showing the flooding in which Acre is affected. In early 2012, Rio Branco presented a leptospirosis epidemic, and the main risk situations were: contact with water or mud flows, local rodents, river, stream or pond (FRANÇA et al., 2016).

Palmas had the lowest percentage of notifications, 0.24% (9/3644) as noted in Table 1. The underdiagnosis increases underreporting, which hinders fight infection and contributes to the lack of recognition as a public health problem, remembered only when related to heavy rains and floods, but there is no routine of community and health services (SAMPAIO et al., 2012; RAIMUNDO et al., 2016).

The most affected age group was young adults ranging from 15 to 39 years (Table 2). Similar age range was described in a study that shows the greatest exposure to occupational factors of such individuals and, consequently, more contamination by leptospirosis (COSTA et al., 2015).

According to collected data, Acre had a greater quantity for all analyzed age groups. It was also found that the highest concentration of cases occurs in young people, which confirms data from another study that puts an average age between 14 and 44.9 years as the most common for infection by leptospirosis, while another author points out an average still under age of 26.8 years and an average of 45 years (SANTOS et al., 2011; JESUS et al., 2012; SAMPAIO et al., 2012). At the same time, Rondônia and Roraima presented low numbers (SILVA et al., 2015).

There was a greater distribution of cases of leptospirosis between the elementary school population, corresponding to 2,109 notifications (43.92%) (Table 3). The population with less education usually lives on the outskirts of large urban centers, with deficient infrastructure, no access to health services, aggravated in cases of natural disasters (GUIMARÃES et al., 2014).

No significant portion, 164 records (3.41%) is composed by the illiterate. It can be inferred, therefore, a smaller scope of the notification system to this group, because the lower the educational level, the greater the number of cases (RAIMUNDO et al., 2016).

The group "ignored, in blank or not applicable," with 1242 records (25.86%), demonstrates a failure during the notification process. A survey highlighted the elevated percentage of cases with no padding in relation to education level. The Record filling failure results in impaired and inefficient analysis of intervention actions in the control and prevention of leptospirosis (SANTOS et al., 2011).

In northern brazilian region there is an obvious variation of rainfall, with maximum density in February to April. In Belem and Macapa, the lower areas of the city tend to get flooded in the rainy season, due to rainwater drainage deficiency, resulting in a morbidity increase of the disease, which usually reach their peak at the beginning of the year (BIGGS et al., 2013; GUIMARÃES et al., 2014; SBMT, 2015; SBI, 2016).

In this article, Table 1, joining the cases reported by capital, Macapa was in 2nd place behind Rio Branco, corroborating the mentioned data (BIGGS et al., 2013; GUIMARÃES et al., 2014; SBMT, 2015; SBI, 2016). According to a study, the mortality rate was lower in years with higher incidences of the

disease; it is believed that in years that there is more rain and hence more flooding, the disclosures on leptospirosis is higher for both public and health professionals, causing quick health services demand and early diagnosis (SAMPAIO et al., 2012).

5. Conclusion

Variations in quantity of leptospirosis cases among northern region states and capitals may be related to population density differences, socioeconomic development and high rainfall.

The predominance of male gender infection seems to have connection with occupational exposure factors and the most affected age group was young adults.

Considering the most affected age and the predominant gender in the sample, it reinforces the relationship of leptospirosis and its occupational character disease, affecting mainly rice culture workers, abattoir animals, exposed soldiers to contaminated environments, examples of occupations where men predominate.

People with low education levels seem to be more exposed to the disease, either by lack of prevention and poor access to health.

Acre and its capital city, Rio Branco, present a higher number of disease records, and this state has low infrastructure index, noting that in 2012 the capital passed through a leptospirosis epidemic in line with the analysis carried out by other research.

The state with the lowest number of records was Roraima and the capital city was Palmas, maybe influenced by underreporting because of the difficulty of confirming the diagnosis, the common misconception with other pathologies and low detection of mild disease forms.

Underreporting contributes to an ineffective positioning of intervention actions in the control and prevention of leptospirosis.

This study reveals the national panorama of leptospirosis and its strong presence nowadays, despite sanitation advances. It shows that still remains a strong occupational and socioeconomic relation, reaching alarming rates in cities with low-income areas, usually compounded when associated with regional characteristics as high rainfall and frequent involvement by floods. This article alerts to the need of investing in prevention and awareness campaigns about the infection, but also to further significant improvements in infrastructure, reducing the risk factors of contamination. In the occupational environment, it is urgent to promote effective reductions of infection by leptospirosis, so in future the pathology can lose this occupational relationship.

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