Geographic distribution of anti-Leptospira antibodies in humans in Côte d'Ivoire, West Africa

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INTRODUCTION

Leptospirosis is a zoonotic bacterial disease with a worldwide distribution caused by pathogenic bacteria of the genus *Leptospira* [1]. It is an endemic disease especially in subtropical and tropical regions and outbreaks can occur after heavy rain or flooding [1]. Transmission occurs through direct or indirect contact with urine of infected animals [1, 2].

Leptospirosis may be unrecognized or misdiagnosed because of the lack of specific clinical symptoms, thus human incidence is commonly underreported.

The World Health Organization (WHO) Leptospirosis Epidemiology Reference Group (LERG) estimated the leptospirosis incidence at 1.03 million cases and 58,900 deaths each year worldwide [3]. West African annual leptospirosis incidence was estimated to be 9.7 per 100,000 population [3].

In West Africa, few studies on *Leptospira* prevalence have been published. And prevalence of acute human leptospirosis ranged from 0.0% to 7.8% in five studies on symptomatic patients [4, 5].

In Côte d'Ivoire, data are sparse, however an unpublished study carried out in 2013 by the "Centre Suisse de Recherche Scientifique" in Yopougon (Abidjan) showed, 4% prevalence in both 124 febrile patients and 99 rodents using MAT showing human and animal infection. Another study showed high prevalence in 93 vaccinated dogs (58%) and 63 non-vaccinated dogs (47%) sampled in Abidjan and in two neighbouring cities using MAT suggesting human exposure [6].

Thus, little is known about leptospirosis in the country and data are needed to inform burden estimates and to inform intervention strategies. Mapping leptospirosis exposure could help find high-risk areas and lead intervention choices against the disease. This study aims to determine the geographic distribution of anti-*Leptospira* antibodies in humans in Côte d'Ivoire.

MATERIAL AND METHODS

This study was carried out from August to November 2015 in the 82 health districts of Côte d'Ivoire.

The study was carry out on stored human specimens previously collected for the national surveillance system for communicable diseases in 2014. Only negative specimens were included in the study.

One to 13 serum samples were randomly selected per health district based on the number of notified cases by health districts in the year to obtain a sample size of 384.

Blood samples were collected from each patient who matches the clinical WHO's case definition for notifiable disease. Samples were sent, at +4°C, to the National Reference Centre at the Institut Pasteur de Côte d'Ivoire for analysis. Anti-*Leptospira* antibody testing was carried out at Institut Pasteur de Côte d'Ivoire (IPCI) and Institut Pasteur in Paris (IP). We used as screening methods the ELISA against type IgG anti-*Leptospira* antibodies previously describe by Bourhy et al. (2013) in IPCI [7]. Confirmation was carried out by MAT in IP with a threshold of 1:50. As antigens, 16 serogroups were used (table 1).

Socio-demographic and clinical data from the National Reference Centre, which manage the samples and results for analysis performed on studied samples, were used to build a database using Epi Info software (CDC, Atlanta, Georgia). Data analyses were done using R software 3.2.0 [8].

RESULTS

Age of patients ranged from 1 month to 78 years old with a mean age of 20.8 years. Patients less than 25 years were more represented with 60.9% of all patients. We noted a male predominance with a sex ratio of 1.55.

Of the samples tested, ELISA positively screened 90. Of these, 36 were confirmed by MAT representing 9.4 % prevalence. People with anti-*Leptospira* antibodies had a mean age of 34.5 years and a Sex ratio of 2. Of the 82 health districts of the country, anti-*Leptospira* antibodies were found in samples from 22. Health districts with anti-*Leptospira* antibodies were mostly located in the western and the southern parts of the country (fig 1).

MAT anti-*Leptospira* antibodies titre ranged from 1:50 to 1:6400. Eight different serogroups of *Leptospira* were found (table 2). Serogroup Panama was the most frequent (36.1 %) followed by Louisiana (19.4 %) and Grippotyphosa and Sejroe (11.1% respectively).

DISCUSSION

This study focuses on anti-*Leptospira* antibodies in human specimens collected in the national surveillance system for communicable diseases in Côte d'Ivoire. Few published data on *Leptospira* and leptospirosis in Côte d'Ivoire are available [4, 5, 9]. Our study, which focus on type IgG antibodies showed a prevalence of 9.4%. This result is in accordance with the LERG who estimated an annual incidence for leptospirosis to 9.6 % in the West sub-Saharan Africa WHO region [3].

Samples from all the 82 health districts of the country were included in this study. So, the studied population were representative of all the country. However, health districts with anti-*Leptospira* antibodies found in this study were mostly located in the western and the southern parts of the country (fig 1). These parts of the country are peculiar by their climate and forest cover. They are the most humid parts of the country with higher forest cover and heavy raining season compare to the northern part of the country, which is mostly arid. It's actually well known that leptospirosis is related to water and wet soils were *Leptospira* find proper conditions for his maintenance in the environment [10, 11, 12]. In these parts of the country, some irrigated farming activities like rice, banana and vegetable farming are associated with risk behaviours like walking barefooted in wet farm soil, sludge or working without wearing appropriated personal protective equipment. The maintenance of *Leptospira* in the environment is better when bacteria are protected from direct UV sunlight [13]. This situation could be achieved in forests or in large farms with trees like cocoa, coffee or rubber plantations mostly seen in the western and southern part of the country. These plantations also offer habitats to small mammals that are considered a reservoir of bacteria and create a Human/ Animal/ Environment interface, which could improve the transmission of the disease.

Regarding people with anti-*Leptospira* antibodies, they were young adults (mean age 34.5 years) mostly men (sex ratio 2) living in rural area; corresponding to active low-income farmers working into agricultural fields. These people could represent an at-risk population and it could be suitable to implement prevention activities against leptospirosis related to them. Indeed, farming is a major activity in Côte d'Ivoire representing 43.5 % of jobs.

This study highlights the circulation of leptospirosis among people in Côte d'Ivoire. Unfortunately, no routine laboratory-based diagnostic strategies are available for leptospirosis or other diseases such as rickettsia or viral hepatitis. Numerous patients suffering from infectious diseases are not correctly diagnosed, and the burden of these diseases is underestimated. Early diagnosis and treatment reduce occurrence of complications and improve recovery rate significantly [1]. There is a need to improve public health by Ivorian authorities and their international partners.

COMPLIANCE WITH ETHICAL STANDARDS

Funding: No funding was received.

Conflict of Interest: The authors declare that they have no conflict of interest.

Ethical approval: The national ethic and research committee of Côte d'Ivoire approved this study under the number 23/MSLS/CNER-dkn.

Informed consent: Not applicable.

REFERENCES

1. Haake DA, Levett PN (2015) Leptospirosis in humans. Curr Top Microbiol Immunol 387:65-97. doi: 10.1007/978-3-662-45059-8_5.
2. Hartskeerl RA, Collares-Pereira M, Ellis WA (2011) Emergence, control and re-emerging leptospirosis: dynamics of infection in the changing world. Clinical Microbiology and Infection 17:494–501. doi: 10.1111/j.1469-0691.2011.03474.x.
3. Costa F, Hagan JE, Calcagno J, Kane M, Torgerson P, Martinez-Silveira MS, Stein C, Abela-Ridder B, Ko AI. (2015) Global Morbidity and Mortality of Leptospirosis: A Systematic Review. PLoS Negl Trop Dis 9: e0003898. doi: 10.1371/journal.pntd.0003898.
4. De Vries SG, Visser BJ, Nagel IM, Goris MG, Hartskeerl RA, Grobusch MP (2014) Leptospirosis in Sub-Saharan Africa: a systematic review. Int J Infect Dis 28:47-64.

5. Allan KJ, Biggs HM, Halliday JEB, Kazwala RR, Maro VP, Cleaveland S, Crump JA. (2015) Epidemiology of Leptospirosis in Africa: A Systematic Review of a Neglected Zoonosis and a Paradigm for 'One Health' in Africa. Plos Neglected Tropical Diseases 9: 3899–3899.
6. Roqueplo C, Marié JL, André-Fontaine G, Kodjo A, Davoust B (2015) Serological survey of canine leptospirosis in three countries of tropical Africa: Sudan, Gabon and Ivory Coast. Comp Immunol Microbiol Infect Dis 38:57-61. doi: 10.1016/j.cimid.2014.10.006.
7. Bourhy P, Vray M, Picardeau M (2013) Evaluation of an in-house ELISA using the intermediate species *Leptospira fainei* for diagnosis of leptospirosis. J Med Microbiol 62(Pt 6):822-7.
8. R Core Team (2015) R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL http://www.R-project.org
9. Pappas G, Papadimitriou P, Siozopoulou V, Christou L, Akritidis N (2008) The globalization of leptospirosis: worldwide incidence trends. Int J Infect Dis 12(4):351-7. Epub 2007 Dec 4.
10. Adler B, De La Pena Moctezuma A (2010) *Leptospira* and leptospirosis. Veterinary Microbiology 140: 287–296. doi: 10.1016/j.vetmic.2009.03.012.
11. Faine S, Adler B, Bolin C, Pérolat P (1999) *Leptospira* and leptospirosis. Melbourne, Australia: MediSci. 296 p.
12. Levett PN (2001) Leptospirosis. Clinical Microbiology Reviews 14(2):296–326.
13. Stamm LV, Charon NW (1988) Sensitivity of pathogenic and free-living *Leptospira spp*. to UV radiation and mitomycin C. Appl Environ Microbiol 54(3): 728–733.

FIGURE CAPTIONS

Fig 1 shows health districts were people with anti-*Leptospira* antibodies were found. Colors are related to number of cases found