Osong Public Health Res Perspect 2014 5(1), 54–67
http://dx.doi.org/10.1016/j.phrp.2014.01.003
pISSN 2210-9099 eISSN 2233-6052

ORIGINAL ARTICLE

Study on the Prevalence of Leptospirosis among Fever Cases Reported from Private Clinics in the Urban areas of Villupuram District, Tamil Nadu, India

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Received: December 23, 2013
Revised: January 13, 2014
Accepted: January 20, 2014

KEYWORDS:
Ig-M ELISA,
leptospirosis,
MSAT,
prevalence,
private clinics

Objectives: To know the prevalence of leptospirosis cases reported in private clinics among fever cases in Villupuram District, Tamil Nadu, India to know its real magnitude of the problem and to diagnose Leptospirosis among fever cases from differential diagnosis.
Methods: 1502 Blood serum samples collected from three urban towns namely Kallakurichi (Latitude: 11° 73′ N; Longitude: 78° 97′ E), Villupuram (Latitude: 11° 75′ N; Longitude: 79° 92′ E) and Thindivanam (Latitude: 12° 25′ N; Longitude: 79° 65′ E) in fifteen clinics based on case definition of leptospirosis delineated by the National Vector Borne Disease Control Programme (NVBDCP), Government of India. Samples were tested in the laboratory of the Zonal Entomological Team (ZET), Cuddalore with Macroscopic Slide Agglutination Test (MSAT) and Ig-M ELISA.
Result: There were 65 positive cases detected from 1502 blood serum samples in both MSAT and Ig-M ELISA. It could be known that there was 4% cases contributed from private clinics among fever cases. From this study, further it was known that all age groups of people affected irrespective of sexes based on their living condition associated with the environment prevailed of the disease.
Conclusion: From this study, it was quantified that 4% of cases reported in private clinics among fever cases and its findings ascertained both the importance of differential diagnosis as well as reports that should be included to the Government for knowing its real magnitude for planning.

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1. Introduction

Leptospirosis is a bacterial disease that affects humans and animals. It is caused by bacteria of the genus *Leptospira* and is a life threatening zoonotic disease which has become an important urban slum health problem [1−3]. In humans, it causes a wide range of symptoms among fever predominant cases in less than 7 days, including conjunctival suffusion, myalgia, vomiting, jaundice, abdominal pain, diarrhea, or a rash. If the disease is not treated, the patient could develop kidney damage, meningitis (inflammation of the membrane around the brain and spinal cord), liver failure, or respiratory distress [4].

It is also known that leptospirosis is a common infection in India and is under-reported due to a lack of clinical awareness and early diagnostic facilities. Since it has a high mortality in the presence of some complications, early diagnosis will save a number of lives in rural areas; there is definitely a need for concern about leptospirosis in patients, clinicians, microbiologists, and public health personnel [4].

In India, the disease is more commonly associated with natural disasters, especially during the monsoon period at which times acute epidemics may occur [5]. A multicentric study in India showed that leptospirosis accounts for about 12.7% of cases of acute febrile illness responsible for attendance at hospitals [6]. Carrier animals include rats, pigs, cattle, bandicoots, and dogs. The predominant serovars are Copenhageni, Autumnalis, Pyrogenes, Grippotyphosa, Canicola, Australis, Javanica, Sejroe, Louisiana and Pomona. Outbreaks of leptospirosis have increasingly been reported in Kerala, Gujarat, Tamil Nadu, and Karnataka, and sporadic cases have been reported in Goa, Andhra Pradesh, and Assam [5].

Further, leptospirosis has been known to be endemic since the early part of the 20th century on the Andaman and Nicobar Islands, where serovars Ratnapura, Valbuzzi, and Grippotyphosa have been recently documented as causes of severe epidemics [7]. The highest rates occur during October and November, with seroprevalence of up to 55% in the general population [8]. Interestingly, the predominance of leptospirosis in coastal regions is most likely correlated with the presence of semi-domestic brown rats. In the inland urban regions, other serovars with other host animals/rodents were presumed to cause the “mild” leptospirosis that is usually unrecognized or misdiagnosed.

Some studies have been found in the literature which show leptospirosis is associated with poor sanitation in household environments [9]. Deficiencies in the sanitation infrastructure where slum inhabitants reside were found to be socio environmental factors; differences in socio economic status contributed to the risk of *Leptospira* infection, indicating that the social factors that produce unequal health outcomes should be addressed [10]. In addition, leptospirosis is transmitted during direct contact with animal reservoirs or water and soil when it is contaminated due to urbanization, due to an increased rodent population; this particularly occurs throughout the developing world during seasonal heavy rainfall and flooding [8,11,12].

Numerous studies have been undertaken on the etiology of the disease and reasons for manifestation of this disease, whereas studies on improving the detection of cases, other than the government health care system and its reporting to public health managers, are found to be scarce. Hence, the present study aimed to ascertain the degree of leptospirosis in private clinics, which might not be included in reports of District Health authorities and the consequences of the real magnitude of this disease not being known for implementation of early control and preventive measures. In addition, this study revealed the differential diagnosis of leptospirosis among fever cases, and that it has a spectrum of symptoms which mimic other prime communicable diseases, such as dengue and malaria.

2. Materials and methods

To study the prevalence of leptospirosis in Villupuram District of Tamil Nadu, India, particularly cases reported from private clinics were investigated. Major urban areas situated in Villupuram District are Kallakuruchi, Tindivanam, and Villupuram (Figure 1). Five private clinics were selected from each area, giving a total of 15 which were assigned for the present study through a Memorandum of Understanding (MoU). The private clinics included are shown in Table 1.

The study was conducted from August 2011 to July 2012.

2.1. Sample collection

Serum samples were collected from fever cases with leptospirosis as delineated by the National Vector Borne Diseases Control Programme, Government of India [13]. This definition was familiarized among medical practitioners prior to the study. Samples were collected from each private clinic every week and subjected to the macroscopic slide agglutination test (MSAT) and Ig-M ELISA, adopting the standard procedures for detecting leptospirosis. Tests were performed by the Zonal Entomological Team, Cuddalore. Soon after positive cases were detected, this was communicated to the Deputy Director of Health Services concerned for Villupuram and Kallakuruchi, to improve the environmental sanitation, medication with prescribed drugs, and water quality, etc. In addition, the topography of the village was also studied to determine whether the environment is conducive for the disease. Total sample collections and the positive status from each clinic of Kallakuruchi,

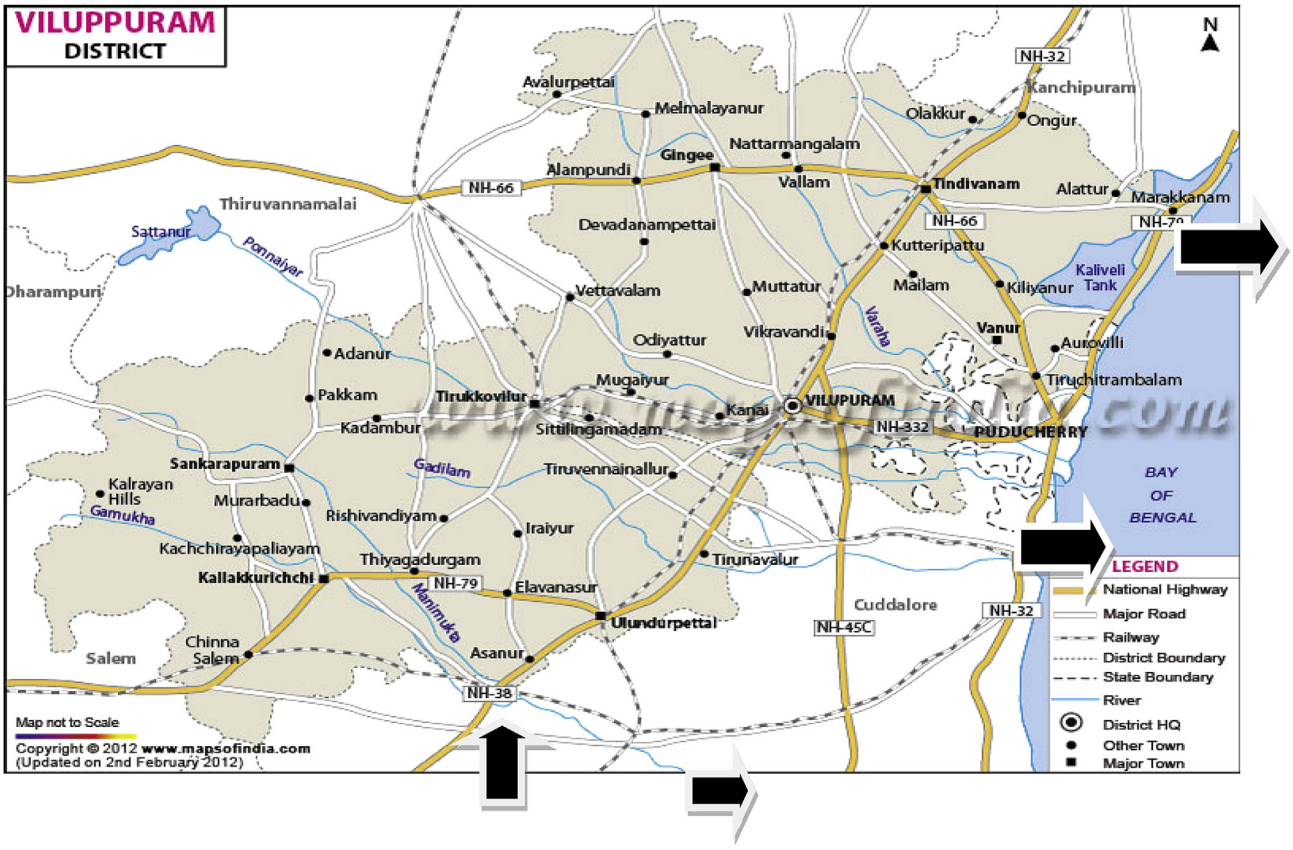

Figure 1. Showing the District Villupuram of Tamil Nadu, India in which study sites are shown in arrows.

Table 1. Showing the private clinic wise serum samples lifted and their positives in M-SAT, IgM ELISA and Both

S. no	Private Clinic	No. of sample collected	No. of sample Tested	No. of sample Positive	No. of sample Negative	M-SAT positive	IgM ELISA positive	Both M-SAT & IgM ELISA positive
VILLUPURAM								
1.	Hari Hospital	45	45	6	39	4	1	1
2.	Jayasankara HinduMission Hospital	231	231	5	226	5	0	0
3.	E.S. Hospital	677	677	29	648	27	1	1
4.	Aswini Hospital	17	17	1	16	1	0	0
5.	Dr.Bandari Hospital	1	1	0	1	0	0	0
Total		971	971	41	930	37	2	2
TINDIVANAM								
6.	Arun Clinic	12	12	0	12	0	0	0
7.	Senthil Clinic	57	57	8	49	7	1	0
8.	Dr.Rajagopal Hospital	28	28	0	28	0	0	0
9.	Dr.Ramadoss Hospital	112	112	2	110	1	0	1
10.	Uma Clinic	9	9	0	9	0	0	0
Total		218	218	10	208	8	1	1
KALLAKURUCHI								
11.	Sri Sanjeevi HospitaL	86	86	5	81	2	3	0
12.	Vijay Poly Clinic	198	198	8	190	5	1	2
13.	Krishna Clinic	0	0	0	0	0	0	0
14.	G.S.Hospital	14	14	1	13	1	0	0
15.	Pugazh Hospital	15	15	0	15	0	0	0
Total		313	313	14	299	8	4	2
Grand Total		1502	1502	65	1437	53	7	5

Tindivanam and Villupuram during the period of this study are given in Table 2.

The standard procedures of MSAT and Ig-M ELISA were followed to analyze all samples.

2.2. Case definition of leptospirosis

Among fever cases, leptospirosis could be identified by sudden onset of headache, severe myalgia and fever, abdominal pain and vomiting, and conjunctival suffusion may follow [13].

2.3. Treatment for positive cases of leptospirosis

Positive cases of leptospirosis were treated with doxycycline 100 mg twice a day for 7 days in patients above 15 years old, and erythromycin 250 mg was a drug of choice for patients below 15 years old, to avoid blackening of teeth [13].

2.4. Active surveillance

Soon after positive cases were detected in a village, an active search was performed to identify further cases in the community; all were confirmed clinically by the medical officer of the Primary Health Center (PHC) and treated with doxycycline or erythromycin. When the number of cases exceeded two, it was considered as an outbreak and efforts were made to determine the sources of the disease and to improve the sanitation in the affected village through community participation and Information Education and Communication (IEC).

2.5. Rectification of water distributing system in the affected village

Leptospirosis is spread through contamination of water when urine and excreta of animal reservoirs, like rodents, cattle and dogs, mix with the drinking water through perforation in the water distributing system, which was rectified wherever it was noticed. Chlorination and IEC on personal hygiene are also associated, as this disease is transmitted to individuals who walk barefoot during a monsoon, those whose occupations are related to paddy cultivation, those with a degree of association with pet animals, and those occupations are veterinarians, butchers, etc.

2.6. Chlorination

Chlorination is indispensable in delivering safe drinking water to the community. A standard procedure has been adopted [14]. This involves the application of 4.20 g of bleaching powder, which should contain 32% chlorine, to 1000 L of drinking water. To introduce 1.2 ppm/4.20 g of chlorine to 1000 L of water, a sufficient quantity of bleaching powder should be pasted in a pail and water poured in to dissolve the paste; this is then left for 30 minutes to settle all lime. Then, the surface water, which contains chlorine, should be decanted over the storage of drinking water, and may be given to consumers after 30 minutes.

2.7. Community participation

To encourage the communities to take part in leptospirosis control measures, various meetings were conducted in schools, and with elected bodies, self-help group members, and volunteers. In these, the basic epidemiology of the disease, the conducive environment which prevailed in the village, like seepages along the pipe lines and possibilities of animal contamination by nocturnal animals, e.g., rodents, and the need to not dig pit traps near to delivering pumps in order to enhance pressure to obtain more water, which in turn could be contaminated by animals such as dogs, pigs, etc., were highlighted. These IEC activities were performed by the public addressing system and interpersonal communication.

2.8. Statistical analysis

The results obtained from the diagnostic tools and proportions of positives with negatives were analyzed by the Chi-square test using the Statistical Package of Social Sciences version 12.0 (SPSS Inc., Chicago, IL, USA).

3. Results

A total of 1502 serum samples were collected from 15 clinics situated in Villupuram District in a 1 year span (August 2011 to July 2012). Out of 1502 serum samples tested, 65 positive cases were confirmed by M-SAT and Ig-M ELISA. Fifty-three cases were confirmed by M-SAT alone, seven cases were confirmed by Ig-M ELISA alone, and five cases were confirmed by both M-SAT and Ig-M ELISA (Table 1 and Figure 2).

In Villupuram town, 971 serum samples were obtained from five private clinics and all were subjected to M-SAT and Ig-M ELISA for detection of leptospirosis. Of these, 41 samples were found to be positive with M-SAT and Ig-M ELISA; 37 samples found positive with M-SAT alone, two samples found positive with Ig-M ELISA alone, and two samples found positive with both of the diagnostic tools. This was 4.2% of the total samples obtained (Figure 3).

In Thindivanam, 218 serum samples were collected from five private clinics. Of these, 10 samples were found to positive; eight were positive with M-SAT alone, one was positive with Ig-M ELISA, and one sample was found to be positive with both M-SAT and Ig-M ELISA. Therefore there was 4.1% positivity among all samples (Figure 4).

In Kallakuruchi, 313 serum samples were collected from five private clinics and subjected to testing for leptospirosis by M-SAT and Ig-M ELISA. Of these, 14 samples were found to be positive; eight samples were positive with M-SAT alone, four with Ig-M ELISA, and two samples were found to be positive with both of the diagnostic tools. Therefore the positivity was 4.4% among the total samples obtained (Figure 5).

Table 2. Week wise, private clinic' sample collection, tested and positive details (from August 2011 to July 2012) of Villupuram District

	Aug-11										Sep-11										Oct-11									
	1st Week		2nd Week		3rd Week		4th week		Total		1st Week		2nd Week		3rd Week		4th week		Total		1st Week		2nd Week		3rd Week		4th week		Total	
Private Clinic	Sample collection & Tested	Sample positive	Sample collection & Tested	Sample positive	Sample collection & Tested	Sample positive	Sample collection & Tested	Sample positive	Sample collection & Tested	Sample positive	Sample collection & Tested	Sample positive	Sample collection & Tested	Sample positive	Sample collection & Tested	Sample positive	Sample collection & Tested	Sample positive	Sample collection & Tested	Sample positive	Sample collection & Tested	Sample positive	Sample collection & Tested	Sample positive	Sample collection & Tested	Sample positive	Sample collection & Tested	Sample positive	Sample collection & Tested	Sample positive
Kallakuruchi urban																														
Sanjeevei Hospital	0	0	0	0	0	0	0	0	**0**	**0**	1	0	2	0	3	0	2	0	**8**	**0**	1	0	1	0	5	0	4	0	**11**	**0**
Vijay Poly clinic	0	0	0	0	0	0	0	0	**0**	**0**	1	0	3	1	11	0	10	0	**25**	**0**	0	0	0	0	8	1	13	0	**22**	**1**
Krishna Clinic	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	**0**	**0**
G.S.Hospital	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	**0**	**0**	2	0	9	1	0	0	0	0	**12**	**1**
Pugazh Hospital	0	0	0	0	0	0	2	0	**2**	**0**	2	0	0	0	0	0	0	0	**2**	**0**	3	0	1	0	3	0	0	0	**7**	**0**
Total	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**2**	**0**	**4**	**0**	**5**	**1**	**14**	**0**	**12**	**0**	**35**	**0**	**6**	**0**	**11**	**1**	**16**	**1**	**17**	**0**	**50**	**2**
Tindivanam urban																														
Arun Clinic	4	0	0	0	0	0	0	0	**4**	**0**	0	0	1	0	0	0	1	0	**2**	**0**	1	0	0	0	0	0	0	0	**1**	**0**
Senthil Clinic	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	5	0	0	0	**5**	**0**	0	0	0	0	4	2	1	0	**5**	**2**
Raja gopal	0	0	0	0	0	0	0	0	**0**	**0**	2	0	0	0	0	0	1	0	**3**	**0**	0	0	0	0	2	0	0	0	**2**	**0**
Dr.Ramadoss Hospital	0	0	0	0	0	0	0	0	**0**	**0**	9	0	2	0	2	0	4	1	**17**	**1**	3	0	3	0	2	0	0	0	**8**	**1**
Uma Clinic	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	**0**	**0**	1	0	0	0	1	0	0	0	**2**	**0**
Total	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**4**	**0**	**11**	**0**	**1**	**0**	**7**	**0**	**6**	**1**	**27**	**1**	**5**	**0**	**3**	**0**	**9**	**2**	**1**	**0**	**18**	**3**
Villupuram urban																														
Hari Hospital	0	0	0	0	0	0	1	0	**1**	**0**	7	0	1	1	2	0	5	0	**15**	**1**	2	0	0	0	1	1	0	0	**3**	**1**
Jayasankara Hospital	0	0	0	0	0	0	3	0	**3**	**0**	3	0	1	0	0	0	1	0	**5**	**0**	0	0	0	0	3	0	1	0	**4**	**0**
E.S.Hospital	0	0	0	0	0	0	0	0	**0**	**0**	1	0	1	0	24	2	46	3	**72**	**5**	29	1	28	1	32	0	30	3	**119**	**2**
Aswini H ospital	0	0	0	0	0	0	2	0	**2**	**0**	2	0	0	0	0	0	4	0	**6**	**0**	0	0	0	0	0	0	2	0	**2**	**0**
Dr.Bandari Hospital	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	1	0	**1**	**0**	0	0	0	0	0	0	0	0	**0**	**0**
Total	**0**	**0**	**0**	**0**	**0**	**0**	**6**	**0**	**6**	**0**	**13**	**0**	**3**	**1**	**26**	**2**	**57**	**3**	**99**	**6**	**31**	**1**	**28**	**1**	**36**	**1**	**33**	**3**	**128**	**3**

Private Clinic	Nov-11										Dec-11										Jan-12									
	1st Week		2nd Week		3rd Week		4th week		Total		1st Week		2nd Week		3rd Week		4th week		Total		1st Week		2nd Week		3rd Week		4th week		Total	
	Sample collection & Tested	Sample positive	Sample collection & Tested	Sample positive	Sample collection & Tested	Sample positive	Sample collection & Tested	Sample positive	Sample collection & Tested	Sample positive	Sample collection & Tested	Sample positive	Sample collection & Tested	Sample positive	Sample collection & Tested	Sample positive	Sample collection & Tested	Sample positive	Sample collection & Tested	Sample positive	Sample collection & Tested	Sample positive	Sample collection & Tested	Sample positive	Sample collection & Tested	Sample positive	Sample collection& Tested	Sample positive	Sample collection & Tested	Sample positive
Kallakuruchi urban																														
Sanjeevei Hospital	3	0	7	0	2	1	4	0	**17**	**1**	2	0	3	1	3	0	2	0	**10**	**1**	0	0	4	1	3	1	4	0	**11**	**4**
Vijay Poly clinic	8	0	6	0	6	1	11	1	**33**	**2**	11	2	8	1	10	0	9	1	**38**	**4**	0	0	11	0	0	0	4	0	**15**	**6**
Krishna Clinic	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	**0**	**0**
G.S.Hospital	0	0	0	0	3	0	0	0	**3**	**0**	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	**0**	**0**
Pugazh Hospital	0	0	1	0	1	0	1	0	**3**	**0**	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	1	0	0	0	**1**	**0**
Total	**11**	**0**	**14**	**0**	**12**	**2**	**16**	**1**	**53**	**3**	**13**	**2**	**11**	**2**	**13**	**0**	**11**	**1**	**48**	**5**	**0**	**0**	**15**	**1**	**4**	**1**	**8**	**0**	**27**	**10**
Tindivanam urban																														
Arun Clinic	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	4	0	0	0	**4**	**0**	0	0	1	0	0	0	0	0	**1**	**0**
Senthil Clinic	2	0	6	0	6	4	3	0	**17**	**4**	1	0	4	0	0	0	7	1	**12**	**1**	0	0	6	1	5	0	4	0	**15**	**1**
Raja gopal	0	0	1	0	2	0	2	0	**5**	**0**	10	0	5	0	1	0	0	0	**16**	**0**	0	0	0	0	0	0	0	0	**0**	**0**
Dr.Ramadoss Hospital	0	0	6	0	0	0	2	0	**8**	**0**	1	0	4	0	5	0	5	0	**15**	**0**	0	0	6	1	0	0	5	0	**11**	**1**
Uma Clinic	0	0	0	0	0	0	0	0	**0**	**0**	0	0	3	0	2	0	2	0	**7**	**0**	0	0	0	0	0	0	0	0	**0**	**0**
Total	**2**	**0**	**13**	**0**	**8**	**4**	**7**	**0**	**30**	**4**	**12**	**0**	**16**	**0**	**12**	**0**	**14**	**1**	**54**	**1**	**0**	**0**	**13**	**2**	**5**	**0**	**9**	**0**	**27**	**2**
Villupuram urban																														
Hari Hospital	3	1	2	1	3	0	3	0	**11**	**2**	1	0	3	0	0	0	2	0	**6**	**0**	0	0	0	0	0	0	0	0	**0**	**0**
Jayasankara Hospital	3	0	2	0	3	0	5	0	**13**	**0**	11	0	8	0	3	0	20	0	**42**	**0**	0	0	30	3	0	0	12	0	**42**	**3**
E.S.Hospital	29	3	35	4	38	5	27	1	**129**	**13**	0	0	38	3	31	1	26	0	**95**	**4**	0	0	0	0	65	0	43	0	**108**	**0**
Aswini Hospital	0	0	3	1	2	0	1	0	**6**	**1**	0	0	0	0	1	0	0	0	**1**	**0**	0	0	0	0	0	0	0	0	**0**	**0**
Dr.Bandari Hospital	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	**0**	**0**
Total	**35**	**4**	**42**	**6**	**46**	**5**	**36**	**1**	**159**	**16**	**12**	**0**	**49**	**3**	**35**	**1**	**48**	**0**	**144**	**4**	**0**	**0**	**30**	**3**	**65**	**0**	**55**	**0**	**150**	**3**

(*continued on next page*)

Table 2 (*continued*)

Private Clinic	Feb-12										Mar-12										Apr-12									
	1st Week		2nd Week		3rd Week		4th week		Total		1st Week		2nd Week		3rd Week		4th week		Total		1st Week		2nd Week		3rd Week		4th week		Total	
	Sample collection &Tested	Sample positive	Sample collection &Tested	Sample positive	Sample collection &Tested	Sample positive	Sample collection &Tested	Sample positive	Sample collection &Tested	Sample positive	Sample collection &Tested	Sample positive	Sample collection &Tested	Sample positive	Sample collection &Tested	Sample positive	Sample collection &Tested	Sample positive	Sample collection &Tested	Sample positive	Sample collection &Tested	Sample positive	Sample collection &Tested	Sample positive	Sample collection &Tested	Sample positive	Sample collection &Tested	Sample positive	Sample collection &Tested	Sample positive
Kallakuruchi urban																														
Sanjeevei Hospital	2	0	3	0	1	0	2	0	**8**	**0**	1	1	3	0	0	0	3	0	**7**	**1**	0	0	5	0	0	0	0	0	**5**	**0**
Vijay Poly clinic	4	0	11	0	4	0	8	0	**27**	**0**	2	0	6	0	0	0	6	0	**14**	**0**	0	0	2	0	0	0	0	0	**2**	**0**
K rishna Clinic	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	**0**	**0**
G .S.Hospital	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	**0**	**0**
Pugazh Hospital	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	**0**	**0**
Total	**6**	**0**	**14**	**0**	**5**	**0**	**10**	**0**	**35**	**0**	**3**	**1**	**9**	**0**	**0**	**0**	**9**	**0**	**21**	**1**	**0**	**0**	**7**	**0**	**0**	**0**	**0**	**0**	**7**	**0**
Tindivanam urban																														
Arun Clinic	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	**0**	**0**
Senthil Clinic	3	0	0	0	0	0	0	0	**3**	**0**	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	**0**	**0**
Raja gopal	0	0	1	0	0	0	0	0	**1**	**0**	0	0	0	0	0	0	0	0	**0**	**0**	0	0	1	0	0	0	0	0	**1**	**0**
Dr.Ramadoss Hospital	5	0	7	0	7	0	4	0	**23**	**0**	0	0	3	0	0	0	11	0	**14**	**0**	0	0	3	0	4	0	0	0	**7**	**0**
Uma Clinic	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	**0**	**0**
Total	**8**	**0**	**8**	**0**	**7**	**0**	**4**	**0**	**27**	**0**	**0**	**0**	**3**	**0**	**0**	**0**	**11**	**0**	**14**	**0**	**0**	**0**	**4**	**0**	**4**	**0**	**0**	**0**	**8**	**0**
Villupuram urban																														
H ari Hospital	2	1	0	0	0	0	4	1	**6**	**2**	1	0	2	0	0	0	0	0	**3**	**0**	0	0	0	0	0	0	0	0	**0**	**0**
J ayasankara Hospital	5	1	12	0	16	0	8	0	**41**	**1**	5	0	18	0	8	0	10	0	**41**	**0**	0	0	7	0	2	1	0	0	**9**	**1**
E.S.Hospital	30	1	30	1	22	0	0	0	**82**	**2**	32	0	0	0	0	0	4	0	**36**	**0**	0	0	0	0	0	0	0	0	**0**	**0**
Aswini H ospital	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	**0**	**0**
Dr.Bandari Hospital	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	**0**	**0**
Total	**37**	**3**	**42**	**1**	**38**	**0**	**12**	**1**	**129**	**5**	**38**	**0**	**20**	**0**	**8**	**0**	**14**	**0**	**80**	**0**	**0**	**0**	**7**	**0**	**2**	**1**	**0**	**0**	**9**	**1**

Private Clinic	May-12										Jun-12										Jul-12										Grand Total	
	1st Week		2nd Week		3 rd Week		4th week		Total		1st Week		2nd Week		3rd Week		4th week		Total		1st Week		2nd Week		3 rd Week		4th week		Total			
	Sample collection &Tested	Sample positive	Sample collection &Tested	Sample positive	Sample collection&Tested	Sample positive	Sample collection &Tested	Sample positive	Sample collection &Tested	Sample positive	Sample collection &Tested	Sample positive	Sample collection &Tested	Sample positive	Sample collection &Tested	Sample positive	Sample collection &Tested	Sample positive	Sample collection &Tested	Sample positive	Sample collection &Tested	Sample positive	Sample collection &Tested	Sample positive	Sample collection &Tested	Sample positive	Sample collection &Tested	Sample positive	Sample collection &Tested	Sample positive	Sample collection &Tested	Sample positive
Kallakuruchi urban																																
Sanjeevei Hospital	0	0	5	0	0	0	0	0	**5**	**0**	4	0	0	0	0	0	0	0	**4**	**0**	0	0	1	0	0	0	0	0	**1**	**0**	**86**	**5**
Vijay Poly clinic	0	0	2	0	0	0	0	0	**2**	**0**	11	0	0	0	7	0	0	0	**18**	**0**	0	0	5	0	0	0	0	0	**5**	**0**	**198**	**8**
Krishna Clinic	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	**0**	**0**	**0**	**0**
G.S.Hospital	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	**0**	**0**	**14**	**1**
Pugazh Hospital	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	**0**	**0**	**15**	**0**
Total	**0**	**0**	**7**	**0**	**0**	**0**	**0**	**0**	**7**	**0**	**15**	**0**	**0**	**0**	**7**	**0**	**0**	**0**	**22**	**0**	**0**	**0**	**6**	**0**	**0**	**0**	**0**	**0**	**6**	**0**	**313**	**14**
Tindivanam urban																																
Arun Clinic	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	**0**	**0**	**12**	**0**
Senthil Clinic	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	**0**	**0**	**57**	**8**
Raja gopal	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	**0**	**0**	**28**	**0**
Dr.Ramadoss Hospital	0	0	4	0	0	0	0	0	**4**	**0**	0	0	5	0	0	0	0	0	**5**	**0**	0	0	0	0	0	0	0	0	**0**	**0**	**112**	**2**
Uma Clinic	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	**0**	**0**	**9**	**0**
Total	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**0**	**4**	**0**	**0**	**0**	**5**	**0**	**0**	**0**	**0**	**0**	**5**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**218**	**10**
Villupuram urban																																
Hari Hospital	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	**0**	**0**	**45**	**6**
Jayasankara Hospital	0	0	12	0	0	0	0	0	**12**	**0**	8	0	0	0	7	0	0	0	**15**	**0**	0	0	4	0	0	0	0	0	**4**	**0**	**231**	**5**
E.S.Hospital	0	0	13	0	0	0	0	0	**13**	**0**	15	0	0	0	8	0	0	0	**23**	**0**	0	0	0	0	0	0	0	0	**0**	**0**	**677**	**29**
Aswini Hospital	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	**0**	**0**	**17**	**1**
Dr.Bandari Hospital	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	**0**	**0**	**1**	**0**
Total	**0**	**0**	**25**	**0**	**0**	**0**	**0**	**0**	**25**	**0**	**23**	**0**	**0**	**0**	**15**	**0**	**0**	**0**	**38**	**0**	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**0**	**4**	**0**	**971**	**41**

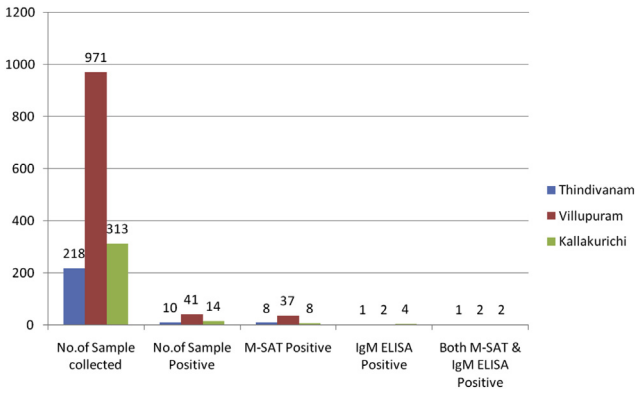

Figure 2. Showing urban wise Number of Serum samples collected and their positives in M-SAT, IgM ELISA and Both.

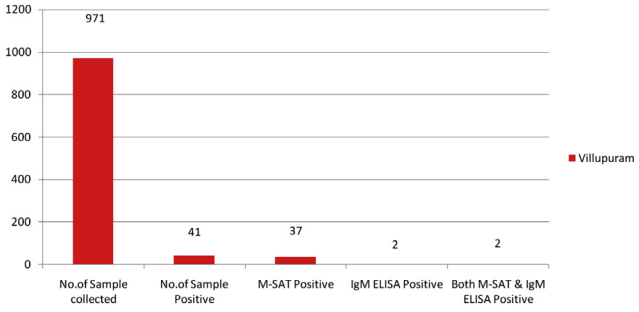

Figure 3. Showing the total samples collected in Villupuran urban alone and their status in M-SAT, IgM ELISA and Both.

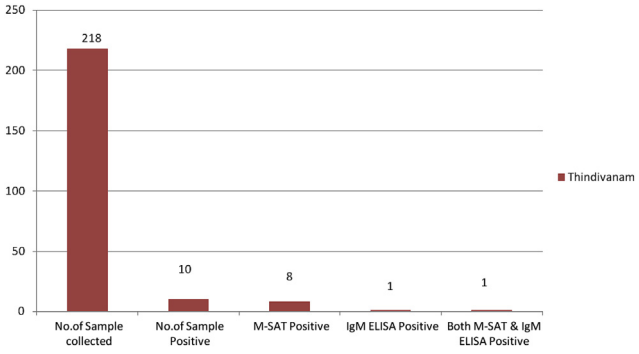

Figure 4. Showing the total samples collected in Tindivanam urban alone and their status in M-SAT, IgM ELISA and Both.

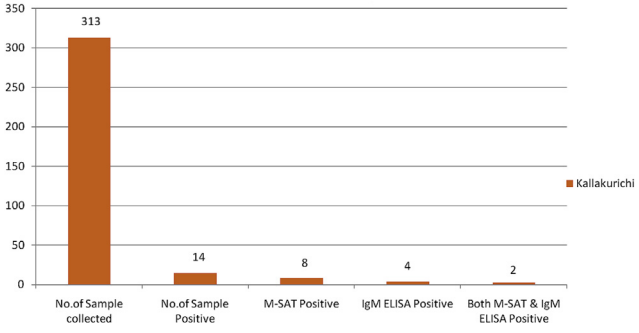

Figure 5. Showing the total samples collected in Kallakuruchi urban alone and their status in M-SAT, IgM ELISA and Both.

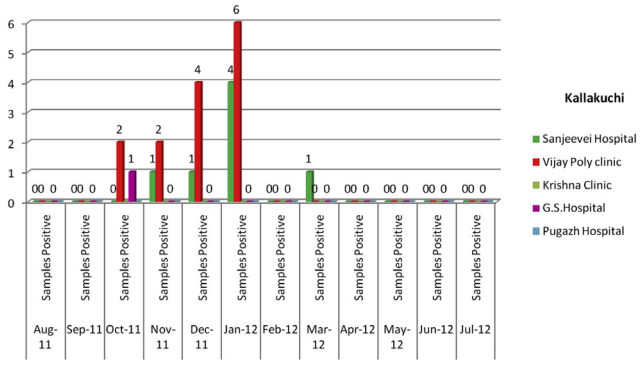

Figure 6. Showing the clinic wise, month wise positive cases of Kallakuruchi urban.

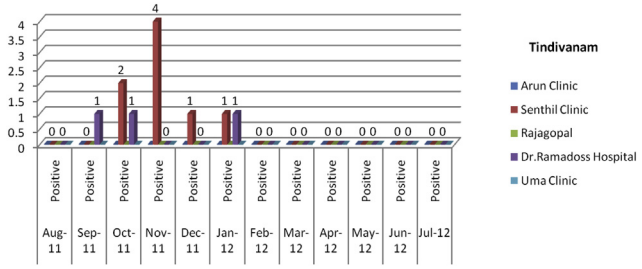

Figure 7. Showing the clinic wise, month wise positive cases of Tindivanam urban.

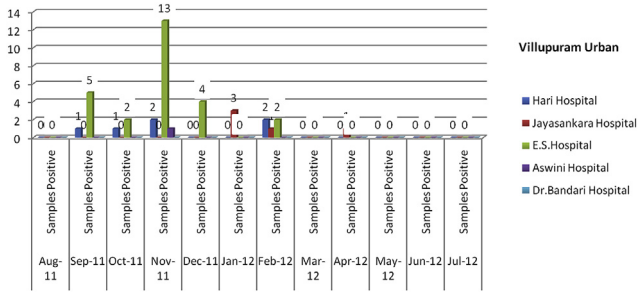

Figure 8. Showing the clinic wise, month wise positive cases of Villupuram urban.

Scrutinizing the weekly and monthly data obtained from clinics, it was found that more samples were received in October and November and the number of positive cases were higher in the months of November and January in all urban areas of Kallakuruchi, Villupuram, and Tindivanam. The number of samples obtained from each clinic increased from September up to January in Kallakuruchi, Tindivanam, and Villupuram. The same trend was also observed towards the prediction of positive cases (Figures 6–8).

Forty-one males were positive for leptospirosis versus 24 females. With regards to age, 57 cases were in

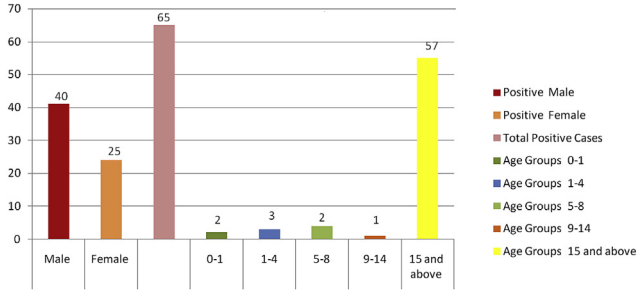

Figure 9. Showing the sex wise, age wise distribution of total positive cases reported from Kallakuruchi, Tindivanam and Villpuram urban.

Table 3. Showing the month wise clinic wise leptospirosis positives in Kallakuruchi, Thindivanam and Villupuram urbans

Private Clinic	Aug-11 Positive	Sep-11 Positive	Oct-11 Positive	Nov-11 Positive	Dec-11 Positive	Jan-12 Positive	Feb-12 Positive	Mar-12 Positive	Apr-12 Positive	May-12 Positive	Jun-12 Positive	Jul-12 Positive	Total Positive
Kallakurichi urban													
Sanjeevi hospital	0	0	0	1	1	2	0	1	0	0	0	0	5
Vijay poly clinic	0	1	1	2	4	0	0	0	0	0	0	0	8
Krishna clinic	0	0	0	0	0	0	0	0	0	0	0	0	0
GS hospital	0	0	1	0	0	0	0	0	0	0	0	0	0
Pugazh hospital	0	0	1	0	0	0	0	0	0	0	0	0	0
Total	0	1	1	3	5	2	0	1	0	0	0	0	13
Thindivanam urban													
Arun clinic	0	0	0	0	0	0	0	0	0	0	0	0	0
Senthil clinic	0	0	2	4	1	1	0	0	0	0	0	0	8
Rajagopal	0	0	0	0	0	0	0	0	0	0	0	0	0
Dr. Ramadoss hospital	0	1	1	0	0	1	0	0	0	0	0	0	2
Uma clinic	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	1	3	4	1	2	0	0	0	0	0	0	10
Villupuram urban													
Hari hospital	0	1	1	2	0	0	2	0	0	0	0	0	6
Jayasankara hospital	0	0	0	0	0	3	1	0	1	0	0	0	5
E.S. hospital	0	5	2	13	4	0	2	0	0	0	0	0	29
Aswini hospital	0	0	0	1	0	0	0	0	0	0	0	0	1
Dr. Bandari hospital	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	6	3	16	4	3	5	0	1	0	0	0	41

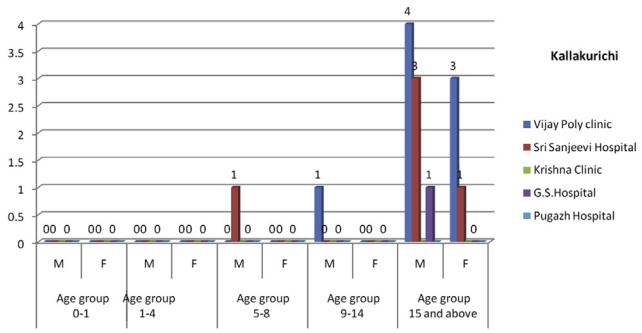

Figure 10. Showing the clinic wise, age wise and sex wise positive cases of Kallakuruchi urban.

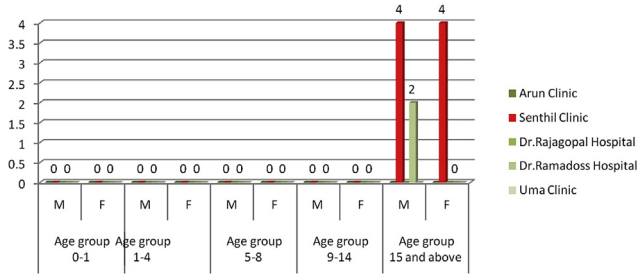

Figure 11. Showing the clinic wise, age wise and sex wise positive cases of Tindivanam urban.

the ≥15 years age group, one was in the 9−14 years age group, two were in the 5−8 years age group, three were in the 1−4 years age group, and two were in the 0−1 years age group. From these observations, it is concluded that all age groups were susceptible to the disease (Figure 9).

When investigating week wise samples lifted from Kallakuruchi, Villupuram, and Tindivanam, it was seen that samples arrived from private clinics from the 4th week of August 2011 onwards and steadily increased until the end of the project. Villupuram contributed 971 serum samples, Kallakuruchi contributed 313 serum samples and 218 serum samples were obtained from Tindivanam (Table 2).

The number of positive cases of leptospirosis was greatest in November, December, and January, with 18, 7, and 23 cases reported in all Kallakuruchi, Villupuram, and Tindivanam, respectively (Table 3).

By examining the data with regards to age and sex obtained from Kallakuruchi, it was seen that there were 14 positive cases reported throughout the study period. Of these, four were female and 10 were male. All females belonged to ≥15 years age group, whereas for the males, one belonged to the 5−8 years age group, one to the 9−14 years age group, and eight to the ≥15 years age group. Therefore, all age groups apart from the 0−1 years and 1−4 years age groups, were affected in Kallakuruchi (Figure 10).

In Tindivanam from August 2011 to July 2012, 10 individuals were affected; six were males and four were females, and all belonged to the ≥15 years age group (Figure 11).

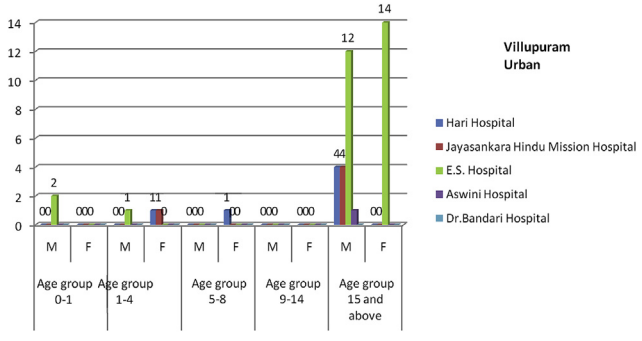

Figure 12. Showing the clinic wise, age wise and sex wise positive cases of Villupuram urban.

There were 41 positive cases reported in Villupuram. Among these, there were 24 males and 17 females. Of the male cases, two belonged to the 0−1 years age group, one belonged to the 1−4 years age group and 21 belonged to the ≥15 years age group. Of the female cases, two belonged to the 1−4 years age group, one belonged to the 5−8 years age group, and 14 belonged to the ≥15 years age group. Thus, all age groups were affected apart from the 9−14 years age group (Figure 12).

Leptospirosis cases were not reported in individuals up to 4 years of age in Kallakuruchi, in Tindivanam, only adult age groups (>15 years) were affected, and in Villupuram, all age groups except the 9−14 years age group were affected. Hence, it could be ascertained that leptospirosis is susceptible to all age groups and there was no information available on its resistance among repeatedly affected individuals.

4. Discussion

This paper presents an overview of the current situation of leptospirosis in the Villupuram District in private clinics, so this may be included when estimating the real magnitude of the problem, in order to implement appropriate control and preventive measures in the affected areas.

From this study on leptospirosis, it is shown that cases were reported in all months, with a peak during the monsoon period. In addition, all age groups, irrespective of sexes, were affected by leptospirosis, including those exposed to the disease. Sixty-five affected individuals were interviewed; some of them became infected from wet land agricultural practices, some others by walking barefoot during a monsoon, some by association with pet animals, and very few were associated with drinking water contamination. Social control measures in all affected villages and awareness and health education among administrative, education and health personals in human and veterinary medicine, including primary health care workers, wild life conservation scientists, and infrastructure and urban planners, are necessary [15,16].

Further, it has been recommended that, especially in India, the timing of rodent control is a vital consideration in the prevention of disease transmission. The rodent breeding period starts with the south west monsoon, suggesting that rodent control measures in the pre-monsoon period would bring better vector control [17].

Leptospirosis is a globally important zoonotic disease [5−7,18], most commonly found in tropical or subtropical countries, and may be prevalent in both urban and rural settings. The annual incidence is estimated to be from 0.1−1/100,000 in temperate climates to 10−100/100,000 in humid tropics. A disease incidence of >100/100,000 is encountered during outbreaks and in high exposure risk groups [19]. Worldwide prevalence rates remain underestimated [19,20]. Further, leptospirosis is caused by spirochetes of the genus *Leptospira*. Leptospirosis was first identified as the cause of Weil's disease in Japan, where it was common among coal miners [15]. Rodents and domestic mammals, such as cattle, pigs and dogs, serve as major reservoir hosts [21,22], however, *Leptospira* has been isolated from virtually all mammalian species. Infected animals may excrete leptospires intermittently or regularly for months or years, or for their lifetime [15]. Vaccinated animals may still shed infectious organisms in the urine.

Human infection results from direct or indirect exposure to the urine of certain animals. Leptospirosis gains entry into the bloodstream via cuts, skin abrasions, or mucous membranes. Leptospirosis has often been considered as an occupational disease, but recreational activities and travelling in endemic countries are also recognized as risk factors [22,23]. Significant exposure also occurs from normal daily activities, with high rates of infections during heavy rainfall and flooding [21,24,25]. Urban slum dwellers in areas with poor sanitation are at particularly high risk [21].

The spectrum of clinical presentations of human leptospirosis ranges from asymptomatic to fatal. Most infections are subclinical, or result in a mild self-limiting illness [24]. However, the fatality rate in severe leptospirosis may be as high as 20% [24]. A particular problem is that leptospirosis can be misdiagnosed, due to its wide spectrum of symptoms which may mimic the clinical signs of many other diseases, such as dengue fever, hantavirus infection, and malaria.

Based on the observations made from this research, it is clearly understood that there is a lacuna in strengthening the present surveillance system, as active, passive, and sentinel surveillance alone contribute to determining the real magnitude of the leptospirosis problem in the Villupuram District, Tamil Nadu, India. Hence, the findings of 4% of leptospirosis detected among fever cases from differential diagnosis in selected private clinics of three urban areas, namely Kallakurichi, Villupuram, and Thindivanam, may help to measure the real magnitude of the problem and to improve the prevention and control of leptospirosis existing in rural areas, with reference to the reports made in private clinics. It is therefore most urgent to strengthen the reporting systems from private clinics, physicians, traditional/native treatment centers, along with routine active, passive, and sentinel surveillance. These findings support the view of leading researchers of leptospirosis, who have mentioned that a 20% case fatality rate in leptospirosis is due to under-reporting and misdiagnosis, due to its wide spectrum of symptoms, which may mimic the clinical signs of many others fever prime diseases, such as dengue fever, hantavirus infection, and malaria [5−7,18,19].

Conflicts of interest

All authors declare no conflicts of interest.

Acknowledgments

The authors thank all field staff engaged in the project to bring about the outcome of this study. We are especially thankful to the Ministry of Health and Family welfare, the Director, National Vector Borne Disease Control Programme (NVBDCP), Delhi, and the Government of India for their grant to carry out this research in Villupuram District, Tamil Nadu, India. Our thanks are due to the Deputy Director of Health Services, District Entomologists of Kallakurichi and Villupuram Health Units for their sustainable encouragement to complete this study successfully. Further, we extend our sincere thanks to all Private Medical practitioners for their kind co-operation throughout this study.

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