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Uncovering the Burden of Leptospirosis in Goa: Insights from Retrospective Data

Dr. Tripti Gaunkar[1], Dr. Utkarsh Betodkar[2], Dr. Shawon Qaudros[3], Dr. Geetanjali Sardessai-Kare[4]

[1]State Microbiologist, IDSP, Directorate of Health Services, Goa, India
Corresponding Author Email: *drtripti.gaonkar[at]gmail.com*

[2]State Surveillance Officer, Directorate of Health Services, Goa, India

[3]District Microbiologist, IDSP, Directorate of Health Services, Goa, India

[4]Consultant NPCCHH, Directorate of Health Services, Goa, India

Abstract: ***Leptospirosis continues to be a public health concern in India, particularly in coastal regions like Goa, where data on disease prevalence remain limited. This study presents a cross-sectional analysis of three years of retrospective data collected through the Integrated Disease Surveillance Program (IDSP) to evaluate leptospirosis incidence across Goa. Patient samples were tested using IgM ELISA, and results were analyzed for district and block-wise distribution, age, sex, seasonality, and spatial patterns. Among 4,415 suspected cases, the overall positivity rate was 8.29%, with higher rates in South Goa. Males and individuals aged 18–60 were disproportionately affected, particularly during the monsoon season from May to October. These findings underline the need for targeted public health strategies tailored to regional epidemiological profiles.***

Keywords: Zoonotic, Leptospira, Acute febrile illness, IgM antibodies, ELISA

1. Introduction

Background on leptospirosis Leptospirosis is one of the most under-reported anthropozoonotic diseases caused by the bacterium Leptospira, which affects humans and animals worldwide.(1) Occupational exposure is the most common cause of infection in humans.(2) With 30 serotypes and more than 350 serovars, leptospira is transmitted through direct or indirect contact with contaminated water, soil, or urine from infected animals.(3) First identified in 1886, leptospirosis has emerged as a significant public health concern, with global burden estimated as 1.03 million cases worldwide annually, with 58,900 deaths attributed to the infection. The disease burden is disproportionately high in tropical regions and low-income countries, particularly affecting Southern and Southeast Asia. (4) Numerous outbreaks have been documented globally in urban areas following natural disasters, including in Guyana, Italy, Indonesia, Malaysia, Philippines and India. (5)

In India, the first Leptospirosis outbreak was suspected among convicts in the Andaman and Nicobar Islands in early 1920. (6) Andaman Haemorrhagic Fever (AHF) remained a mystery for five years until a 1995 study during an outbreak in Diglipur, North Andaman, provided strong evidence of its leptospiral origin. (7) In 2015, the Government of India initiated the National Programme for Prevention and Control of Leptospirosis (NPPCL) in the endemic regions of Gujarat, Kerala, Tamil Nadu, Maharashtra, Karnataka, and the Andaman & Nicobar Islands. (8) The program aims to reduce the morbidity and mortality caused by leptospirosis.
Risk factors associated with a high prevalence of leptospirosis encompass occupational exposure (fishing, mining, agriculture, and cattle farming), recreational activities, flooding, climate change, and inadequate sanitation. (9) Leptospira can be either pathogenic, intermediate or saprophytic. While pathogenic and intermediate strains need a host to spread the infection, the saprophytic biflexa group can cause infection without relying on a transmission host, as it feeds on organic matter. The primary symptom of leptospirosis is an A.U.F.I. (acute undifferentiated febrile illness) in humans that is often undifferentiated. (10) Additional clinical features include headache, myalgia, arthralgia, prostration and Calf muscle tenderness. While signs like Conjunctival suffusion, anuria or oliguria and/or proteinuria, Jaundice, haemorrhagic manifestations of Meningeal irritation, gastrointestinal symptoms such as nausea, vomiting diarrhoea, and abdominal pain can also occur, lymphadenopathy and rash are relatively rare. Hepatomegaly and splenomegaly are also not uncommon.

Early diagnosis and treatment are crucial to prevent complications and reduce mortality. Leptospirosis is an acute bacterial infection caused by a special and fastidious bacterium leptospira species, that requires sophisticated laboratory requirements for diagnosis. (11) The diagnosis of leptospirosis can be achieved by many methods. In the first week, the diagnostic modality of choice is polymerization chain reaction assay (PCR) or culture of the blood. (12,13) After the first week, the sensitivity of these tests on blood decreases substantially. PCR or culture in the urine samples is useful in the second week. These tests are, however, limited by availability, cost, and resource intensiveness. After the first week, serology is the preferred method. Microagglutination test [MAT] is the gold standard serological method of choice, but it requires maintenance of live cultures of leptospira and is usually available at reference centers. (14,15) IgM Enzyme-linked immunosorbent assay (IgM ELISA) is the most commonly used serological method for diagnosing leptospirosis. (16) The only limitations of Conventional serological methods like ELISA are requirements of expertise and considerable turn-around time.

Antibiotics are the mainstay of treatment for leptospirosis.

Doxycycline dose of 100 mg twice a day for seven days in adults. Pregnant & lactating mothers should be given capsule ampicillin 500 mg every 6 hourly. Dialysis is often required in patients with severe renal involvement. Chemoprophylaxis for individuals at high risk of exposure (sewage workers, paddy farmers) during the peak transmission season (monsoon) has shown to be effective. Mass chemoprophylaxis in regions with heavy floods has also been advocated. (17)

Integrating humans, animals, and the environment is essential to prevent and control zoonotic diseases. Measures for prevention and control include animal vaccination, supplying personal protective equipment to at-risk groups, enhancing sanitation, and raising public awareness. (18)

This study aims to uncover the burden, sex & age distribution, epidemiological trends, and geo spatial pattern of leptospirosis cases in Goa India. Also, this study provides crucial insights for developing targeted public health strategies, contributing to the broader understanding of region-specific disease dynamics in coastal India.

2. Materials & Method

Study area, population, and period

This study utilized data collected from Integrated Health Information Platform (IHIP) State surveillance unit Goa, India. The analysis covered the period from January 1, 2022, to December 31, 2024. Serological evaluations were performed on samples from patients who visited outpatient services or were admitted as inpatients with a clinical suspicion of leptospirosis. Samples were sent to the Microbiology laboratory from various departments, particularly Medicine, Paediatrics, Casualty, and ICU.

Serological evaluation:

IgM ELISA (Enzyme-Linked Immunosorbent Assay) is a valuable tool for the serological diagnosis of leptospirosis. It detects the presence of IgM antibodies against Leptospira in the patient's serum. Patient samples were analyzed using a commercially available ELISA kit. A qualitative analysis was performed as per the manufacturer's instructions.

In this study, we retrospectively analyzed the positivity rate district and block wise, sex & age wise distribution, seasonal patterns & trends, and the Geospatial distribution of cases in Goa, India.

3. Results

The current study included a total of 4,415 patients. Among these, 8.29% (366 out of 4,415) tested positive for anti-leptospira-specific immunoglobulin (IgM) antibodies, while district wise positivity was 7.67% and 10.52% for the north and south district respectively. Results also showed that area of residence was statistically associated ($P < 0.05$) with leptospiral seropositivity, revealing that people living in Salcete (16.45%) & Quepem (12.26%) block of south Goa and Bardez (10.5 %) block of north Goa are at higher risk.

Table 1: District & block-wise distribution of cases and positivity rate

District	Block	Tested	Positive	Positivity
North	Pernem	188	17	9.04
	Bardez	1591	167	10.5
	Bicholim	300	29	9.67
	Satari	210	16	7.62
	Tiswadi	869	16	1.84
	Ponda	297	20	6.73
	Total	3455	265	7.67
South	Dharbandora	29	1	3.45
	Mormugao	281	10	3.56
	Salcete	456	75	16.45
	Quepem	106	13	12.26
	Sanguem	47	1	2.13
	Canacona	41	1	2.44
	Total	960	101	10.52
	Grand Total	4415	366	8.29

The age is ranged from 0 to 81 years with a mean age of 32 years and a median value of 29 years. Of the total 366, 259 (70.77 %) were adults and 83 (22%) were minors ≤18 years of age and 24 (6.56%) were senior citizens >60 years. The age group most affected is between 18 - 60 years. Within the group of 366 seropositive patients, 229 (62.57%) were male, resulting in a male-to-female ratio of 1.67:1

Table 2: Sex & age-wise distribution of cases

	Attributes	Count	Percentage
Age slab	Minor (0-17)	83	22.68
	Adults (18-60)	259	70.77
	Senior citizen (61-90)	24	6.56
Sex	Male	229	62.57
	Female	137	37.43

The analysis of attack rates over the three-year (2022-2024) period indicates a consistently higher incidence among males compared to females. Furthermore, the attack rate in males has demonstrated a progressive increase over the years from 0.5 to 1.8 males per 1000 population. Similarly, the overall population has also experienced rising attack rates suggest a growing public health concern.

Table 3: Assessment of Attack Rate Among Males, Females, and the Total Population Over a Three-Year Period

	Year	No. of cases	Projected population	Attack rate per 1000
Male	2022	36	79200	0.5
	2023	49	79600	0.6
	2024	144	79900	1.8
Female	2022	23	77900	0.3
	2023	40	78400	0.5
	2024	74	78800	0.9
Total	2022	59	157100	0.4
	2023	89	157900	0.6
	2024	218	158700	1.4

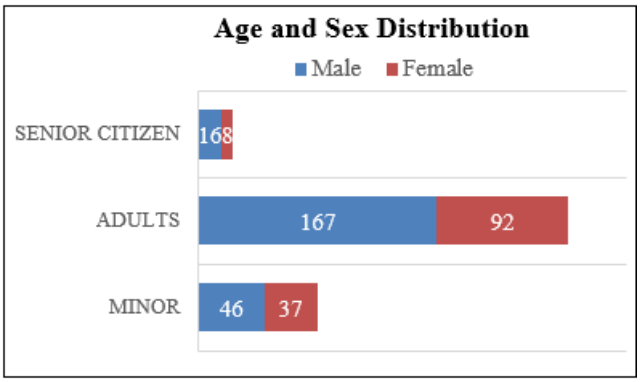

Figure 1: Age and Sex-wise distribution of cases

Seasonal variation in leptospirosis incidence was observed, with the highest number of cases occurring during the monsoon season (May to October) across all three years. The peak incidence was recorded in August 2024 with 44 cases, followed by 26 cases in August 2023 and 19 cases in August 2022.

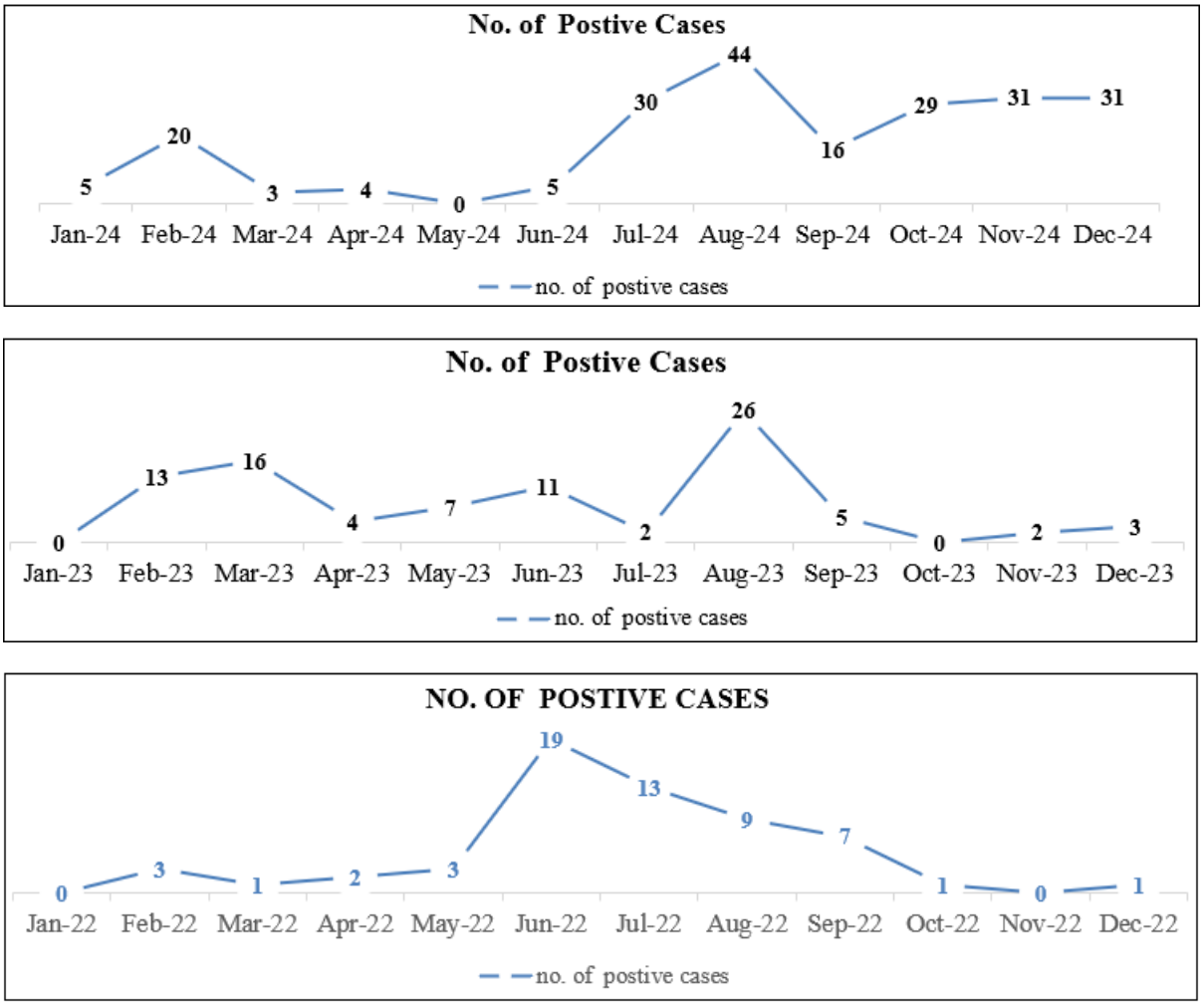

Figure 2: Seasonal distribution of cases (2022- 2024)

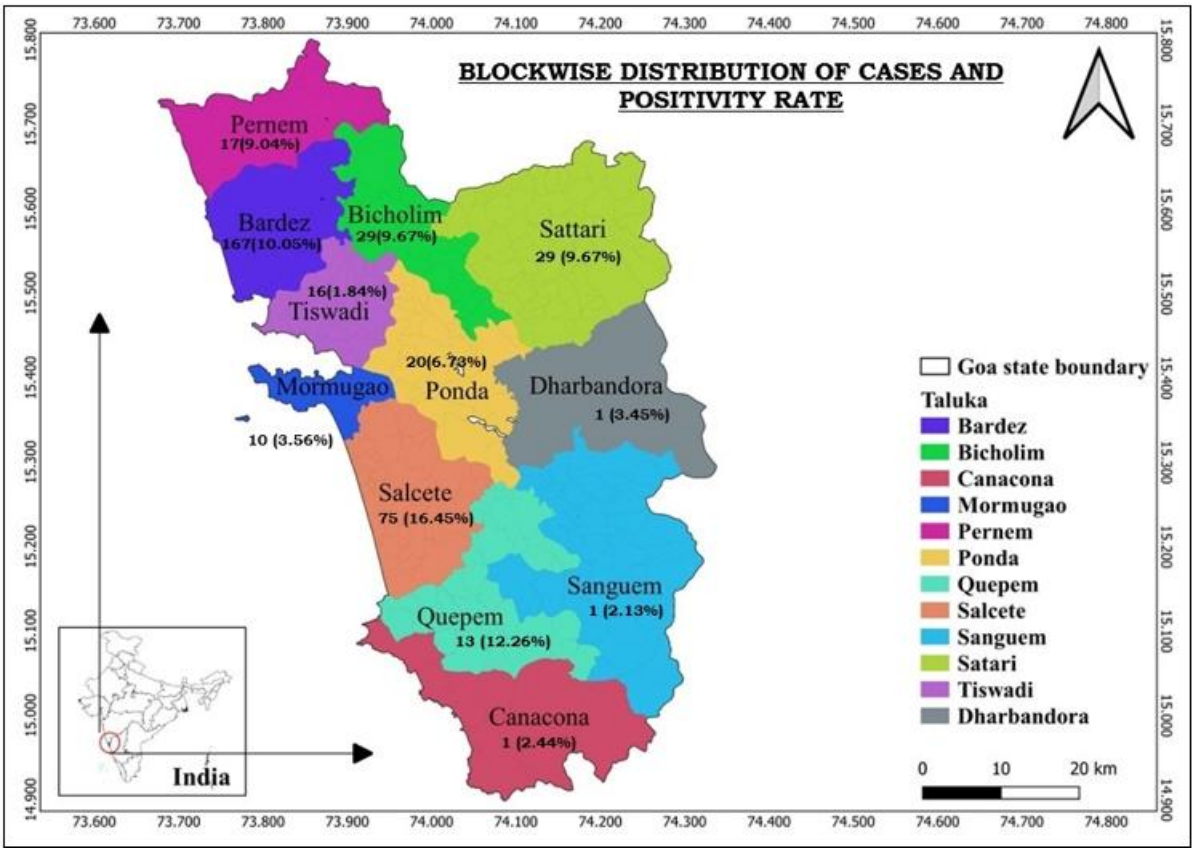

Figure 3: Geospatial distribution of cases

4. Discussion

Leptospirosis is a zoonotic disease, sustained in the kidneys of reservoir animals such as rodents, cattle, goats, and pigs. (19) Humans contract the infection through contact with water tainted by the urine of infected animals. Most cases reported from India are from the four major states i.e., Kerala, Gujarat, Tamil Nadu, and Maharashtra. (20,21) There is limited information regarding the incidence of leptospirosis in the Goan population. Goa is primarily known for Paddy and Arecanut farming, livestock farming in rural areas, requiring substantial water irrigation which is associated with higher exposure of humans to contaminated water. Hence a major chunk of farmers gets exposed to the infection and later disease. Other vulnerable professions are veterinary doctors and sewage workers in urban regions.

Goa also experiences heavy rainfall, which may lead to waterlogging, predisposing the population to infection. (22) During floods, contaminated animal urine easily mixes with surface water, putting large populations, particularly those in low-lying areas, at risk of leptospirosis (23). This helps to explain the increased incidence of cases during the rainy season (May to October). Another reason for the increased incidence in Goa could be the increased survival of leptospires in warm and humid environments (16).

In this study, we have included patients with clinical criteria for leptospirosis, 8.31% of cases were seropositive for leptospirosis. A serological survey of leptospirosis in Chennai showed seropositivity of 32%.(24) whereas in northern states like New Delhi seroprevalence was observed as low as 6.47%.(1) Seropositivity was noted in central India, specifically across 24 districts of Madhya Pradesh 13.12%.(25) Sex variation in seroprevalence i.e., with higher antibody prevalence observed in males (62.57 %, $P < 0.05$) is in consistent with other studies.(26,27) The higher prevalence in young males is generally attributed to their more frequent outdoor activities and occupations associated with an increased risk of leptospirosis, such as occupational work with exposure to rodents (e.g. sewer or field worker) or livestock, or water-based recreational activities. (28)

The seasonal variation was observed in this study which revealed higher incidence of leptospirosis cases during monsoon season, which is consistent with some of the earlier studies and higher rate of contamination may be implicated during monsoon season. (27). A study conducted in Kerala indicated that the number of leptospirosis cases was higher between July and November, peaking on average in August and September. Additionally, the incidence rate of the disease is greater in the coastal districts of Kerala, India, compared to other areas. (9) In our study, Seroprevalence rate was higher in people living and working in coastal areas. This might be due to the following reasons: coastal population being more involved in paddy agriculture activities and northern regions are more exposed to betelnut plantations and are more exposed to rodents as agriculture in Goa India. Furthermore, presence of water bodies like lakes, rivers, and canals, which can be contaminated with the urine of infected animals. Moreover, fishing practices in coastal regions expose humans to polluted water and soil and increase their chances of contracting the infection. Also, a larger population of rodents are found in Coastal areas. Our results are in line with previous published studies. (29)

The co-existing infections like dengue, scrub typhus, chikungunya, influenza, hepatitis, viral haemorrhagic fevers,

or enteric disease, may present diagnostic challenges. Therefore, it is essential that a high index of suspicion for the diseases is required particularly in endemic areas followed by diagnostic investigation.

5. Limitations of the study

Data was not cross-checked with other diseases like dengue, scrub typhus, enteric fever, and chikungunya. Paired sampling two weeks apart to increase the specificity of serological tests which was also not performed in this study due to its retrospective nature.

6. Conclusion

Leptospirosis is prevalent across Goa; however, its spatial distribution is heterogeneous, with a higher incidence reported in the southern coastal blocks. This geographic pattern could be influenced by environmental factors such as marshy terrain, frequent waterlogging, and proximity to contaminated water sources. Leptospirosis in Goa primarily affects males and individuals in the working-age population. This demographic trend could be attributed to occupational and lifestyle factors. Males engaged in outdoor professions such as agriculture, fishing, construction, and manual labor are at greater risk due to increased exposure to contaminated water and soil. Additionally, people of working age (typically 18–60 years) are more likely to be involved in activities that put them in direct contact with potential sources of infection. A clear seasonal trend is evident in the occurrence of leptospirosis cases, with the highest number of infections recorded between May and October. This period aligns with Goa's monsoon season, characterized by heavy rainfall leading to water stagnation and flooding. Given this endemicity and seasonal surge, preventive measures such as improved drainage systems, protective gear for high-risk workers, and awareness programs targeting primary care providers, at-risk populations, and public health authorities are crucial in mitigating the impact of leptospirosis in Goa.

Declarations

Ethics approval and consent to participate
This study was approved by the Institutional Ethics Committee of [Directorate of Health Services, Goa] (Approval No. DHS/Sp.Cell/F.No.24-166(Ethics)/2024-25/420, dated 22/05/2025)

Consent for publication
Not applicable.

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Conflicts of interest:
No conflicts of interest

References

[1] Agrawal, S. K., Chaudhry, R., Gupta, N., Arif, N., & Bhadur, T. (2018). Decreasing trend of seroprevalence of leptospirosis at All India Institute of Medical Sciences New Delhi: 2014–2018. Journal of Family Medicine and Primary Care, 7(6), 1425–1428. https://doi.org/10.4103/jfmpc.jfmpc_387_18

[2] Ratnam, S., Everard, C. O. R., Alex, J. C., & Harrison, T. J. (2006). Seroprevalence of leptospirosis in high risk groups in Calicut, North Kerala, India. Indian Journal of Medical Research, 123(5), 627–630. https://pubmed.ncbi.nlm.nih.gov/17185876/

[3] Rahimi, R., Omar, E., Tuan Soh, T. S., MohdNawi, S. F. A., & Md, N. S. (2018). Leptospirosis in pregnancy: A lesson in subtlety. Malaysian Journal of Pathology, 40(2), 169–173. https://pubmed.ncbi.nlm.nih.gov/30173235/

[4] Costa, F., Hagan, J. E., Calcagno, J., Kane, M., Torgerson, P., Martinez-Silveira, M. S., Stein, C., Abela-Ridder, B., & Ko, A. I. (2015). Global morbidity and mortality of leptospirosis: A systematic review. PLoS Neglected Tropical Diseases, 9(9), e0003898. https://doi.org/10.1371/journal.pntd.0003898

[5] Antima, & Banerjee, S. (2023). Modeling the dynamics of leptospirosis in India. Scientific Reports, 13(1), 19791. https://doi.org/10.1038/s41598-023-46919-2

[6] Vijayachari, P., Sugunan, A. P., Singh, S. S., & Mathur, P. P. (2015). Leptospirosis among the self-supporting convicts of Andaman Island during the 1920s—the first report on pulmonary haemorrhage in leptospirosis? Indian Journal of Medical Research, 142(1), 11–22. https://doi.org/10.4103/0971-5916.162083

[7] Vijayachari, P., Sugunan, A. P., Sharma, S., Roy, S., Natarajaseenivasan, K., & Sehgal, S. C. (2008). Leptospirosis in the Andaman Islands, India. Transactions of the Royal Society of Tropical Medicine and Hygiene, 102(2), 117–122. https://doi.org/10.1016/j.trstmh.2007.09.005

[8] Costa, F., Hagan, J. E., Calcagno, J., Kane, M., Torgerson, P., Martinez-Silveira, M. S., Stein, C., Abela-Ridder, B., & Ko, A. I. (2015). Global morbidity and mortality of leptospirosis: A systematic review. PLoS Neglected Tropical Diseases, 9(9), e0003898. https://doi.org/10.1371/journal.pntd.0003898

[9] Antima, & Banerjee, S. (2023). Modeling the dynamics of leptospirosis in India. Scientific Reports, 13(1), 19791. https://doi.org/10.1038/s41598-023-46919-2

[10] One Health Outlook. (2024). Leptospirosis in India: Insights on circulating serovars, research lacunae and proposed strategies to control through one health approach. One Health Outlook, 6(1), 98. https://doi.org/10.1186/s42522-024-00098-5

[11] Sethi, S., Sharma, N., Kakkar, N., Taneja, J., Chatterjee, S. S., Banga, S. S., & et al. (2010). Increasing trends of leptospirosis in northern India: A clinico-epidemiological study. PLoS Neglected Tropical Diseases, 4(1), e579. https://doi.org/10.1371/journal.pntd.0000579

[12] Baburaj, P., Nandkumar, V. S., & Khanna, L. (2006). Polymerase chain reaction in the diagnosis of leptospiral infection. Journal of the Association of Physicians of India, 54(4), 339–340.

[13] Martin, P. L., Stanchi, N. O., Brihuega, B. F., Bonzo, E., Galli, L., & Arauz, M. S. (2019). Diagnosis of canine leptospirosis: Evaluation of two PCR assays in comparison with the microagglutination test. Pesquisa Veterinária Brasileira, 39(5), 255–262. https://doi.org/10.1590/1678-5150-pvb-5912

[14] Shivakumar, S., & Krishnakumar, B. (2006). Diagnosis of leptospirosis—role of MAT. Journal of the Association of Physicians of India, 54(4), 338–339.
[15] Picardeau, M., Bertherat, E., Jancloes, M., Skouloudis, A. N., Durski, K., & Hartskeerl, R. A. (2014). Rapid tests for diagnosis of leptospirosis: Current tools and emerging technologies. Diagnostic Microbiology and Infectious Disease, 78(1), 1–8. https://doi.org/10.1016/j.diagmicrobio.2013.09.012
[16] Levett, P. N. (2001). Leptospirosis. Clinical Microbiology Reviews, 14(2), 296–326. https://doi.org/10.1128/CMR.14.2.296-326.2001
[17] National Centre for Disease Control. (n.d.). Case management guidelines for leptospirosis.
[18] Coker, R., Rushton, J., Mounier-Jack, S., Karimuribo, E., Lutumba, P., Kambarage, D., ... & Fèvre, E. M. (2011). Towards a conceptual framework to support one-health research for policy on emerging zoonoses. The Lancet Infectious Diseases, 11(4), 326–331. https://doi.org/10.1016/S1473-3099(10)70312-1
[19] Desai, K. T., Patel, F., Patel, P. B., Nayak, S., Patel, N. B., & Bansal, R. K. (2016). A case-control study of epidemiological factors associated with leptospirosis in South Gujarat region. Journal of Postgraduate Medicine, 62(4), 223–227. https://doi.org/10.4103/0022-3859.191005
[20] Chaudhry, R. (2013). Leptospirosis: Current scenario in India. ResearchGate. https://www.researchgate.net/publication/235800331_Leptospirosis_Current_Scenario_in_India
[21] World Health Organization. (2006). Report of the brainstorming meeting on Leptospirosis prevention and control. Geneva: WHO. https://scholar.google.com/scholar_lookup?title=Report+of+the+Brainstorming+meeting+on+Leptospirosis+Prevention+and+Control&publication_year=2006
[22] Gupta, N., Wilson, W., & Ravindra, P. (2023). Leptospirosis in India: A systematic review and meta-analysis of clinical profile, treatment and outcomes. Infezioni in Medicina, 31(3), 290–305. https://doi.org/10.53854/liim-3103-12
[23] Karande, S., Kulkarni, H., Kulkarni, M., De, A., & Varaiya, A. (2002). Leptospirosis in children in Mumbai slums. Indian Journal of Pediatrics, 69(10), 855–858. https://doi.org/10.1007/BF02723708
[24] Kanimozhi, R., Geetha, R., Anitha, D., & Ramesh, V. (2016). A serological study of leptospirosis in Chennai. International Journal of Research in Medical Sciences, 4(1), 268–271. https://doi.org/10.18203/2320-6012.ijrms20151527
[25] Manjunathachar, H. V., Barde, P. V., Chouksey, V., Tiwari, P., Mathapati, B., Shrivastava, S., & et al. (2024). Leptospirosis in central India: A retrospective study to explore burden of tropical illness. Indian Journal of Medical Microbiology, 51, 100689. https://doi.org/10.1016/j.ijmmb.2024.100689
[26] Garvey, P., Connell, J., O'Flanagan, D., & McKeown, P. (2014). Leptospirosis in Ireland: Annual incidence and exposures associated with infection. Epidemiology and Infection, 142(4), 847–855. https://doi.org/10.1017/S0950268813001504
[27] Sohail, M. L., Khan, M. S., Ijaz, M., Naseer, O., Fatima, Z., Ahmad, A. S., & et al. (2018). Seroprevalence and risk factor analysis of human leptospirosis in distinct climatic regions of Pakistan. Acta Tropica, 181, 79–83. https://doi.org/10.1016/j.actatropica.2018.01.002
[28] Mwachui, M. A., Crump, L., Hartskeerl, R., Zinsstag, J., & Hattendorf, J. (2015). Environmental and behavioural determinants of leptospirosis transmission: A systematic review. PLoS Neglected Tropical Diseases, 9(9), e0003843. https://doi.org/10.1371/journal.pntd.0003843
[29] Mgode, G. F., Japhary, M. M., Mhamphi, G. G., Kiwelu, I., Athaide, I., & Machang'u, R. S. (2019). Leptospirosis in sugarcane plantation and fishing communities in Kagera Northwestern Tanzania. PLoS Neglected Tropical Diseases, 13(5), e0007225. https://doi.org/10.1371/journal.pntd.0007225