Indian J Lepr 2025, 97 : 153-161

http://www.ijl.org.in

Original Article

Spatiotemporal Changes of Leprosy in the 11 Districts of National Capital Territory of Delhi, India

KS Baghotia[1], PSS Rao[2]

Received: 24.09.2024 Revised: 13.12.2024 Accepted: 18.12.2024

Leprosy caused by *Mycobacterium leprae*, has a very long and distinguished history with varying endemicity globally. Spatiotemporal analyses have helped to pinpoint areas where more intensive and effective control strategies are needed. The monthly progress reports of the National Leprosy Eradication Programme (NLEP) are excellent sources of studying the spatial temporal changes. These secondary data were used to analyses the changes over the 11 districts of NCT. Multibacillary (MB) rates vary from a low of 61.4% to a high of 86.0%. There are variations in child% and female% also but not closely correlated with the MB rates. While the mean new case detection rate (NCDR) is lowest in New Delhi, 1.2 (SD 0.6), the highest is in Shahdara, 18.4 (SD 2.1). The prevalence rates also show wide fluctuations, NCDR shows a decline from about 7/100,000 to around 4/100,000. The prevalence rate (PR) kept on fluctuating from 0.7 to 0.4 / 10000 population. Deeper analyses of the NLEP data especially the multi-bacillary cases in terms of socioeconomic and environmental factors might be productive in detecting possible areas for more intensive control programs including education and surveys of children and women. Further research on the secondary data will help clarify possible gaps in the programs and more intensive follow-up of high MB cases.

Keywords: NLEP Delhi, Secondary District Data, Spatiotemporal Changes, Leprosy

Introduction

Changes over time and geographic variations provide critical clues in disease control programs especially for communicable diseases (Sharma & Tilak 2021, Duarte-Cunha et al 2015). Much before the advent of multi-drug treatment (MDT) many countries endemic for leprosy have been showing significant declines in prevalence and incidence with better quality and standards of life (Sundar Rao 2010). Within countries such as India, significant associations with geographical areas have helped to make control programmes more focused and efficient (Shetty 2010, Sharma & Singh 2022). Positive declines over time served as encouragement to better and more efficient control and eradication program in leprosy (Queiroz et al 2010). Leprosy caused by *Mycobacterium leprae*, has a very long and distinguished history with high endemicity in some countries such as in India and Brazil (Sundar Rao 2010, WHO 2012). The endemicity of leprosy has been uneven and then conquest of the disease quite varied among the states of India (Grantz et al 2018). Spatiotemporal analyses have helped to pinpoint areas where more intensive and effective control strategies can be implemented (Wu et al 2021). In an analysis of the geographical distribution of cases of leprosy,

[1] KS Baghotia, MD, DNB, MBA, PhD; Hony. Secretary HKNS; Addl. Director PH-III, Delhi and Head (Academics & Research), Indira Gandhi Hospital, Dwarka, New Delhi, India

[2] PSS Rao, MPH, DrPH (Biostatistics), Adjunct Professor, MLCU Shillong; formerly, Research Consultant TLM India; LEPRA India; Director SLRTC, Karigiri; Prof. and Head, Dept. of Biostatistics, Christian Medical College Vellore, Tamilnadu, India

Corresponding Author: Dr K S Baghotia, **Email:** baghotia@gmail.com

in Rio de Janeiro, during 2001-2012, Gracie et al (2017) reported meaningful correlations to prompt future actions. Chen et al (2019) described interesting spatial-temporal dynamics of leprosy in Wuhan, China, over 60 years from 1950–2017. Similar and smaller studies (Aceng et al 2019) - spatial distribution and temporal trends of leprosy in Uganda, 2012–2016, Africa, and Fischer et al (2008) in Bangladesh for 15 years reported significant associations based on retrospective of public health surveillance data.

While MDT has made outstanding impact on prevalence of leprosy, the incidence rates continue unabated especially in some geographically areas and the goal of zero leprosy appears still a dream (Katoch 2024). Further in-depth research is obviously urgently needed to identify possible gaps and challenges in control programs (Baghotia 2022, Rodrigues & Lockwood 2011**).**

The National Leprosy Control Programme (NLCP) was launched by the Govt. of India in 1954-55. Multi Drug Therapy (MDT) came into wide use from 1982, and the National Leprosy Eradication Programme (NLEP) was introduced in 1983 (Govt of India, Ministry of HFW, NLEP). The strategy of NLEP was based on controlling the disease through reduction in the quantum of infection in the population and reduction in infective source, thus breaking the chain of disease transmission. During the past four decades many significant changes were made such as integration of

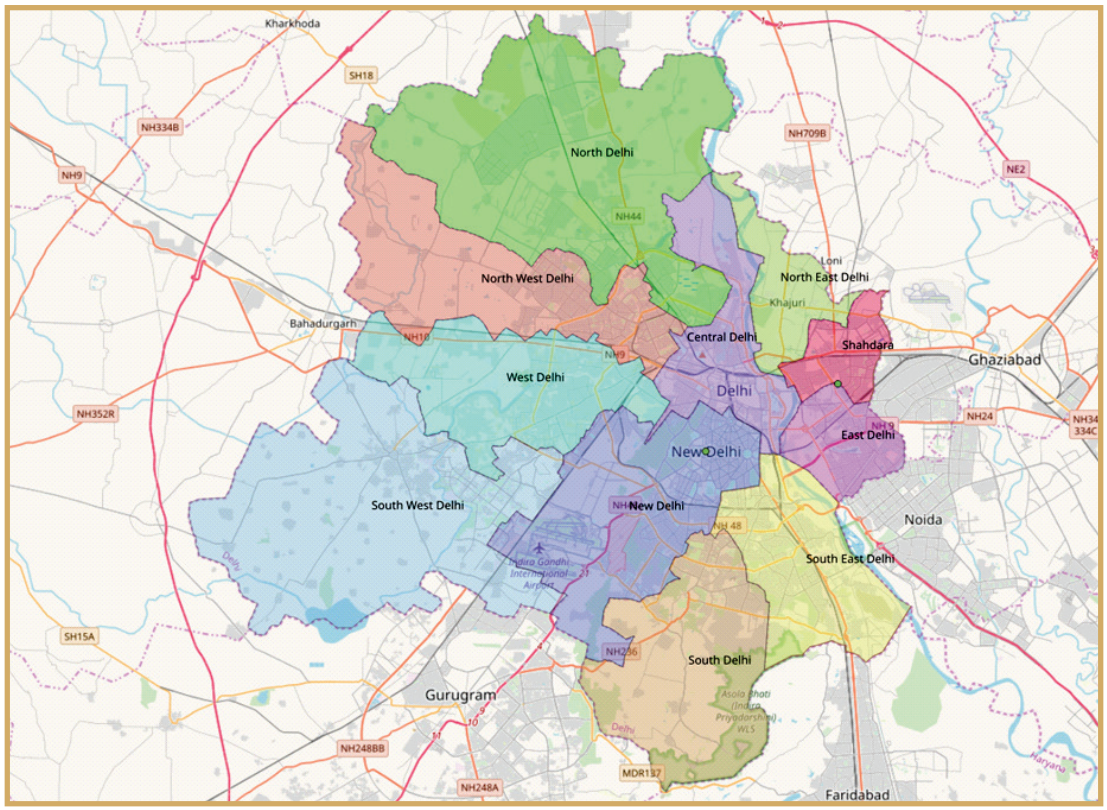

Fig. 1: Geographic map of National Capital Territory (NCT) of Delhi.

leprosy care into general health services as part of National Health Mission, involvement of auxiliary nurse midwives (ANM), Accredited Social Health Activist (ASHA) and village level women health workers, free issue of MDT, etc. to attract all suspected cases of leprosy to avail of the treatment. In December 2005, India declared that the disease was "eliminated" implying that the all-India prevalence was less than 1 per 10,000 population (Govt. of India 2005). It was hoped that soon India will attain "eradication" of leprosy, namely zero incidence (Desikan 2012, WHO 2021). However, even after two decades, there is no significant drop in the incident cases, amounting to 100- 150,000 new cases each year. Recent publication using Delphi technique among experts highlighted several gaps and challenges for the NLEP to overcome if eradication is to become a reality (Baghotia & Rao 2021). Meanwhile the support of all concerned public and private health personnel are urgently needed to increase awareness and motivate early reporting of suspected cases.

The monthly progress reports of the NLEP are excellent sources of studying the spatial temporal changes. In the present study, these secondary data were used to analyses the changes over the 11 districts of NCT and secular changes over the past few years. Highlights of these analyses are presented in this paper and discussed to improve future strategies of NLEP. The findings are part of the doctoral thesis of the first author approved by the Ethics Committee of the Martin Luther Christian University, Shillong, Meghalaya, India (Baghotia 2022).

Material and Methods

Populations in capital cities can be highly dynamic due to high migrations of rural to urban population bringing with it the inevitable burdens of illiteracy, poverty and disease. Geographic boundaries keep spreading taxing

Table 1: District-wise data of new cases for the period 2012-2020 according to type, age and gender.

District of Delhi	Population 2012-2020	New Cases detected 2012-2020	Among New cases					
			Multi Bacillary		Children		Females	
	Mean	Total No.	No.	%	No.	%	No.	%
East	1628435.9	486	346	71.2	18	3.7	109	22.4
Shahdara	1236228.3	1815	1560	86.0	126	6.9	401	22.1
Northeast	1537277.4	403	323	80.1	28	6.9	107	26.6
North	1566303.5	472	290	61.4	23	4.9	130	27.5
Northwest	2504291	1339	1035	77.3	74	5.5	377	28.2
West	2822325.5	714	594	83.2	40	5.6	181	25.4
Southwest	1519278.4	653	463	70.9	28	4.3	187	28.6
South	1375052.3	886	581	65.6	53	6.0	278	31.4
Southeast	1672661.9	369	261	70.7	18	4.9	82	22.2
New Delhi	1185424.8	111	74	66.7	3	2.7	24	21.6
Central	1630004	317	235	74.1	19	6.0	112	35.3
Total for NCT	18677283	7565	5762	76.2	430	5.7	1988	26.3

the Administration to the limit. The National Capital Territory (NCT) of Delhi is no exception. Much can be learned in a careful analysis of the statistics of leprosy collected by NLEP, analysed and disseminated widely. Currently, there were eleven administrative districts in NCT of Delhi with an estimated population of 20,262,493. (Vide Map, Fig. 1)

As per Government directives, Delhi submits monthly progress reports (MPR) in the uniform pro-forma designed by national leprosy eradication Programme, Data reported during last eight years (April 2012 to March 2020-NLEP 2020) were analyzed by year and district wise and the following summary statistics are presented: New Case Detection Rate, Prevalence rate, Proportion of Multi-bacillary leprosy, Females, Children and Disability Rates. The paper summarizes the secondary data of NLEP and identifies possible future actions.

Results

District-wise data on Multi-bacillary (MB) leprosy cases, Children and Females, both numbers and percentages based on total new cases detected are given in Table 1.

In general, the proportions of MB cases were found to be relatively high ranging from a low of 61.4% (290 out of 472) in North Delhi to a high of 86.0% (1560 out of 1815) in Shahdara. There are variations in the proportions of children and females also with no statistically significant correlation with the MB rates.

District-wise grades of disability, NCDR (New Case Detection Rate) and PR (Prevalence Rate) are presented in Table 2.

Table 2: WHO grades of disability, NCDR and PR in new cases analysed district-wise.

District of Delhi	Population	New Cases detected	Among New Cases				New Case Detection Rate (NCDR)		Prevalence Rate (PR)	
	2012-2020	2012-2020	Grade 1 Disability		Grade 2 Disability					
	Mean	Total No.	No.	%	No.	%	Mean	SD	Mean	SD
East	1628435.9	486	45	9.3	41	8.4	3.8	1.2	0.3	0.2
Shahdara	1236228.3	1815	276	15.2	277	15.3	18.4	2.1	1.6	0.4
Northeast	1537277.4	403	45	11.2	55	13.6	3.4	2.2	0.4	0.3
North	1566303.5	472	44	9.3	39	8.3	3.9	3.0	0.2	0.2
Northwest	2504291.0	1339	125	9.3	144	10.8	6.7	1.4	0.7	0.2
West	2822325.5	714	67	9.4	92	12.9	3.2	1.5	0.3	0.3
Southwest	1519278.4	653	65	10.0	87	13.3	5.4	1.8	0.6	0.3
South	1375052.3	886	77	8.7	120	13.5	8.2	3.6	1.0	0.6
Southeast	1672661.9	369	15	4.1	35	9.5	2.8	1.1	0.2	0.2
New Delhi	1185424.8	111	8	7.2	9	8.1	1.2	0.6	0.1	0.1
Central	1630004.0	317	25	7.9	24	7.6	2.4	0.6	0.2	0.1
Total in NCT	18677283	7565	792	10.5	923	12.2	5.1	1.3	0.5	

Table 3: Year wise analysis of new cases according to type, age and gender.

Years	Population	Cases on record as on First April	New Cases detected (cumulative from 1st April)	Among New cases (cumulative from 1st April)					
		Total	Total	MB		Children		Females	
				No.	%	No.	%	No.	%
2012-13	17445631	1165	1252	876	70.0	85	6.8	297	23.7
2013-14	17784077	1262	1145	829	72.4	69	6.0	261	22.8
2014-15	18129088	1138	1112	803	72.2	76	6.8	269	24.2
2015-16	18480792	943	911	674	74.0	54	5.9	279	30.6
2016-17	18839320	790	835	656	78.6	38	4.6	239	28.6
2017-18	19204803	683	725	574	79.2	42	5.8	225	31.0
2018-19	19577376	656	800	672	84.0	37	4.6	211	26.4
2019-20	19957177	755	785	678	86.4	29	3.7	207	26.4

Table 4: Year wise new case analysis by grade of disability, NCDR and PR.

Years	Population	Cases on record as on First April	New Cases detected (cumulative from 1st April)	Among New cases (cumulative from 1st April)				Rates	
		Total	Total	G1D		G2D		NCDR per 100,000	PR per 10,000
					%	No	%		
2012-13	17445631	1165	1252	112	8.9	127	10.1	7.18	0.7
2013-14	17784077	1262	1145	125	10.9	150	13.1	6.44	0.7
2014-15	18129088	1138	1112	101	9.1	170	15.3	6.13	0.6
2015-16	18480792	943	911	109	12.0	108	11.9	4.93	0.5
2016-17	18839320	790	835	82	9.8	101	12.1	4.43	0.4
2017-18	19204803	683	725	102	14.1	97	13.4	3.78	0.4
2018-19	19577376	656	800	65	8.1	87	10.9	4.09	0.3
2019-20	19957177	755	785	96	12.2	83	10.6	3.93	0.4

Proportions of grade 1 disabilities were found to vary from a low of 4.1% in Southeast to 15.2% in Shahdara, while proportions of grade 2 disability varied from 7.6% in Central to a high of 15.3% in

Shahdara.

While the mean NCDR is lowest in New Delhi, 1.2 (SD 0.6), the highest is again in Shahdara, 18.4 (SD 2.1). The Prevalence rates also show wide fluctuations, reflecting the same picture as NCDR, with a low of 0.1 (SD 0.1) in New Delhi and the highest of 1.6 (SD 0.4) in Shahdara.

The year wise analysis by MB%, Female% and Child% from 2012 to 2020 combining all districts are presented in Table 3.

Proportions of MB cases seem to have increased from 70% to 86%, with a mean (SD) of 77.1 (5.9) %. No trends are seen for females with a mean (SD) of 26.7 (3.1) %. The child rates have shown a decrease from 6.8 to 3.7%, with a mean (SD) of 5.5 (1.1).

The analysis of secular trends of grades of disability, NCDR (New Case Detection Rate) and PR (Prevalence Rate) are presented in Table 4.

Both grade 1 and 2 disability rates show yearly fluctuations with mean (SD) for grade 1 disability of 10.6 (SD 2.0) %, and for grade 2 disability a mean (SD) of 12.2 (1.7) %, overall, over 20% of both. The NCDR shows a decline from about 7/10,000 to around 4/10000. The PR keeps fluctuating from 0.7 to 0.4.

Discussion

The NLEP has provided an excellent data base from all leprosy centres in India through the monthly summaries, which have been used in the present paper for NCT Delhi**.**

From a population of nearly 19 million people living in 11 districts of NCT of Delhi, over 7500 new cases of leprosy have reported over an eight-year period from 2012 to 2020. Their main features are presented in Tables 1 and 2 district-wise and in Tables 3 and 4 by year. Nearly 80% of new cases are multi-bacillary which is at variance with what is seen in population-based studies (Katoch et al 2017). Likewise, the proportions of children and women in the new cases are very low reflecting the health seeking habits of the population despite integrating leprosy services with general health services (Samraj et al 2012). Hospital based statistics usually include delayed or complicated cases and will be different from sample survey data as seen for example from the data of using practicing dermatologists (Rao et al 2020).

Although, spatial distribution did not reveal significant associations with ranking of districts by socioeconomic status, there are some variations which need further in-depth analyses, since even within a relatively high development area, there would be large segments of low-income groups of domestic workers, migrants and other labourers. It is also possible that persons of a higher social class prefer to seek the private practitioner and not attend the government primary health centres.

The NCT of Delhi covers a massive geographical area with a population of 19 million but contiguous where considerable intra- and inter-district migrations are possible. Further, while the inhabitants of each district represent different socioeconomic layers of society, each district will still have clusters and subgroups of population consisting of domestic workers, maintenance and small labouring classes, who are lower socioeconomic status, live in slum-like residences with poor hygienic standards and also having high migration rates, thus the spatiotemporal patterns are not clear-cut. The data base does not -provide details of socioeconomic status or type of housing or migratory details, which are necessary to refine the statistics to properly represent the main population group in each district.

Although the lack of spatial associations is a disappointment, the data reveal a very high case load of multi-bacillary cases, many of whom have already developed physical disabilities and hence would have been harbouring leprosy

shedding infectious agents and affecting all the household and other contacts. This aspect of not only personal but social implications of delayed reporting poses a great challenge to NLEP to address these issues. Simionato de Assis et al (2018) after a careful study in Latin America concluded that social factors are strongly related with leprosy risk and temporal trends (Pandey & Rathod 2010).

While the 11 contiguous districts cover a large area and generally distinguished by specific layers of society, each district harbours colonies of domestic and other labourers living in slum-like areas. It is possible that these areas incubate and spread *M. leprae* by virtue of the poor standards of living. The deeper analyses of the NLEP data especially the multi-bacillary cases in terms of socioeconomic and environmental factors might be productive in detecting possible areas for more intensive control programs including education and surveys of children and women.

A Delphi study among the panel of leprosy experts identified grave challenges and wide gaps in the current working of the NLEP and no lack of collaboration with private practitioners or general public (Baghotia & Rao 2021). The NCT of Delhi is a highly prestigious and compact area, where NLEP should attempt better coordination with medical institutions, dermatologists and other private practitioners to obtain a more realistic profile of new cases of leprosy. Further studies indicated the urgent need for training and better monitoring of the leprosy grass-root workers (Baghotia & Rao 2021).

The time trends in Tables 3 and 4 seem more promising with slight declines in the incidence, prevalence and some of the leprosy variables. Although the linear correlations are not statistically significant, a more critical in-depth analyses by time and specific districts would be very revealing and helpful to refining future strategies (Meima et al 2004, Scollard et al 2006). The large number of MB cases would require focussed educational interventions to encourage and motivate them to bring in all contacts and specially the suspicious cases of women and children. Such follow-ups have been recommended but not successful; thereby losing a great opportunity to detect early cases and prompt treatment. Thus, although the original objective of detecting spatiotemporal association has not been fully achieved, the data are invaluable in providing critical leads for further analyses and fruitful action. The study proves that even secondary data provides useful research ideas that need to be pursued diligently so that India inches closer to achieving the three zero goals of eradicating leprosy.

Spatiotemporal analyses, although useful, need proper study designs and specific detailed analyses as seen from the diverse results of many investigators, poverty alone could not be considered a predominant factor (Lockwood 2004). Explaining the variations on lack of correlations) unlike several other chronic communicable diseases, leprosy is unique in terms of the high social stigma it produces making access to health care complex and often difficult (Raju et al 2008). Much of the hospital-based data would suffer from the help-seeking habits in the presence of prevailing social stigma. Nevertheless, the NLEP must take the credit for enabling a massive data base which if studied further will surely yield great insights to conquer the disease.

Conclusion

Spatiotemporal analyses of overall prevalence of leprosy and certain characteristics such proportions of MB cases, children, females, grade 1 and Grade 2 disabilities show considerable inter-district variations even for a contiguous population of over 18 million population. While spatial analysis did not reveal any specific associations, the time trends show a promising

decline. Each district must be harbouring significant subgroups of populations consisting of domestic servants, variety of labourers and working classes with high rates of migratory habits, who need to be separated for further refined analyses. Such details are not available in the data base, and needs to be collected at least on a sample basis. NLEP is collecting a very big data base on a national basis and further research on this secondary data will help clarify possible gaps in the programs and provide clues for more intensive and effective follow-up of high MB cases as well as their contacts, which is ultimate aim of spatiotemporal analyses.

Acknowledgement

We are greatly indebted to Dr. V M Katoch, former Director-General ICMR and ex-Secretary Department of Health Research, Govt. of India for helpful advice and guidance in these researches.

References

1. Aceng FL, Kawuma HJ, Majwala R et al (2019). Spatial distribution and temporal trends of leprosy in Uganda, 2012–2016: A retrospective analysis of public health surveillance data. *BMC Infect Dis*. **19(1):** 1016.
2. Baghotia KS, Rao PSS (2021). Delphi Study on Eliminating Leprosy in India. *Indian J Lepr*. **93**: 281-289.
3. Baghotia KS (2022). Challenges and gaps in the implementation of NLEP, PhD Thesis, Martin Luther Christian University, Shillong, Meghalaya, India.
4. Chen L, Chen J, ManQing L et al (2019). Spatial-temporal dynamics of leprosy in Wuhan, China, 1950-2017. *Lepr Rev.* **90(1**): 46-56.
5. Desikan KV (2012). Elimination of leprosy & possibility of eradication–the Indian scenario. *Indian J Med Res.* **135(1):** 3-5.
6. Duarte-Cunha M, Marcelo da Cunha G, Souza-Santos R (2015). Geographical heterogeneity in the analysis of factors associated with leprosy in an endemic area of Brazil: Are we eliminating the disease? *BMC Infect Dis.* **15**: 1-8.
7. Fischer E, Pahan D, Chowdhury S et al (2008). The spatial distribution of leprosy cases during 15 years of a leprosy control program in Bangladesh: An observational study. *BMC Infect Dis*. **8**: 125.
8. Government of India, Ministry of Health and Family Welfare, Special Report 2005.
9. National Leprosy Eradication Programme (NLEP) (2020), Government of India, Director-General of Health Services, New Delhi.
10. Gracie R, Peixoto JND, Soares FBDR et al (2017). Analysis of the geographical distribution of cases of leprosy. Rio de Janeiro, 2001-2012. *Ciên Saúde Colet*. **22(5)**: 1695-1704.
11. Grantz KH, Chabaari W, Samuel RK et al (2018). Spatial distribution of leprosy in India: an ecological study. *Infect Dis Poverty*. **7(1):** 20
12. Katoch K, Aggarwal A, Yadav VS et al (2017). National sample survey to assess the new case disease burden of leprosy in India. *Indian J Med Res*. **146(5):** 585-605.
13. Katoch VM (2024). Eradication of leprosy from India: Reflections on past, present & future. *Indian J Med Res*. **159(1**): 1-5.
14. Lockwood DN (2004). Commentary: leprosy and poverty. *Int J Epidemiol*. **33(2**): 269-270.
15. Meima A, Smith WCS, van Oortmarssen GJ et al (2004). The future incidence of leprosy: a scenario analysis. *Bull World Health Organ*. **82(5)**: 373-380.
16. Pandey A, Rathod H (2010). Integration of leprosy in general health system vis-a-vis leprosy endemicity, health situation and socioeconomic development: observations from Chhattisgarh & Kerala. *Lepr Rev.* **81(2):** 121-128.
17. Queiroz JW, Dias GH, Nobre ML et al (2010). Geographic information systems and applied spatial statistics are efficient tools to study Hansen's disease (leprosy) and to determine areas of greater risk of disease. *Am J Trop Med Hyg*. **82(2):** 306-314.
18. Rao PN, Rathod S, Suneetha S et al (2020). The DermLep Study I: results of prospective nation-wide survey of the number & profile of leprosy patients seen by dermatologists in India. *Indian Dermatol Online J*. **11(5):** 701-711.

19. Rodrigues LC, Lockwood DN (2011). Leprosy now: epidemiology, progress, challenges, and research gaps. *Lancet Infect Dis:* **11(6):** 464-470.
20. Raju MS, Rao PSS, Mutatkar RK (2008). A study on community-based approaches to reduce leprosy stigma in India. *Indian J Lepr*. **80(3**): 267-273.
21. Samraj A, Kaki S, Rao PSS (2012). 1 Help-seeking habits of untreated leprosy patients reporting to a referral hospital in Uttar Pradesh, India. *Indian J Lepr*. **84(2):** 123-129.
22. Scollard DM, Adams LB, Gillis TP et al (2006). The continuing challenges of leprosy. *Clin Microbiol Rev*. **19(2):** 338-381.
23. Sharma M, Singh P (2022). Epidemiological scenario of leprosy in marginalized communities of India: Focus on scheduled tribes. *Indian J Med Res*. **156(2**): 218-227.
24. Sharma PK, Tilak R (2021). Outbreak prone communicable diseases of public health importance in the northern districts of West Bengal–Current status & the way forward. *Indian J Med Res.***153(3):** 358-366.
25. Shetty VP (2010). Challenges facing the control of leprosy in the Indian context. *Ann Acad Med Singap*. **39(1)**: 1-3.
26. Simionato de Assis I, Arcoverde MAM, Ramos ACV et al (2018). Social determinants, their relationship with leprosy risk and temporal trends in a tri-border region in Latin America. *PLoS Negl Trop Dis*. **12(4):** e0006407.
27. Sundar Rao PSS (2010). Leprosy scenario: Beyond 2010. In: IAL Textbook of Leprosy, (Kumar B, Kar HK, eds), 1st ed, Jaypee Brothers Medical Publishers (P) Ltd, New Delhi and London, pp605-612.
28. World Health Organization (2012). WHO Expert Committee on leprosy: eighth report. World Health Organization.
29. World Health Organization. (2021). Towards zero leprosy: global Leprosy (Hansen's disease) Strategy 2021–2030. World Health Organization.
30. Wu L, Shen Y, Yao Q et al (2021). Temporal-spatial distribution characteristics of leprosy: A new challenge for leprosy prevention and control in Zhejiang, China. *PLoS Negl Trop Dis.* **15(1):** e0008956.

How to cite this article : Baghotia KS, Rao PSS (2025). Spatiotemporal Changes of Leprosy in the 11 Districts of National Capital Territory of Delhi, India. *Indian J Lepr.* **97**: 153-161.