



Original Research Article

CLINICO-EPIDEMIOLOGICAL PROFILE OF NEW LEPROSY CASES DETECTED DURING 2020-2024 IN A DISTRICT OF WESTERN MAHARASHTRA: A CROSS-SECTIONAL STUDY

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ABSTRACT

Background: Leprosy continues to persist in endemic pockets of India despite national elimination. Active case-finding strategies such as the Leprosy Case Detection Campaign (LCDC) have been implemented to identify hidden cases. Evaluating the contribution of LCDC in comparison to routine National Leprosy Eradication Programme (NLEP) surveillance is essential for guiding elimination strategies. **Objectives:** To describe the socio-demographic and clinical profile of newly detected leprosy cases, compare cases detected through LCDC and routine NLEP surveillance and assess epidemiological indicators in a district of Western Maharashtra.

Materials and Methods: A cross-sectional study was conducted among all new leprosy cases registered between January 2020 and December 2024. Data was collected from district leprosy records and patient interviews using a structured case record form. Socio-demographic, clinical and programmatic variables were analysed using descriptive statistics.

Results: Out of 652 new leprosy cases 32.36% were detected through LCDC and 67.64% through routine NLEP surveillance. Most cases belonged to the 15-59 year age group, with male predominance (62.6%). Rural residents constituted 68.3% of cases; however, LCDC identified a higher proportion of urban cases. Multibacillary leprosy accounted for 66.4% of cases. Treatment completion rate was 91.6%, and post-exposure prophylaxis coverage among contacts was 94.0%.

Conclusion: LCDC significantly complements routine surveillance by identifying hidden cases, particularly in underserved populations. Sustained integration of active and passive surveillance is crucial for achieving district-level interruption of leprosy transmission.

Keywords: Leprosy, LCDC, NLEP, Active case detection.

INTRODUCTION

Leprosy is an ancient infectious disease that continues to be associated with stigma and social exclusion worldwide. The World Health Organization (WHO) classifies leprosy as a neglected tropical disease, emphasizing the persistent challenges in its control and treatment.^[1]

Although the global burden of leprosy has declined due to sustained control efforts, the disease remains a public health concern in specific regions. In 2019, a total of 202,256 leprosy cases were reported from 118 countries, with nearly 70% of the global burden contributed by the South-East Asia Region. India, along with Indonesia and Brazil, continues to report the highest number of cases, underscoring the need for continued vigilance and targeted public health strategies.^[1]

India's leprosy control efforts have evolved from endemicity to elimination; however, transmission persists in several pockets. India has adopted the National Strategic Plan (NSP) and Roadmap for Leprosy 2023-2027, with the goal of interrupting transmission by 2030. The NSP aims to achieve interruption of transmission at the district level, indicated by zero new child cases for at least five consecutive years, followed by elimination defined as zero new cases for three consecutive years.^[2]

Operationally, leprosy is classified into paucibacillary (PB) and multibacillary (MB) forms based on clinical features, slit-skin smear results, and treatment requirements. This simplified classification replaced complex histopathological systems to facilitate treatment decisions in programmatic settings.^[3]

Leprosy reactions, namely Type 1 (reversal reaction) and Type 2 (erythema nodosum leprosum), may occur during the disease course or treatment and are dependent on the host immune response. These reactions can result in acute nerve damage and contribute significantly to disability. Nerve involvement in leprosy affects sensory, motor, and autonomic functions, and is the principal cause of physical disability associated with the disease.^[4,5]

The physical consequences of leprosy, including deformities, neuropathic pain and disabilities, profoundly affect psychosocial well-being, leading to stigma, discrimination and reduced quality of life.^[6,7,8]

To identify hidden cases and strengthen early detection, LCDC was introduced by the Central Leprosy Division in high-endemic districts. Operational since 2016, LCDC involve intensive information, education and communication (IEC) activities, house-to-house screening by trained health workers, systematic supervision, and confirmation of suspected cases by medical officers. The entire population above two years of age is screened during the campaign using standardized case definitions, ensuring early diagnosis and prompt initiation of treatment.^[9]

Understanding the clinico-epidemiological profile of newly detected leprosy cases and comparing cases identified through LCDC and routine NLEP surveillance is essential to evaluate program performance, identify gaps in early detection, and guide locally relevant interventions. Therefore, the present study was undertaken to describe the socio-demographic, clinical and epidemiological characteristics of new leprosy cases detected over a five-year period in a district of Western Maharashtra and to assess the contribution of LCDC in the current post-elimination phase.

MATERIALS AND METHODS

Study Design and Setting

A cross-sectional observational study was conducted in a district of Western Maharashtra, India. The

district has a mixed rural-urban population and is administratively divided into multiple blocks and villages, with leprosy services delivered through an established network of subcentres, primary health centres, community health centres and district hospital under the NLEP.

Study Population and Period

The study included all newly detected leprosy cases registered under the District Leprosy Control Unit between 1 January 2020 and 31 December 2024. Cases were detected through two surveillance mechanisms: routine NLEP surveillance and the LCDC.

Data Collection

Data were collected after obtaining permission from the Assistant Director of Health Services (Leprosy) and approval from the Institutional Ethics Committee. Preliminary data was extracted from NLEP registers, patient treatment cards and district records. Additional information was collected through interviews after obtaining written informed consent. Interviews were conducted in the local language in a private setting to ensure participant comfort and confidentiality using a structured Case Record Form developed in accordance with NLEP guidelines. It included:

Socio-demographic variables: Age, sex, place of residence (rural/urban), education, occupation, family income, family size and socioeconomic status.

Clinical variables: Mode of detection, presenting signs and symptoms, duration of symptoms, number and site of skin lesions, sensory impairment, nerve involvement, deformity status and grading, disease classification as paucibacillary or multibacillary and lepra reactions.

Programmatic variables: Initiation and completion of multidrug therapy, treatment outcomes, contact tracing and post-exposure prophylaxis coverage among contacts.

Outcome Measures

Key epidemiological and programmatic indicators were assessed, including prevalence rate, annual new case detection rate (ANCDR), multibacillary case proportion, child case rate, female case rate, Grade-2 disability rate, treatment completion rate and post-exposure prophylaxis coverage.

Statistical Analysis

Data were checked for completeness and consistency before entry into a Microsoft Excel worksheet. Descriptive statistical analysis was performed using Microsoft Excel 2024. Categorical variables were summarized as frequencies and percentages, while trends over the five-year period were presented using tables and graphical representations.

Ethical Considerations

Ethical approval for the study was obtained from the Institutional Ethics Committee with reference no. GMCM/IEC/C/24/2024. Written informed consent was obtained from all participants prior to data collection. Participation was voluntary and confidentiality was maintained throughout the study.

The study was observational in nature and did not involve any intervention.

RESULTS

During the five-year study period from January 2020 to December 2024, a total of 652 new leprosy cases were registered under the District Leprosy Control Unit. Of these, 211 cases (32.36%) were detected through the LCDC, while 441 cases (67.64%) were identified through routine NLEP surveillance. No LCDC activity was conducted in 2020, and all cases detected during that year were through routine surveillance.

Socio-demographic Profile

The majority of cases belonged to the 15–59-year age group, representing the economically productive population. Males constituted 62.58% of cases, with a male-to-female ratio of approximately 1.67:1. Rural residents accounted for 68.25% of the total cases, whereas 31.75% were from urban areas. Routine NLEP surveillance detected a higher proportion of rural cases, while LCDC contributed relatively more to urban case detection. Educational attainment was generally low among the study population. More than one-third of cases were illiterate, and over 80% had education up to middle school or below. Most patients belonged to lower socioeconomic classes, and daily wage labourers formed the largest occupational group, followed by housewives and farmers. The socio-demographic characteristics of cases detected through LCDC and routine NLEP surveillance were broadly comparable. [Table-1].

Clinical Profile

Clinically, multibacillary leprosy predominated, accounting for 66.41% of all cases, while 33.59% were classified as paucibacillary. The proportion of

multibacillary cases was high across both detection methods. Most patients presented with skin lesions accompanied by sensory impairment, and a substantial proportion had nerve involvement at the time of diagnosis. [Table-2].

Disability Status

Grade-2 disability was notably uncommon during the study period. No cases with Grade-2 disability were detected in 2020, 2021, 2022 or 2024. In 2023, three cases (1.82%) were identified with Grade-2 disability, corresponding to 0.09 cases per 100,000 population. The consistently low disability rates across most years suggest early detection of the majority of new cases. [Table-3].

Programmatic and Treatment-related Outcomes

Treatment outcomes were favourable across both detection mechanisms. Release from treatment was achieved in 91.56% of cases. Migration, death and untraceable cases together accounted for less than 7% of the total. Post-exposure prophylaxis coverage among eligible contacts was high at 94.02%, with similar coverage observed for cases detected through LCDC and routine NLEP surveillance. Program records were found to be complete for all registered cases. [Table-2].

Trends in Epidemiological Indicators

Trend analysis showed fluctuations in key epidemiological indicators over the five-year period. The prevalence rate declined from 2020 to 2021, increased in 2022 following intensified detection activities, and subsequently decreased through 2024. A similar pattern was observed for the annual new case detection rate (ANCDR), which peaked in 2022 and declined thereafter. The child case rate increased in 2022 and fell in subsequent years, while the Grade-2 disability rate remained close to zero throughout the study period. [Table-3].

Table 1: Sociodemographic Characteristics of New Leprosy Cases Detected During 2020-24

Description	Categories	LCDC Cases (%)	Routine NLEP Cases (%)	Total Cases (%)
Age	≤ 14 Years	8 (3.79)	24 (5.44)	32 (4.91)
	15 - 29 Years	54 (25.59)	108 (24.49)	162 (24.85)
	30 - 44 Years	50 (23.70)	110 (24.94)	160 (24.54)
	45 - 59 Years	47 (22.27)	109 (24.72)	156 (23.93)
	≥ 60 Years	52 (24.64)	90 (20.41)	142 (21.78)
Sex	Male	135 (63.98)	273 (61.90)	408 (62.58)
	Female	76 (36.02)	168 (38.10)	244 (37.42)
Residence	Rural	133 (63.03)	312 (70.75)	445 (68.25)
	Urban	78 (36.97)	129 (29.25)	207 (31.75)
Education	Illiterate	73 (34.60)	144 (32.65)	217 (33.28)
	Primary	58 (27.49)	114 (25.85)	172 (26.38)
	Middle	47 (22.27)	96 (21.77)	143 (21.93)
	Secondary	25 (11.85)	66 (14.97)	91 (13.96)
	Higher Secondary	8 (3.79)	19 (4.31)	27 (4.14)
	Graduate	0 (0)	2 (0.45)	2 (0.31)
Occupation	Unemployed	17 (8.06)	39 (8.84)	56 (8.59)
	Self Employed	19 (9.00)	45 (10.20)	64 (9.82)
	Daily Wages	76 (36.02)	147 (33.33)	223 (34.20)
	Housewife	38 (18.01)	72 (16.33)	110 (16.87)
	Farmer	37 (17.54)	73 (16.55)	110 (16.87)
	Student	24 (11.37)	65 (14.74)	89 (13.65)
Socioeconomic Class	I - Upper	0 (0)	0 (0)	0 (0)
	II - Upper Middle	6 (2.84)	25 (5.67)	31 (4.75)
	III - Middle	29 (13.74)	74 (16.78)	103 (15.80)

	IV - Lower Middle	48 (22.75)	89 (20.18)	137 (21.01)
	V - Lower	128 (60.66)	253 (57.37)	381 (58.44)

Table 2: Clinical Characteristics of New Leprosy Cases Detected During 2020-24

Description	Categories	LCDC Cases (%)	Routine NLEP Cases (%)	Total Cases (%)
Clinical Classification	PB	76 (36.02)	143 (32.43)	219 (33.59)
	MB	135 (63.98)	298 (67.57)	433 (66.41)
Number of Patches	0	2 (0.95)	7 (1.59)	9 (1.38)
	1 - 5	74 (35.07)	135 (30.61)	209 (32.06)
	> 5	135 (63.98)	299 (67.80)	434 (66.56)
Nerve Involvement	No Involvement	51 (24.17)	175 (39.68)	226 (34.66)
	Single	123 (58.29)	198 (44.90)	321 (49.23)
	Multiple	37 (17.54)	68 (15.42)	105 (16.10)
Disability	Grade - 0	171 (81.04)	363 (82.31)	534 (81.90)
	Grade - 1	38 (18.01)	77 (17.46)	115 (17.64)
	Grade - 2	2 (0.95)	1 (0.23)	3 (0.46)
Lepra Reaction	No Reaction	168 (79.62)	336 (76.19)	504 (77.30)
	Type - 1	33 (15.64)	76 (17.23)	109 (16.72)
	Type - 2	10 (4.74)	29 (6.58)	39 (5.98)
Outcome	Released from Treatment	194 (91.94)	403 (91.38)	597 (91.56)
	Under Treatment	0 (0)	15 (3.40)	15 (2.30)
	Migrated	9 (4.27)	15 (3.40)	24 (3.68)
	Not Traceable	2 (0.95)	3 (0.68)	5 (0.77)
	Died	6 (2.84)	5 (1.13)	11 (1.69)
Post Exposure Prophylaxis Done	Yes	199 (94.31)	414 (93.88)	613 (94.02)
	No	12 (5.69)	27 (6.12)	39 (5.98)
Records	Complete	211 (100)	441 (100)	652 (100)
	Incomplete	0 (0)	0 (0)	0 (0)

Table 3: Epidemiological Indicators During 2020-24

Year	PR (Per 10,000)	ANCDR (Per Lakh)	MB Case Rate (%)	Child Case Rate (%)	Female Case Rate (%)	Grade 2 Disability Rate (Per Lakh)
2020	0.30	3.05	65.96	4.26	44.68	0.00
2021	0.25	2.53	75.64	3.85	35.90	0.00
2022	0.61	6.10	55.32	8.51	38.83	0.00
2023	0.52	5.20	67.27	3.03	33.94	0.09
2024	0.40	4.01	76.38	3.15	35.43	0.00

DISCUSSION

The present cross-sectional study was carried out on newly detected leprosy cases between 1st January 2020 and 31st December 2024. These cases were detected through two primary approaches; first one is routine NLEP in which 441 (67.64%) cases were detected and second one is LCDC in which 211 (32.36%) cases were detected. Suryawanshi and Lokhande⁹ reported that new leprosy cases detected in 2018, 2019 and 2020 were 32.24%, 33.38% and 34.38% respectively. This shows routine NLEP continues to be the dominant mode for case detection, but active campaigns (LCDC) play a substantial role, detecting nearly one-third of cases.

Socio-demographic Profile

The present study highlights the continued socio-demographic concentration of leprosy among economically and socially vulnerable populations, despite India having achieved elimination at the national level. The findings underscore persistent transmission dynamics and the complementary role of active case detection in the post-elimination phase. Leprosy affected individuals across all age groups, with a clear predominance among adults aged 15–59 years, who constituted more than 70% of newly

detected cases. This pattern is consistent with the long incubation period of the disease and increased cumulative exposure during economically productive years. Similar age distributions have been reported across several Indian studies from Maharashtra, Karnataka, Rajasthan and North India, confirming that leprosy continues to disproportionately affect the working-age population.^[10,12-15]

Paediatric cases constituted less than 5% of the total, comparable to recent national estimates and regional studies.^[14,16] The relatively low proportion of child cases suggests declining recent transmission, however, evidence from household contact studies indicates that paediatric leprosy remains strongly linked to exposure to multibacillary cases within families.^[17]

A noteworthy finding was the relatively higher proportion of elderly cases, particularly those detected through LCDC. This reflects the effectiveness of active case-finding in identifying neglected or late-diagnosed cases among older individuals, who often have limited healthcare-seeking behaviour and higher vulnerability to disability due to comorbidities.^[18]

Male predominance was observed, with a male-to-female ratio of 1.67:1, consistent with national and international literature.^[10,12-15] WHO data also report

a similar global pattern.^[11] While greater occupational exposure and mobility among men may partly explain this trend, sociocultural barriers, stigma and restricted healthcare access among women likely contribute to under-detection and delayed diagnosis.^[16]

Most cases were detected from rural areas, reflecting persistent rural endemicity of leprosy. This finding is consistent with studies from Western Maharashtra.^[9] However, LCDC identified a relatively higher proportion of urban cases compared to routine surveillance, highlighting its role in uncovering hidden transmission in urban and peri-urban settings. Low educational attainment was a prominent feature, with over 80% of cases being illiterate or educated only up to middle school. This aligns with multiple Indian and international studies demonstrating that low literacy is associated with poor disease awareness, delayed health-seeking, and increased disability.^[10,12]

Occupational distribution revealed that daily wage workers, farmers and housewives constituted the majority of cases, reflecting the strong association between leprosy and informal or unskilled employment. These findings are consistent with a study reporting higher disease burden among labourers and agricultural workers.¹⁰ International evidence similarly supports the association between manual labour and leprosy risk.^[19]

Socioeconomic status emerged as a major determinant, with nearly 80% of cases belonging to lower and lower-middle socioeconomic classes. This pattern mirrors findings from several Indian and international studies that consistently identify poverty as a key driver of leprosy.^[10,12,19]

Clinical Profile

The clinical profile observed in the present study reflects persistent challenges in achieving early diagnosis of leprosy despite strengthened surveillance mechanisms. A predominance of MB cases was noted, consisting nearly two-thirds of all newly detected cases. This pattern was consistent across both NLEP surveillance and LCDC, though NLEP detected a marginally higher proportion of MB cases. The predominance of MB disease indicates delayed diagnosis, prolonged infectivity, and continued community transmission. Similar findings have been widely reported across India, confirming that MB leprosy remains the dominant clinical form in the post-elimination era.^[10,12,15]

Nerve involvement patterns further support early detection through active strategies. Nearly half of the cases showed single-nerve involvement, particularly among LCDC detections, while a substantial proportion had no nerve involvement at diagnosis. These findings contrast sharply with tertiary care studies reporting high rates of multiple nerve involvement, reflecting referral bias toward complicated cases.^[15,20] In contrast, community-based studies report nerve involvement patterns similar to those observed in the present study, suggesting that LCDC and NLEP are effective in

detecting disease before extensive neural damage occurs.^[12,21]

The pattern of nerve involvement observed followed the classical neuropathic profile of leprosy, with ulnar, lateral popliteal and median nerves being most frequently affected. This distribution has been consistently reported across Indian studies and reflects the predilection of *Mycobacterium leprae* for superficially located nerves exposed to trauma and cooler temperatures.^[10,12,15,20]

Encouragingly, the majority of patients were detected without any disability and Grade 2 disability (G2D) was rare. The predominance of Grade 0 disability and very low G2D rates indicate effective early detection and timely initiation of treatment. Compared with studies reporting substantially higher disability rates due to diagnostic delays, these findings suggest strong programmatic performance in disability prevention.^[8,13,20]

Most newly detected cases did not exhibit lepra reactions, although Type 1 and Type 2 reactions were observed in nearly one-fourth of cases. The distribution of reactions aligns with known immunopathological associations, with higher reaction rates among multibacillary cases.^[9,10,15,20]

Programmatic performance was strong, with high treatment completion rates, minimal loss to follow-up and negligible differences between LCDC and NLEP outcomes, indicating effective treatment adherence and monitoring. Post-exposure prophylaxis (PEP) coverage among contacts exceeded 94%, reflecting robust contact tracing and preventive chemotherapy implementation.

Epidemiological Profile

The epidemiological profile of leprosy in the present study from 2020 to 2024 demonstrates fluctuating trends across key programmatic indicators, reflecting the combined effects of intensified case detection activities and disruptions caused by the COVID-19 pandemic.

The prevalence rate declined during 2020-2021, likely due to reduced surveillance and under-reporting during the pandemic, followed by a sharp rise in 2022 coinciding with intensified active case detection through LCDC. The subsequent gradual decline in 2023 and 2024 suggests successful detection and treatment of previously hidden cases rather than a true increase in transmission. Similar trends have been reported from other districts in Maharashtra and align with national data showing a long-term declining trend in prevalence.^[15,22,23]

A parallel pattern was observed for ANCDR, with a decline during pandemic-affected years, a marked increase in 2022 and a gradual reduction thereafter. This fluctuation highlights the strong influence of surveillance intensity and active case-finding on detection rates. Comparable findings from state and district-level analyses further support that targeted activities such as LCDC significantly enhance case detection, particularly following periods of program disruption.^[15,24]

MB leprosy remained the predominant clinical category throughout the study period, with consistently high MB proportions. Higher MB rates in certain years indicate delayed diagnosis and detection of advanced disease, whereas relatively lower proportions during intensified case detection suggest identification of earlier cases. The persistent predominance of MB leprosy, as reported in several Indian studies, underscores ongoing transmission and the need for strengthened early diagnosis.^[13,15,24]

The child case rate peaked during the year of intensified detection and declined thereafter, indicating improved identification of hidden paediatric cases followed by reduced recent transmission. Similar declining trends in child case rates have been reported suggesting progress toward interruption of transmission, although continued surveillance remains essential.^[23]

Female case rates remained consistently lower than male rates across the study period, reflecting persistent gender-related barriers to detection. Comparable female proportions reported at state and national levels suggest that sociocultural factors and differential healthcare access continue to influence case detection among women.^[13,15,22,24]

The Grade-2 disability rate remained very low throughout the study period, indicating effective early detection and timely initiation of treatment. Compared with much higher disability rates reported from tertiary care settings, the findings suggest that community-level surveillance in the study district is successfully preventing late presentation and visible deformities.^[13,15,22]

Strengths and Limitations

This study is strengthened by its use of complete, program-based data from NLEP and LCDC, encompassing all newly detected cases over a five-year period, thereby minimizing selection bias and enabling comprehensive clinico-epidemiological assessment. The inclusion of both active and routine surveillance allowed meaningful comparison of detection strategies, while high data completeness enhanced reliability of findings. However, the cross-sectional design limits causal inference and reliance on secondary program records may have resulted in under-reporting or misclassification, particularly during the COVID-19 pandemic. As the study was confined to a single district, generalizability to other settings is limited. Additionally, the absence of laboratory or molecular confirmation and the inability to assess behavioural, social and health-seeking factors restrict deeper exploration of transmission dynamics.

CONCLUSION

This study highlights that, despite elimination status, leprosy persists among socioeconomically vulnerable populations in Western Maharashtra, with a predominance of multibacillary disease indicating delayed diagnosis and ongoing transmission. The low

burden of Grade-2 disability, high treatment completion, extensive post-exposure prophylaxis coverage and complete documentation reflect effective surveillance, early detection and strong program implementation under both NLEP and LCDC activities. Fluctuations in epidemiological indicators during the study period largely reflect COVID-19-related service disruptions and subsequent intensified active case detection, underscoring the value of periodic campaigns in uncovering hidden cases. Sustained integration of routine surveillance with targeted active case-finding, early diagnosis and comprehensive contact management remains essential to consolidate gains and progress toward the national and global goals of zero leprosy and zero disability.

Declarations

Consent to Participate: Written informed consent obtained from all participants.

Consent to Publish: Participants informed about anonymised data use.

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