

# Trends and patterns of leprosy over a decade in a tertiary care hospital in Northern India: A retrospective analysis

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## Abstract

**Background:** Leprosy was declared to be eliminated from India in 2006, but recent reports point to an increase in newly detected cases despite the overall fall in prevalence.

**Aim:** This study aimed to analyze the patterns and trends of epidemiological and operational indicators of leprosy at a tertiary care center in northern India over a decade.

**Methods:** This is a 10-year retrospective study from 2005 to 2014 conducted at the urban leprosy centre (ULC) of the Department of Dermatology, Venereology, and Leprology, Government Medical College, Jammu (J and K), India. Data were obtained from the preformatted standard leprosy cards of the urban leprosy centre. Details of demographic data, clinical features, smear results and treatment received were collected from individual cards and analyzed to observe various epidemiological trends.

**Results:** A total of 743 cases were analyzed for the period 2005–2014, of which 8.6% were childhood cases, 52.5% patients were immigrants, and 56.4% were farmers and laborers. Lepromatous cases showed a significantly increasing trend when compared with tuberculoid cases ( $P < 0.05$ ). Smear positivity was seen in 29.6% of cases and showed an increasing trend ( $P < 0.05$ ). An important observation was the increase in multibacillary cases. World Health Organization (WHO) grade 2 disability also showed an increasing trend over the past decade pointing to delayed diagnosis.

**Limitation:** The study is limited by its retrospective design.

**Conclusion:** The increasing trend of lepromatous and multibacillary cases and cases with grade 2 disability is a poor sign as it indicates delays in diagnosis. Further, smear-positive cases contribute to continued transmission of disease in the community. Leprosy has been declared to be eliminated, but recent reports including the present study suggest a rise in newly detected cases and hence in disease burden.

**Key words:** Disability, epidemiology, lepromatous leprosy, leprosy, National Leprosy Eradication Programme, trends

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## Introduction

Leprosy is a chronic infectious disease affecting mainly the skin and peripheral nerves, with varied clinical presentations.<sup>1</sup> At present, the five countries that host more

than 80% of new leprosy cases are India, Brazil, Indonesia, Bangladesh, and Ethiopia.<sup>2</sup> With the introduction of World

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Health Organization (WHO)–recommended multidrug therapy (MDT), the prevalence rate came down from 57.66 per 10,000 population in 1982 to 0.95 at the national level by 31<sup>st</sup> December 2005 under the National Leprosy Eradication Programme (NLEP).<sup>3,4</sup> India officially announced the elimination of leprosy as a public health problem at the national level on 30<sup>th</sup> January 2006, an exceptional achievement for the country in the global health arena.<sup>4</sup> National-level elimination, however, does not imply that elimination has been achieved in all states, districts, blocks, or at other subdistrict levels.

In India, a total of 127,334 new leprosy cases were detected during 2015–2016 as against 125,785 cases during 2014–2015.<sup>5</sup> While we have not been able to achieve the set target of the WHO at state and district levels, leprosy is raising its head again, as reflected in various recent studies from different parts of the country. There have been reports of increases in smear-positive cases, childhood leprosy, lepromatous cases, and cases with grade 2 disability even in the post-elimination phase.<sup>6–9</sup> Therefore, despite national elimination of leprosy, a lot of ground has to be covered to further eliminate it from all the states and districts.

Jammu and Kashmir (J and K), a state in northern India, has a long history of leprosy dating back to the times of British and Maharaja rule. The first leprosy hospital, which is now a leprosy colony, was set up by the Christian Missionary Society in 1891.<sup>10,11</sup> NLEP was launched in the state in 1963 and multidrug therapy was introduced in 1987–1988 on the initiative of the state government. The state is categorized as low endemic for leprosy.<sup>12</sup> As per the NLEP figures for Jammu and Kashmir, the annual new case detection rate for the year 2015–2016 was 1.35, a steep 16.37% surge when compared with the rate (1.16) in 2014–2015.

Although the prevalence rate in the state of Jammu and Kashmir in the post-elimination era has remained well below 1/10,000, new cases continue to be reported, pointing to ongoing transmission.<sup>5</sup> Disease trend analysis over the years is important to understand the nature of ongoing transmission, the prevalence, and the risks for transmission. The distribution, demographics, magnitude, and evolution of the disease in the region have not been studied adequately previously. This study is aimed at studying the trends of leprosy in a tertiary care center in the state of Jammu and Kashmir over a decade.

## Methods

### Study area and population

Jammu is one of the distinct climatic regions of Jammu and Kashmir state, the northern-most extremity of India. It has an area of 26,239 sq. km with a population of 5.35 million (2011 Census) spread over 10 districts in the region. The Government Medical College and Hospital is the only tertiary health care centre catering to the region and is located

in the heart of Jammu city. This study was performed at the urban leprosy center (ULC) attached to the postgraduate Department of Dermatology, Venereology, and Leprology, Government Medical College, Jammu (J and K), India. The target population included all patients who were diagnosed with leprosy and started on multidrug therapy at the urban leprosy centre.

### Study design and data collection

This is a retrospective analysis of the data of 10 years (April 2005–March 2015) collected at the urban leprosy centre of the Department of Dermatology. Data were obtained from the preformatted standard leprosy cards of the urban leprosy centre. Demographic data, details of clinical features, peripheral and cranial nerve involvement, clinical diagnosis, smear results, treatment received, disability, deformity and status of treatment completion were collected from individual cards by Dr. Sabha Mushtaq at the ULC and analyzed to observe various epidemiological trends. Patients with incomplete cards were excluded from the analysis. For cranial nerve involvement, no specialized laboratory or electrophysiological tests were conducted. As a routine, fifth (trigeminal) and seventh (facial) cranial nerves were tested clinically for sensory and motor functions and other nerves were tested only if the patient reported any symptoms. The new Indian Association of Leprologists (IAL) classification was used to classify the disease, and cases were classified as multibacillary or paucibacillary according to WHO criteria.

### Data management and statistical analysis

The data were entered and managed in MS Excel 2007 and were later exported to SPSS version 20 for further statistical calculations. The qualitative and nominal variables were measured in percentages and proportions, and  $\chi^2$  test was applied to find statistical significance. Confidence interval of means was calculated by the SPSS, whereas those of proportions were calculated by modified Wald method (Agresti–Coull method) which is considered more accurate.<sup>13</sup> Quantitative variables were expressed as mean  $\pm$  standard deviations, and analysis of variance (ANOVA) was applied. ANOVA was followed by *post hoc* Tukey's honest significance difference (HSD) test for analysis of significance between different years, independently.  $P < 0.05$  was considered statistically significant.

### Ethics

Ethical clearance to conduct the study was obtained from the institutional ethics committee.

## Results

A total of 768 patients took treatment for leprosy from 2005 to 2014. The records had incomplete data for 25 (3.26%) patients, who were removed from further statistical analyses. The mean age of patients at presentation was  $36.43 \pm 14.92$  (range 5–90) years, and a majority (77.4%) were males. The paediatric age group ( $\leq 18$  years) and

females contributed to 8.6% (64/743) and 22.6% (168/743) respectively to the total leprosy load. A majority of the patients were laborers (287, 38.6%) and farmers (132, 17.8%). A sizable proportion (390, 52.5%) of the patients were immigrants from Chhattisgarh (16.6%), Bihar (11.6%), Uttar Pradesh (9.8%), and other states/country (14.5%). The mean duration of disease was  $16.38 \pm 25.58$  (median, 8) months at presentation. The descriptive characteristics of the study population are shown in Table 1.

Multibacillary (MB) leprosy was the most common form of leprosy, encountered in 627 (84.4%). Borderline tuberculoid leprosy (BT) (255, 34.3%) was the most common morphologic type, followed by borderline lepromatous (190, 25.6%), mid-borderline (104, 14.0%), lepromatous (82, 11.0%), pure neuritic (53, 7.1%), histoid (27, 3.6%), tuberculoid (15, 2%), and indeterminate leprosy (11, 1.5%) [Figure 1]. Six (0.8%) patients had no mention of the type of leprosy in the cards. Leprosy reactions were observed in 14.2% (106/743) of patients at presentation – type 1 in 67 (9%) and type 2 in 39 (5.2%).

Family history of multidrug therapy taken was present in 18 (2.4%), the majority (11/18, 61%) of whom were migrants. The multibacillary or paucibacillary status of

such contacts could not be established as this data was not available in the records. Smear results were positive in 220 (29.6%) patients.

Clinically thickened peripheral nerves were found in 675 (90.8%) patients, with a majority (550, 74%) having multiple nerve enlargement. The ulnar nerve was the most commonly thickened nerve, found in 540 (72.7%) followed by the common peroneal nerve in 471 (63.4%), radial cutaneous nerve in 374 (50.3%), and posterior tibial nerve in 231 (31.1%) [Table 1]. Cranial nerve involvement was seen in 17 (2.28%) patients, including facial (16, 94%), trigeminal (1, 5.9%), and olfactory (1, 5.9%) nerve involvement.

At the time of presentation, grade 1 disability was present in 201 (27.1%) and grade 2 disability in 149 (20.1%) patients. Ulnar claw hand (57, 7.7%) was the most common paralytic deformity followed by complete claw hand (27, 3.6%), foot drop (13, 1.7%), claw foot (2, 0.3%), and wrist drop (1, 0.1%). Shortening of digits was found in 89 (12%) patients, while 2 (0.3%) had autoamputation of digits. Eye involvement in the form of madarosis, conjunctivitis, lagophthalmos, pterygium, and cataract was observed in 55 (7.4%) patients.

A total of 39.3% (292/743) patients were found to have defaulted from treatment.

**Table 1: Descriptive statistics of the study population (n=743)**

Variable	No. of patients, n	Mean±SD/percentage	95% CI
Age group (years)	743	36.43±14.92	35.35-37.50
0-14	22	3.0	1.94-4.47
15-29	255	34.3	30.99-37.81
30-44	241	32.4	29.17-35.89
45-59	147	19.8	17.08-22.81
≥60	78	10.5	8.48-12.92
Occupation	743		
Laborers	287	38.6	35.19-42.18
Farmers	132	17.8	15.18-20.68
Armed forces	48	6.5	4.89-8.48
Service/business	92	12.4	10.20-14.95
Students	38	5.1	3.73-6.96
Homemakers	108	14.5	12.18-17.26
Others	38	5.1	3.73-6.96
Nerves involved	725		
Supraorbital	40	5.4	3.96-7.26
Supratrochlear	2	0.3	0.07-0.98
Infraorbital	13	1.7	0.99-3.00
Greater auricular	205	27.6	24.50-30.92
Supraclavicular	12	1.6	0.89-2.83
Ulnar	540	72.7	69.36-75.76
Radial cutaneous	374	50.3	46.75-53.92
Median	7	0.9	0.41-1.97
Lateral popliteal	471	63.4	59.87-66.78
Sural	7	0.9	0.41-1.97
Posterior tibial	231	31.1	27.86-34.51

SD: standard deviation; CI: confidence interval

#### Sociodemographic trends

The mean age of the patients was  $33.53 \pm 15.06$  years in 2005 compared to  $41.98 \pm 15.28$  years in 2014. Comparing the means of age across different years using ANOVA revealed an insignificant difference [ $F(1,9) = 1.59, P = 0.114$ ]. Furthermore, *post hoc* analysis using Tukey's HSD testing was found to be positive only between 2005 and 2014, their difference in means being 8.45 ( $P = 0.016$ ). Childhood leprosy ( $\leq 18$  years) cases showed no significant difference over the years [ $\chi^2(9, N = 743) = 12.87, P = 0.17$ ]. The average number of childhood leprosy cases detected during the study period was six per year.

A higher number of males were found to be suffering from leprosy. The percentage of females was found to be significantly more in the years after 2005, when compared with 2005, but the overall trend was nonsignificant [ $\chi^2(9, N = 743) = 12.609, P = 0.18$ ]. Over the years, most of the leprosy patients were laborers, and an analysis of trends from 2005 to 2014 did not reveal any statistically significant difference in this [ $\chi^2(54, N = 743) = 59.881, P = 0.27$ ].

Although migrants from other states made up a greater proportion of leprosy cases, trend analysis revealed that since 2010, the reported cases have been more in natives than migrants. Of the total leprosy cases, 47.5% (353/743) were natives and 47.5% (390/743) were migrants. However, a 5-yearly analysis reveals that the proportion of natives was



**Figure 1a:** Multiple nodular lesions and infiltration in lepromatous leprosy



**Figure 1b:** Dome-shaped shiny papules and nodules in histoid leprosy



**Figure 1c:** Hypopigmented macules in borderline tuberculoid leprosy



**Figure 1d:** Enlarged superficial peroneal nerve in pure neuritic leprosy

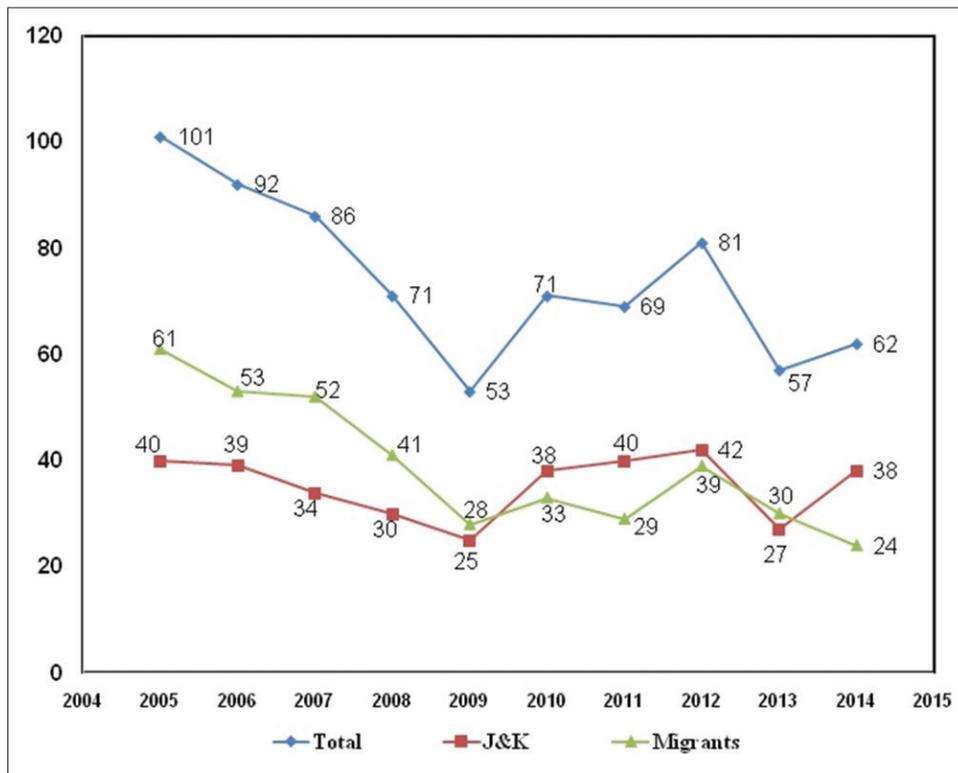
168 (47.6%) from 2005 to 2009 and 185 (52.4%) from 2010 to 2014 [Figure 2], the increase found significant on statistical analysis [ $\chi^2(1, N = 743) = 12.00, P = 0.001$ ].

A decreasing trend of leprosy cases was observed during 2005–2014, although this was not statistically significant. Whereas the mean case detection of leprosy based on voluntary reporting was  $84.60 \pm 22.37$  during the first 5 years (2005–2009), it reduced to  $69.00 \pm 8.34$  during the last 5 years (2010–2014). This decreasing 5-yearly trend also was statistically nonsignificant [ $t(8) = 1.341, P = 0.22$ ]. On a 3-yearly analysis, a significant decrease was noted between

2005–2007 and 2008–2010 [ $t(4) = 3.78, P = 0.02$ ], but no significance was seen with 2011 and 2013 [ $t(4) = 0.44, P = 0.68$ ].

**Clinical profile trends**

The clinical presentation of leprosy changed during the years included in analysis. Tuberculoid and borderline tuberculoid leprosy cases decreased from 51 (50.5%) in 2005 to 10 (16.13%) in 2014, whereas mid-borderline cases increased from 13 (12.8%) to 14 (22.6%) and cases in the lepromatous spectrum increased from 29 (28.7%) to 32 (51.6%) [Table 2]. The overall trend analysis was statistically significant [ $\chi^2(72, N = 743) = 113.817, P = 0.001$ ].



**Figure 2:** Trends in new leprosy cases detected during the study period (2005–2014): total, in migrants, and in the native population

**Table 2: Distribution of new leprosy cases registered during the 10-year period (2005-2014)**

Year	Type of leprosy, n (%)								Total, n (%)
	TT	BT	BB	BL	LL	Histoid	PN	IND	
2005-2006	1 (6.7)	50 (19.6)	13 (12.9)	17 (8.9)	10 (12.1)	2 (7.4)	5 (9.4)	3 (27.2)	101 (13.5)
2006-2007	8 (53.3)	36 (14.1)	10 (9.6)	13 (6.8)	7 (8.5)	3 (11.1)	9 (16.9)	3 (27.2)	89 (11.9)
2007-2008	3 (20)	33 (12.9)	12 (11.5)	19 (10)	7 (8.5)	2 (7.4)	9 (16.9)	0	85 (11.4)
2008-2009	2 (13.3)	24 (9.4)	7 (6.7)	21 (11)	4 (4.8)	3 (11.1)	8 (15)	1 (9)	70 (9.4)
2009-2010	1 (6.6)	11 (4.3)	8 (7.6)	19 (10)	7 (8.5)	2 (7.4)	4 (7.5)	1 (9)	53 (7.1)
2010-2011	0	22 (2.9)	12 (11.5)	21 (11)	4 (4.8)	6 (22.2)	5 (9.4)	1 (9)	70 (9.4)
2011-2012	0	23 (9.01)	8 (7.6)	18 (9.4)	13 (15.8)	3 (11.1)	3 (5.6)	0	69 (9.2)
2012-2013	0	25 (9.8)	11 (10.5)	26 (13.6)	13 (15.8)	4 (14.8)	1 (3.7)	1 (9)	81 (10.9)
2013-2014	0	21 (2.8)	9 (8.6)	15 (7.8)	7 (8.5)	1 (3.7)	4 (7.5)	0	57 (7.6)
2014-2015	0	10 (1.3)	14 (1.8)	21 (2.8)	10 (12.1)	1 (3.7)	5 (9.4)	1 (9)	62 (8.3)
Total, n (%)	15 (2)	255 (34.3)	104 (14)	190 (25.6)	82 (11)	27 (3.6)	53 (7.1)	11 (1.5)	737 (99.2)*

\*There was no mention of the type of leprosy in the cards of 6 (0.8%) patients. BT: borderline tuberculoid, TT: tuberculoid, BB: mid-borderline, BL: borderline lepromatous, LL: lepromatous leprosy, IND: indeterminate, PN: pure neuritic

The median duration of leprosy at presentation had increased in the later years, although no statistical significance was reported on ANOVA and *post hoc* Tukey’s HSD test for the mean duration of disease during these years [F (1, 9) = 0.755, P = 0.658].

The proportion of smear-positive cases significantly increased from 21 (20.79%) in 2005 to 34 (54.84%) in 2014 [Figure 3]. The proportion of multibacillary cases increased from 81/101 (80.20%) in 2005 to 58/62 (93.55%) in 2014. The proportion of defaulters however, decreased over the years and this change was statistically significant [ $\chi^2$  (9, N = 743) = 18.415, P = 0.031].

Multiple nerve involvement had increased over the years when compared with single nerve involvement and the trend was statistically significant [ $\chi^2$  (18, N = 743) = 32.493, P = 0.019].

Grade 2 disability had increased from 16.83% (2005) to 27.42% (2014), when compared with lower grades (<2), but the overall trend was not significant [ $\chi^2$  (9, N = 743) = 10.973, P = 0.278]. The proportion of deformities in patients with leprosy decreased over the years, but this trend too was not statistically significant [ $\chi^2$  (9, N = 743) = 6.144, P = 0.725].

**Discussion**

The total number of new cases of leprosy detected worldwide in the year 2016 was 214,783, of which the South-East Asian region accounted for 75% and India contributed more than 60% of the total.<sup>2</sup> Although global leprosy programs have made substantial progress in reducing disease burden, new case detection plateaued in the range of 215,000–245,000 worldwide between 2009 and 2013.<sup>14</sup>

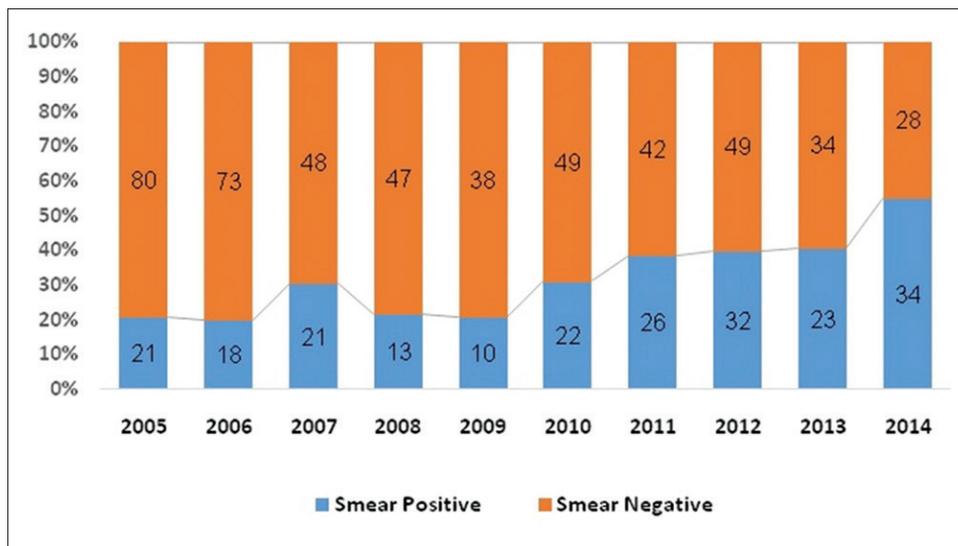
According to the NLEP report for 2015–2016, Jammu and Kashmir accounts for 1.06% of the national population

but constitutes only 0.26% of the country’s leprosy load. A total of 189 new cases were detected during 2015–2016 against 159 cases during 2014–2015, an increase of 21.4% in the prevalence rate. Multibacillary cases constituted 86.77%, female patients 14.81%, and childhood leprosy patients, 5.29%. The number of patients who reported with grades 1 and 2 disability were 3.17% and 5.29%, respectively. The major epidemiological indicators for leprosy from the present study are compared with the corresponding state and national NLEP figures for the year 2014–2015 in Table 3.

In spite of continued efforts, leprosy is a major public health problem in India, affecting many people every year with a high new case detection rate (9.71/100,000).<sup>5</sup> In this study, leprosy has shown a decreasing trend although not statistically significantly. Different studies in the last few years from India have uniformly reported similar observations on the pattern and trends in leprosy.<sup>6-9</sup>

In our study, a majority of the patients (66.7%) were in the second and third decades of life. The mean age of patients showed a uniform trend with no statistically significant difference over the years. About 8.6% (64/743) of the new cases were children (≤18 years) which is lower than the figure reported by Rao (11.43%) from south Indian state of Andhra Pradesh<sup>15</sup> but twice that reported by Dogra *et al.* (4.8%) from Punjab in north India.<sup>16</sup> This indicates continued transmission of leprosy in the community as well as inadequacy and inefficiency of the ongoing disease control programs. In this study, no significant difference in childhood cases was found over the years. However, the consistent proportion of paediatric patients over the years highlights the fact that leprosy continues to affect children and that the chain of transmission continues.

We found that the disease was commoner in males (M:F = 3.4:1) but with an increasing trend in females over



**Figure 3:** Bacteriological status of leprosy cases registered during 2005–2014. Smear-positive cases increased during the study period [ $\chi^2$  (9, n = 743) = 38.204, P = 0.001]

**Table 3: Comparison of leprosy indicators with state and NLEP figures for the year 2014-2015**

NLEP indicator	Percentage of new leprosy cases		
	Present study <sup>#</sup>	Jammu and Kashmir <sup>‡</sup>	National <sup>‡</sup>
MB	84.4	80.5	52.8
Grade 2 disability	20.1	1.3	4.6
Female cases	22.6	25.2	36.8
Childhood leprosy	8.6	1.3	9

<sup>#</sup>Proportion of new leprosy cases detected in 2005-2014, <sup>‡</sup>Data from NLEP annual report 2014-2015. NLEP: National Leprosy Eradication Programme, MB: multibacillary

**Table 4: Residential status of the study population (n=743)**

State/country	No. of cases, n (%)
Jammu and Kashmir	353 (47.51)
Chhattisgarh	123 (16.55)
Bihar	86 (31.53)
Uttar Pradesh	79 (20.25)
Madhya Pradesh	42 (10.76)
Jharkhand	12 (3.07)
Orissa	12 (3.07)
West Bengal	4 (1.02)
Andhra Pradesh	4 (1.02)
Punjab	3 (0.77)
Rajasthan	3 (0.77)
Haryana	2 (0.27)
Uttarakhand	2 (0.27)
Assam	2 (0.27)
Karnataka	2 (0.27)
Nepal	14 (1.9)
Total, n (%)	743 (100)

the years. Tiwary *et al.* have also observed continuous increasing proportion of female cases in the past.<sup>17</sup> The higher male: female ratio in our study could be due to increased opportunities for contact in males and the rising trend in females could be due to an increased healthcare-seeking attitude in them as well as changing social perceptions toward female healthcare. The gender distribution has social implications since women affected by leprosy face higher levels of stigmatization and social isolation than affected men.<sup>18</sup>

Although a majority of the cases in our study were laborers and farmers (56.4%), a significant proportion belonged to the armed forces and service/business class (18.9%). This is against the usual belief that leprosy affects the poor and downtrodden classes of society.

Borderline tuberculoid leprosy was the most common (34.3%) morphologic type encountered which is similar to the observations made by Rehlan *et al.*,<sup>6</sup> Chhabra *et al.*,<sup>7</sup> Nair *et al.*,<sup>8</sup> Sasidharanpillai *et al.*,<sup>9</sup> and Tiwary *et al.*<sup>17</sup> However, leprosy in the lepromatous part of its spectrum has shown an increasing trend when compared with the tuberculoid

spectrum over the past 10 years. A statistically significant shift toward the lepromatous spectrum was also observed in a recent study in Kerala.<sup>9</sup> This increase in lepromatous leprosy is a worrying sign as the relative risk of leprosy in household contacts of lepromatous patients is 8–10 fold as opposed to 2–4 fold in tuberculoid leprosy.<sup>19</sup>

The proportion of histoid leprosy was 3.6% in our study which is higher than that reported by Nair *et al.*<sup>8</sup> (2.48%) and Chhabra *et al.*<sup>7</sup> (0.5%). The continued occurrence of histoid leprosy even in areas of low endemicity is again a matter of concern as these cases have a high bacillary load and can potentially serve as a reservoir of infection to others.<sup>20</sup>

The increasing trend of lepromatous, multibacillary and smear-positive cases is a matter of grave concern. We observed a much higher proportion of multibacillary leprosy (84.4%) than paucibacillary cases (15.6%). Also, during the 10-year period studied, there was an increase in the number of patients who required multibacillary treatment. The rise in multibacillary cases is a common finding noted in many other recent studies from tertiary care hospitals.<sup>6,7,9</sup> This could be due to delayed diagnosis<sup>6</sup> which may be due to lack of access to services or low awareness in the population. A high proportion of multibacillary cases contributes to an increased grade 2 disability rate due to the high bacillary load.<sup>6</sup> Smear-positive cases also showed an increasing trend over the 10-year period which is consistent with the results of Nair *et al.*<sup>8</sup> and Sasidharanpillai *et al.*<sup>9</sup> A significant percentage of smear-positive cases among newly detected cases is a proxy determinant for leprosy transmission in the community.<sup>8</sup>

Multiple nerve involvement was observed in a majority (74%) of the cases though at a lower frequency than reported by Rehlan *et al.*<sup>6</sup> (81.1%) in 2016 and Chhabra *et al.*<sup>7</sup> (88.9%) in 2014 from tertiary care hospitals in Delhi. Over the years, a statistically significant increase was seen in patients with multiple nerve involvement as opposed to single nerve involvement.

Our study showed a higher incidence of WHO grade 2 disability at presentation (20.1%) than those reported by Rehlan *et al.*<sup>6</sup> (19.03%), Jindal *et al.*<sup>21</sup> (17.8%), and Shetty *et al.*<sup>22</sup> (12%), while the study by Chhabra *et al.*<sup>7</sup> showed a much higher incidence (37.9%). Grade 2 disability, in our study, showed an increasing trend over the years although not to a statistically significant extent. This may indicate a lack of awareness of early signs and symptoms of the disease leading to delays in seeking consultation and hence in diagnosis and treatment.

A significant decline was found in the proportion of defaulters over the years which may be credited to good communication between patients and health professionals, as motivated patients take the whole prescribed course of treatment

properly if they understand their disease and its treatment well.<sup>23</sup>

The overall burden of leprosy contributed by the migrants was more than that by the native population (52.5% vs 47.5%). However, the study period witnessed an increase in the proportion of native patients. The proportion of migrants in the study by Chhabra *et al.* was 54.3% which is comparable to that in our study.<sup>7</sup> However, Rehlan *et al.* reported a much higher proportion of migrants (89.5%) in their study.<sup>6</sup> In this era of urbanization and globalization, interstate migration is a well-recognized phenomenon in India. Most of the migrants to our state belong to the leprosy-endemic regions of Bihar, Chhattisgarh, Jharkhand, Uttar Pradesh, Orissa, and others [Table 4], who migrate to our state in search of employment. Migration has been suspected to increase the overall new leprosy cases and hence leprosy load in Surat district of Gujarat<sup>24</sup> and Gudiyatham Taluk of Tamil Nadu<sup>25</sup> in India. Migration has been hypothesized as a risk factor in continued leprosy incidence and is a hindrance to leprosy elimination and control efforts.<sup>26</sup> It is possible that the migration of smear-positive undetected leprosy cases from an area with high prevalence to areas with low prevalence for occupational prospects might facilitate the transmission of leprosy.<sup>8</sup> Thus, the role of migration in increasing the number of new cases cannot be ignored. But at the same time, to say that migrants broadcast leprosy infection to the natives would also be an oversimplification; this aspect needs to be further studied and analyzed before drawing any conclusions. Efficient screening and active surveillance strategies for migrants from endemic states and districts should be in place to identify these cases.

In the present study, the major epidemiological indicators i.e. grade 2 disability, lepromatous leprosy, multibacillary and smear-positive cases show an increase over the past decade. The results of our study and of many other studies published on the subject thus emphasize that we have not been able to keep the major program indicators of NLEP and WHO under control.<sup>6-9,27</sup>

### Conclusion

The results of this 10-year retrospective analysis of leprosy data from an otherwise nonendemic region revealed an increasing trend of cases with grade 2 disability, lepromatous, and multibacillary cases. All these collectively signal towards delays in diagnosis and treatment. The consistent reporting of paediatric cases and the increasing trend in smear-positive cases is an indicator of ongoing transmission of the disease in the community and this calls for a robust strategy for active case detection and contact examination. The considerable proportion of migrants in the overall leprosy load warrants further investigation. The present scenario calls for a more stringent, focused, and aggressive approach to take on this ancient scourge and make India a leprosy-free country.

### Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patients have given their consent for their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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### Conflicts of interest

There are no conflicts of interest.

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