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Original Article

Clinico-epidemiological Trends of Leprosy in 21st Century and During COVID-19 Pandemic

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Leprosy is the oldest disease affecting humankind since ancient times. Despite MDT's availability for disease curability, vast pockets of multi-bacillary (MB) cases persist in the community. We conducted this study to know the clinico-epidemiological trends of leprosy over four years and five months in this era of the COVID-19 pandemic (C19P). A total of 90 cases were registered; 59 (65.5%) were males, and 31 (34.5%) were females. The majority (69%) of cases were in the 15-45 age groups. Childhood leprosy was detected in 3(3.3%) cases. A history of contact with leprosy patients could be established in 16 (17.8%) cases. The cases comprised 54.5% local inhabitants and 45.5% were migrants. The MB cases 77 out of 90 (85.6%) were in higher proportion than pauci-bacillary (PB) cases. In the clinical spectrum, BL leprosy was most common in 39% of cases, followed by LL and BT leprosy. Thirty-seven (41%) patients were suffering from lepra reactions (LR), and out of them, 59.4% had type 2 reactions (T2R), and the rest had type 1 reactions (T1R). Disabilities were found in a total of 56 (62.2%) cases, and grade 2 disabilities (G2D) were recorded in 25 (44.6%) patients. Ulnar nerve (UN) was most commonly affected nerve in 64.4% of cases, followed by lateral peroneal (LPN) and posterior tibial nerve (PTN). We observed the impact of Covid 19 infection peak C19P in two ways; firstly, during the C19P peak in 2020, there was a drastic fall in total registered cases (TRC) to 4/year against 22/year in pre-C19P with a relative increase in LRs and disabilities. In post-C19P peak periods, not only was there a marked rise in TRC (20/5 months), but LR (50%) and disabilities (75%) also showed a significant rise. A high proportion of MB cases, LRs and disability rates indicate the need for population-based studies and subsequent public health measures for early diagnosis and treatment. Further large sample-sized, in-depth studies can tell the exact impact of C19P on leprosy.

Keywords : Leprosy**,** COVID-19 Pandemic, Lepra Reactions, Disabilities

Introduction

Leprosy is the oldest infectious disease caused by *Mycobacterium leprae.* A new species *Mycobacterium lepromatosis,* was isolated in 2008 in Mexican patients with diffuse lepromatous leprosy (Han et al 2012). Subsequ-

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ently, *M. lepromatosis* was implicated with other forms of MB leprosy, and dual or mixed infection by two was also reported (Deps & Collin 2021). Since the discovery of the causative pathogen, multiple goals have been achieved successfully in leprosy control. The landmark achievement was global leprosy elimination in 2000 and from India in 2005. Despite being eliminated, the global scenario of 2019 shows 202256 new leprosy cases, 14893 childhood cases and 10816 cases with G2D (WHO Global Leprosy Update, 2020). India constitutes 60% of the global burden and carries a current prevalence rate of 0.41, with 5.76% childhood cases and 2.41% G2D (NLEP 2021). Leprosy has not been a public health problem in Himachal Pradesh since 2000, but still, new cases are being reported from various centres in our state (Mahajan et al 2021, Tegta et al 2019).

COVID-19 has been the most severe public health problem of the 21st century. It has affected global health in terms of poor public access to the health system, suspension of essential health services, and delayed diagnosis and reporting of several neglected diseases like leprosy. Global 2020 leprosy data reveals a drastic fall in TRC to 129152, with a 37.1% reduction in new cases, a 2% reduction in G2D and a 0.6% reduction in childhood cases (WHO Global Leprosy Update, 2020). A population-based study on the impact of C19P on leprosy also reported a marked reduction in leprosy diagnosis and an increase in MB cases (Matos et al 2021). We conducted this study to see the clinico-epidemiology of leprosy in a tertiary care centre of a hilly state in Northern India and to observe the impact of the COVID-19 pandemic on leprosy in our setup.

Material and Methods

A total of 90 cases were registered over four years and five months (April 2017 to August 2021). Patients were diagnosed based on the presence of at least one of three cardinal signs (Eichelmann et al 2013) of leprosy.

Inclusion criteria

1. All newly detected cases of leprosy.
2. All defaulters and relapsed cases restarted on MDT

Exclusion criteria

We excluded the cases in whom

1. Deformities and disabilities were attributed to non-leprosy-related causes
2. Patients having incomplete records.

We recorded the details of the patient's demographic profile, occupation, clinical history and physical examination. The disease was classified according to the Ridley-Jopling (RJ) classification and the Indian Association of Leprologists (Ridley & Jopling 1966, IAL 1982). The patient's disability was categorized into Grades 0, 1 and 2 as per the WHO disability grading system (Brandsma & Brakel 2003). In investigations, slit skin smear (SSS) and histopathology details were recorded in most of the cases. Electro-myogram (EMG), nerve conduction studies and nerve biopsy details were noted only in patients with pure neural (PN) leprosy. These cases were classified into PB and MB types for treatment purposes per WHO Criteria (Gaschignard et al 2016).

Results

A total of 90 cases were registered during the study period. The majority, 62(69%) of patients, were in the age group of 15-45 years, followed by 18(20%) patients in 46-60 years (Figure 1). There were 56(62.2%) males and 31(34.5%) females, with a gender ratio of 1.9:1. Childhood leprosy was found in 3.3% of cases (Table 1). History of contact with leprosy patients was established in a total of 16(17.8%) cases, and out of them, 13(81.2%) cases had contact within the family,

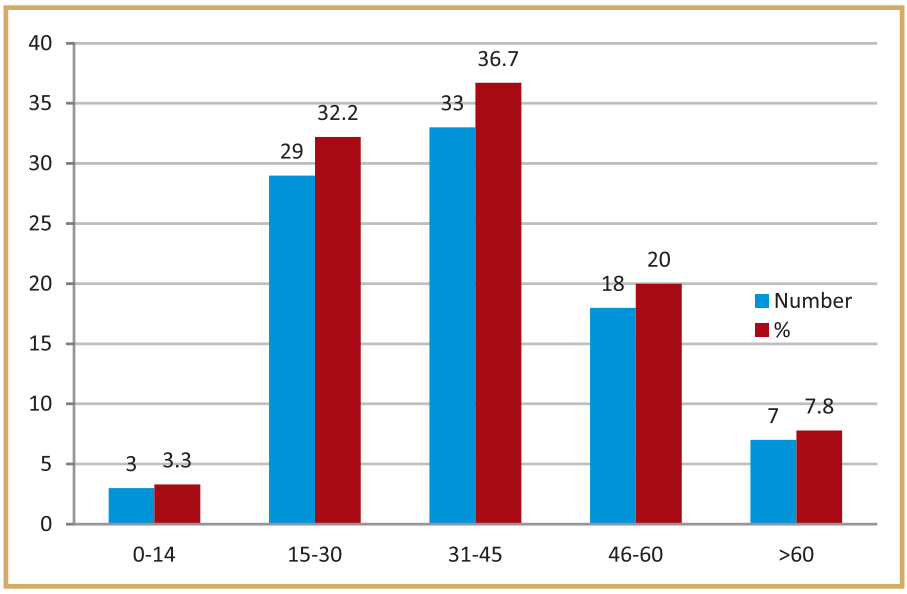

Figure 1 : Age wise distribution of Cases (Age groups in years)

Table 1 : Clinico-demographic characteristics of leprosy patients

Characteristics		Number	(%)
Gender			
	Males	56	62.2
	Females	31	34.5
	M:F	2:1	
Children	Males	3	3.3
Age Groups in Years			
	0-14	03	3.3
	15-30	29	32.2
	31-45	33	36.7
	46-60	18	20.0
	>60	07	07.8
Residents	Natives	49	54.4
	Migrants	41	45.5
Contact History	Family	13	14.4
	Co-workers	02	02.2
	Neighbourhood	01	01.1
	Total	16	17.8
Study Period	April 2017 to Aug 2021	90	

2(12.5%) in the neighbourhood and 1(6.3%) at workplace (Table 1).

We found 49(54.5%) local inhabitants belonging to Himachal Pradesh (HP), and the rest were migrants (Table 1). Among the local inhabitants, the majority of cases (26) belonged to the district Shimla (located in the Sub-Himalayan region of HP), in which our study centre is located, and others were from neighbouring districts (Figure 2). We did not find cases from the rest of the districts as adjacent medical colleges were draining their population. Amongst immigrants, the maximum number of patients (24) were from Nepal, and the rest were from adjoining Northern states like Uttar Pradesh 9(22%), Bihar 5(12.2%), Uttrakhand 2(4.95) and Jharkhand 1(2.4%). As per the disease spectrum, most cases had BL (39%) followed by LL (34.4%), as shown in Table 2. The MB cases (85.6%) were in higher proportion than PB cases (Table 2). Multiple peripheral nerves were thickened in almost all MB cases. The involvement of the UN was most common in 58(64.4%) cases, followed by LPN (59%) and PTN (51%). In our study facial nerve was the only cranial nerve involved in 2.2% of cases (Figure 3). LRs were recorded in a total of 37(41%) cases, and out of them, 22(59.5%) patients had T2R, and the rest were in (T1R). T1R were seen mainly in BT (66.7%) and BB (33.3%) spectrum, while T2R were observed predominantly in BL (40%) and LL (25.8%) spectrum (Table 2). LL is a stable polar disease, but one of our cases had T1R (Table 2), suggesting the need for sub-polar LL in RJ classification.

Disabilities were found in 56 (62.2%) cases; 25 (44.6%) cases had G2D. Hand and feet disabilities

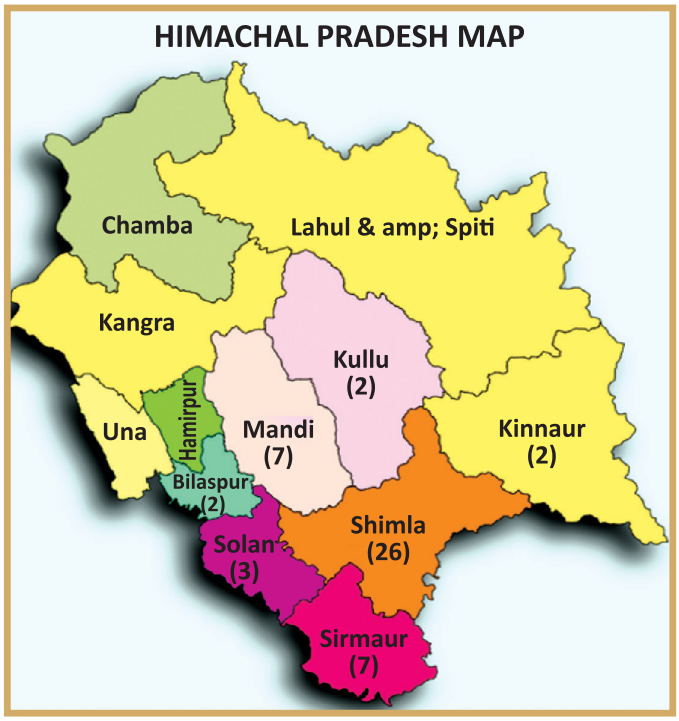

Figure 2 : District wise distribution of Cases (n)

Table 2 : Clinical features of leprosy patients

Clinical features			**Leprosy**	**Number of Patients (n)/ (%)**
Disease spectrum		**Total**	Spectrum	
	PB	13 (14.4%)	TT	04 (4.4%)
			BT	09 (10%)
	MB	77 (85.6%)	BB	06 (6.7%)
			BL	35 (39%)
			LL	31 (34.4%)
	Pure Neuritic		PN	05 (05.5%)
Reactions	**Types**	**Total**	**Spectrum**	**(n/%)**
Total 37(41%)	Type 1	22 (24.4%)	BL	13 (14.4%)
			BT	06 (6.6%)
			BB	01 (1.1%)
			LL	01 (1.1%)
			PN	01 (1.1)
	Type 2	15 (16.6%)	LL	08 (8.9%)
			BL	07 (7.8%)
Disabilities Sites	Hands	40 (44.4%)	Grade 1	21 (23.3%)
			Grade 2	19 (21.1%)
	Feet	41 (45.5%)	Grade 1	32 (35.5%)
			Grade 2	09 (10%)
	Eyes	07 (7.7%)	Grade 2	07 (7.7%)
Disabilities distribution natives vs. migrants	**Resident**	**Grade 1 (n/%)**	**Grade 2 (n/%)**	**Total (n/%)**
	Natives	16 (32.6%)	12 (24.5%)	28/49 (57.1%)
	Migrants	15 (36.6%)	13 (31.7%)	28/41 (68.3%)
	Total	31 (34.4%)	**25 (27.8%)**	**56/90 (62.2%)**

were encountered in 40 (71.4%) and 41(73.2%) cases, respectively, while eyes were affected in 7(12.5%) cases (Table 2). Out of 49 local inhabitants, 28 (57.1%) cases had disabilities and 12(24.5%) cases were in G2D. There were 41 immigrants, 28 (68.3%) of them had disabilities, and 13 (31.7%) were in G2D (Table 2, Figure 4). Disabilities were proportionately higher among immigrants, but this difference was not statistically significant (p-value -0.999). Further, the higher proportion of disabilities was not compounded by the age factor as per logistic

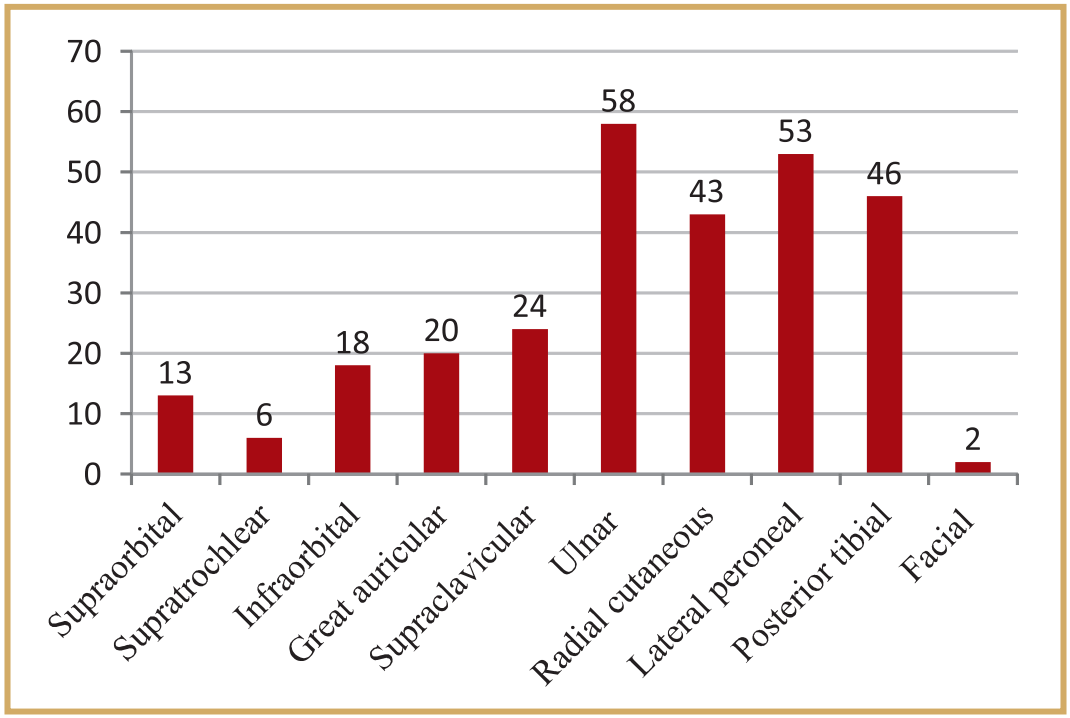

Figure 3 : Patterns of nerve involvement (n)

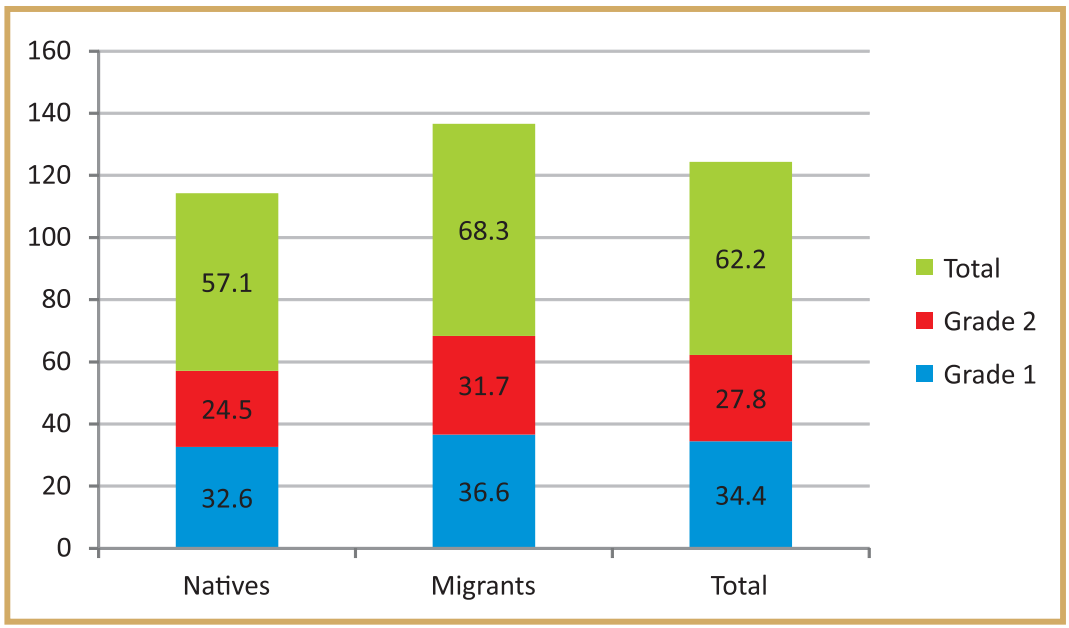

Figure 4 : Disabilities distribution amongst migrants and natives according to grades

Table 3 : Year wise distribution of total registered cases, lepra reactions and disabilities during study period with impact of COVID-19 Pandemic (n)

Year (April to March) with C19P relation*	PB	MB		Total	Reactions (out of total cases)	%	Disability (Out of total cases)	%
2017-18 (1Y) *	1	16	17	**22**	7	**8.3**	12	**13**
2018-19 (1Y) *	4	24	28	**(24.4%)**	10	**(37.7%)**	14	**(59%)**
2019-20 (1Y) *	6	15	21		8		13	
2020-21 (1Y) #	2	2	04	**(4.4%)**	2	**(50%)**	2	**(50%)**
2021 (April-August-5M) @	0	20	20	**(22.2%)**	10	**(50%)**	15	**(75%)**

regression. In our study, we found 5 (5.5%) relapsed cases and 3 (3.3%) defaulters, all in the MB spectrum. All relapsed patients were local inhabitants, while all defaulters were immigrant workers.

Impact of the COVID-19 pandemic

Data on total registered cases (TRC), LRs and disabilities during pre-pandemic, peak pandemic and post-peak pandemic years have been shown in Table 3 and Figure 5. The impact of C19P was observed mainly on TRC with the registry of 22 cases/year on an average in the pre-C19P period (2017-2020), 4 cases in 2020 during the C19P peak, and 20 cases recorded just over five months in the post-C19P peak times (April to Aug 2021). In pre- C19P out of TRC (22), 37% of cases had LR, and 59% had disabilities. During the C19P peak, 50% had LR and disabilities, while in the post-C19P peak, 50% had LR, and 75% had disabilities. So the impact of the COVID-19 pandemic was observed in two ways; firstly, during the COVID-19 pandemic peak (2020), there was a drastic fall in TRC with a relative increase in LR and disabilities. In the post, C19P peak periods, there was a marked rise in TRC and most cases presented with LRs and disabilities. (Table 3).

Discussion

Historically leprosy was declared an incurable disease during the 1st International Congress in Berlin. The discovery of *M. leprae* in 1873 as etiological agent of leprosy, then identification of effectiveness of chaulmoogra oil and later on of dapsone generated the hope that leprosy is treatable (Dogra et al 2013). Multi-Drug Therapy (MDT) came into wide use in 1982, and National Leprosy Eradication Programme was introduced in 1983. Subsequently, leprosy was eliminated from India in 2005, and the vertical programme was integrated with the general health care system (NLEP 2021). Now simple clinical signs and tools can diagnose leprosy, and readily available MDT can cure the disease. Despite this, leprosy has still not been eliminated in many countries, states and districts.

It is a well-known fact that leprosy is a disease of all ages and all genders. But the male gender and economically productive age group (20-40 years) are affected more than females and other age groups. We also found the same in corroboration with other studies (Gupta et al 2019, Arif et al 2019). Factors for middle age group affection and male preponderance are similar, like more outdoor

activities, disease awareness, and health-seeking behaviour. Further, gender differences can vary in studies as it also depends on culture. Most of our cases were local inhabitants of Shimla and other adjoining districts due to the close vicinity of our centre. The immigrant population mainly comprised residents from high-endemic regions. Similar trends have been reported in our state and other parts of the country (Rehlan et al 2016, Rathod & Mistry 2017, Mahajan et al 2021, Tegta et al 2019).

Detection of leprosy in children has ominous implications due to the disease spreading to other children in their schools. Moreover, childhood leprosy in the post-elimination era indicates continued transmission of infection in the community (Nair et al 2017). Recent (2020) childhood leprosy rate is 6.2% across the world (Global leprosy update 2020), 5.77% for our nation (NLEP, 2020-21 Annual report) and 5.1% - 11.43% in different studies (Nair 2017) but in our study, this rate was slightly lower (3.3%). This can be due to our people's treatment-seeking behaviour, especially of mothers, due to increased female literacy in our state (Tiwary et al 2011).

In our study, 85.6% of cases had MB leprosy. Arif et al (2009) and Tiwari et al (2011) also reported higher MB cases in their studies. Even globally, 27 countries reported a high proportion of MB cases and recently, WHO reported 67.3% cases of MB leprosy (Global Leprosy Update 2020). The high number of MB cases is not only a major source of infection; they are also susceptible to reactions and consequently deformities. The greater proportion of MB cases also indicates delayed diagnosis due to the inability to get health services, especially during C19P. Most of our patients were in BL and LL spectrum in contrast to other studies (Vashisht et al 2021, Tiwary et al 2011, (Mahajan et al 2003) as they found the majority of cases in BT spectrum followed by BL and LL. Our results are in corroboration the studies by Mahajan et al (2021) and Tegta et al (2019), showing the majority of cases in BL and LL spectrum. Increased LL and BL cases indicate late diagnosis due to delayed presentation because of hilly terrain. Also, in the last five months of our study, the delayed presentation might have been due to poor access to seek medical advice due to C19P.

Leprosy is a neurotropic disease affecting not only peripheral nerves but also cranial nerves. In our study, the facial nerve was the only cranial nerve involved in 2.2% of cases. Trauma and cold-exposed peripheral nerves are predominantly affected by leprosy. In our research, the UN was most commonly involved in 64.4% of cases, followed by CPN and PTN. Gupta et al (2019) also observed peripheral nerve thickening in 90% of cases, with UN involvement in 77.58 % being the commonest.

In our study, LRs were recorded in a total of 41% of cases, while Gupta et al (2019) found LRs in 34.9%, Chhabra et al (2015) in 37.4% and Relhan et al (2016) in 23.4%. Higher rates of LRs indicate more MB cases attributing to a higher bacterial load. Further, due to C19P, sicker patients in LRs sought medical care from tertiary centres compared to asymptomatic leprosy patients. Chhabra et al (2015) found more cases of T1R, and Jacob et al (2008) reported an equal no of cases with T1R and T2R, while we observed higher T2R in corroboration with the results of Gupta et al (2019). Predominance of T2R is attributed to a higher number of LL and BL cases in our study in accordance with Gupta et al (2019).

Deformities and disabilities in leprosy can make an individual handicapped. They directly lead to significant morbidity for the patient and indirectly

increase the financial burden on the family. G2D in new cases often indicates delayed diagnosis, often due to a lack of awareness and delay in seeking medical care. We found disability in 62.2% of cases falling between the documented disability rates of 10% to 80% in various studies (Reyila et al 2019). The wide disparity in disability is related to the type of studies. It is seen that hospital-based studies record higher disabilities than field studies because patients visit tertiary care centres, usually in an advanced stage of the disease. Further, dermatologists at tertiary centres can detect even lower grades of disability than general practitioners at the field level.

In our study, C19P resulted in minimal case detection during the peak and later on agglomeration of MB cases, lepra reactions and disabilities. A population-based study by Matos et al (2021) also reported a 44.4% reduction in the diagnosis of leprosy, a 2.32 % increase in MB cases, 6.14% rise in disabilities after comparing 2019 data with 2020. The patient presentation and even the reporting of leprosy cases were affected during C19P. Worldwide out of 221, only 127 countries reported leprosy data in 2020 compared with 160 in 2019. C19P does indirectly hamper the leprosy control programme.

Conclusions

Even after decades of leprosy elimination, a reasonable number of new leprosy cases are still being detected in our state. Many MB cases, G2D, and LRs suggest the need to strengthen active case detection and early diagnosis activities. The new childhood cases are markers of continued leprosy transmission in the community. As expected, a sudden fall in leprosy cases was observed during the C19P peak. In post C19P peak period, the overall disease burden was increased by piling up MB cases with the relative rise in reactions and deformities. More studies with a large sample size are recommended to know the exact impact of C19P on the leprosy programme.

Limitations

Limitations of our study are small sample size, retrospective assessment of records and single centre-based analysis.

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