Journal of Rural Medicine

Original article

Effect of COVID-19 lockdown on the pathway of care and treatment outcome among patients with tuberculosis in a rural part of northern India: a community-based study

Aravind Periyasamy Gandhi[1a], Soundappan Kathirvel[1a], and Tanveer Rehman[1]

[1]*Department of Community Medicine and School of Public Health, Postgraduate Institute of Medical Education and Research, India*

Abstract

Objectives: The coronavirus disease 2019 (COVID-19) pandemic affected routine healthcare services across all spectra, and tuberculosis (TB) care under the National Tuberculosis Elimination Program have been affected the most. However, evidence available at the community level is minimal. The clinical features, care cascade pathway, and treatment outcomes of TB patients pre- and during/post-COVID-19 pandemic lockdown in a rural community health block in northern India were assessed and compared.

Materials and Methods: This was a retrospective cohort study that included all patients diagnosed with TB and initiated treatment under programmatic settings between January 1 and June 30, 2020, in a rural TB unit in northern India. The periods from January 1 to March 23 and March 24 to June 30 were marked as pre-lockdown and during/post-lockdown, respectively.

Results: A total of 103 patients were diagnosed and treated for TB during the study period. A significantly higher proportion of pulmonary TB cases were reported during/post-lockdown (43, 82.7%) compared to that pre-lockdown (32, 62.7%), and a higher diagnostic delay was noted during/post-lockdown (35, 81.4%). Through adjusted analysis, patients diagnosed during/post-lockdown period (adjusted risk ratio [aRR], 0.85; 95% confidence interval [CI], 0.73–0.98) and previously treated (aRR, 0.77; 95% CI, 0.60–0.995) had significantly lower favorable treatment outcomes.

Conclusions: The symptom and disease (pulmonary/extrapulmonary) pattern have changed during/post-lockdown. The care cascade delays are still high among TB patients, irrespective of the lockdown status. Lockdown had a significant adverse impact on the outcomes of TB treatment.

Key words: tuberculosis, COVID-19, India, time-to-treatment, treatment outcome, pathway of care

(J Rural Med 2022; 17(2): 59–66)

Introduction

Owing to the coronavirus disease 2019 (COVID-19) pandemic, routine healthcare services have taken a hit to various extents, with a greater intensity among the low- and middle-income countries[1, 2]. The National Tuberculosis Elimination Program (NTEP) of India was not spared from this. Reports have indicated that COVID-19 adversely impacted tuberculosis (TB) diagnosis and management[3, 4]. Modelling studies from various countries have predicted an increase in the TB burden in the long run due to disruptions caused by the COVID-19 lockdown[5–7]. TB is one of the major causes of morbidity and mortality in India, a Southeast Asian country. The estimated incidence of TB in India is approximately 2.8 million, accounting for approximately a quarter of the world's TB cases[8].

Delayed presentation is a major problem contributing to the high burden and transmission of TB in developing countries. The delay may be due to patient delay if the patient visits a health facility for diagnosis after the onset of symptoms of >2 weeks or health system delay if the patient is not diagnosed and treated at the time of the first visit[9]. Analysis of

Received: July 21, 2021
Accepted: November 26, 2021
[a]These authors contributed equally.
Correspondence: Soundappan Kathirvel, Department of Community Medicine and School of Public Health, Postgraduate Institute of Medical Education and Research, Chandigarh 160012, India
E-mail: selvkathir@gmail.com

patients' health-seeking behavior managed by the national disease control programs can shed light on those who are not appropriately detected by the programs and provide detailed information on other healthcare providers' practices and their contribution to increasing the duration of infectivity in the community[10]. Studies have found that even with free provision of TB care, 21% of households face economic hardship over TB management[11].

India imposed a nationwide lockdown from March 24, 2020, to contain the COVID-19 pandemic. The adverse impact of the lockdown on the economic livelihood and the movement restrictions may have precipitated delays in the care cascade of TB patients. Their health-seeking behavior and out-of-pocket expenditure (OOPE) incurred may have also changed during the lockdown period. However, no studies could be found in the Indian program settings regarding the impact of the lockdown on the abovementioned domains of TB care. It is important to determine the effect of the COVID-19 pandemic on TB service delivery and the outcomes to identify the gaps, if any, to be worked upon to improve the services and reignite the elimination mission. With this background, the clinical features, care cascade delays, and treatment outcomes of TB patients before and during the COVID-19 pandemic lockdown in a rural block in northern India were assessed and compared.

Materials and Methods

Study design

A retrospective cohort study was conducted through record review and patient interviews.

Study setting

The study was conducted in one rural TB unit covering a total population of 200,000, that is, the coverage area of a community health center in northern India. TB diagnostic and treatment services are provided under the NTEP of India in designated microscopy centers and directly observed treatment short-course (DOTS), centers, respectively. NTEP is a federally sponsored scheme implemented with resource sharing between state governments and the Government of India[12]. TB diagnostic and treatment services are predominantly provided by the public health system (for free), and private providers are also involved to a certain extent. Of the 2,576 patients notified from the district (for the year 2019) where the study site is situated, 390 (15.1%) were notified by private health facilities[13]. Under the Nikshay Poshan Yojana (NPY) of NTEP, nutritional support is provided to TB patients in India. For example, patients with drug-sensitive TB receive cash assistance of ₹500/month for the complete duration of anti-TB treatment, that is, 6 months, which is transferred directly to the patient's bank account every month[14].

The countrywide lockdown for the prevention and control of the COVID-19 pandemic was initiated on March 24, 2020, and extended until the first week of June 2020. Some minor relaxations were given in the latter part of the lockdown. During the lockdown, except for essential health services such as antenatal, immunization, and emergency services, all routine healthcare services were stopped in public health facilities. However, TB diagnostic and treatment services were provided in a restricted manner due to the deployment of human resources and laboratories for COVID-19 response. Similarly, most private health facilities were providing limited services during the lockdown period.

Study population and period

All patients diagnosed with TB and registered for treatment with the public health system under NTEP from January 1 to June 30, 2020, in the selected TB unit were included. The study period was divided into "pre-lockdown" (January 1 to March 23, 2020) and "during/post-lockdown" (March 24 to June 30, 2020).

Study procedure

A list of patients diagnosed with TB and registered for treatment under NTEP was obtained from the study TB unit. A pretested, interviewer-administered, semi-structured questionnaire was used to assess the (a) sociodemographic and economic characteristics; (b) nutritional status (c) clinical and treatment-seeking characteristics such as symptom profile with the date of onset of each symptom, contact history, type of healthcare provider first contacted, site of TB, and drug resistance status; and (d) receipt of public health action measures such as enrolment with NPY and OOPE from onset of symptoms to the initiation of treatment among the study population. The resident doctors conducted the interviews who were involved neither in the diagnosis nor in the initiation of the treatment. All interviews were conducted at home or at the patient's place of convenience.

Operational definitions

History of unintended weight loss: >10% weight loss in 6 months or >5% loss in 1 month indicates severe weight loss[15].

Diagnostic delay: Diagnostic delay was assessed in patients with pulmonary tuberculosis (PTB), based on the date of symptom onset, date of eligibility for sputum examination (which is 14 days from the date of symptom onset in case of cough and fever and the same day in case of hemoptysis), and the actual date of diagnosis[16–18]. PTB patients were categorized as those with delayed diagnosis if the difference between the date of diagnosis and the date of eligibility was >1 day.

Treatment delay: Treatment delay was defined as the duration between the date of diagnosis and treatment initiation

among patients with PTB and extrapulmonary TB (EPTB). Patients with TB were categorized as those with delayed treatment if the difference between the date of treatment initiation and the date of diagnosis was >1 day.

Treatment outcome: Favorable treatment outcomes were marked in patients who were declared cured or completed the prescribed course of treatment under the NTEP. Unfavorable treatment outcomes were marked in patients with relapse, loss to follow-up, developed resistance, death, and continuing treatment due to persistent symptoms.

Ethics

Ethical clearance to conduct the study was obtained from the Institute Ethics Committee, Postgraduate Institute of Medical Education and Research, Chandigarh, India. Written informed consent was obtained from all patients.

Statistical analysis

Data were documented using Epicollect5[19]. The analysis was performed using SPSS (version 26.0, IBM Corp, Armonk, NY, USA). Quantitative data were tested for normality using the Shapiro–Wilk test. Median and interquartile range (IQR) were calculated, and the Mann–Whitney U test was applied to test the significant difference of the continuous variables pre- and during/post-lockdown. The difference in frequency (proportion) of diagnosis and treatment delay and type and pattern of TB was compared using the chi-square test. Factors with $P<0.2$ in the univariate analysis associated with favorable TB treatment outcomes were included in the adjusted analysis using a generalized linear model, and adjusted risk ratio (aRR) along with 95% confidence interval (CI) was calculated. P-values <0.05 were considered statistically significant.

Results

A total of 103 patients with TB were registered under the NTEP during the study period. Of them, 51 were diagnosed pre-lockdown, and 52 were diagnosed during/post-lockdown. The overall, pre-, and during/post-lockdown period median (IQR) ages of the patients were 38.0 (27.0, 56.0), 36.0 (24.0, 50.0), and 43.5 (30.5, 61.5) years, respectively. Similarly, 68 (66.0%), 30 (58.8%), and 38 (73.1%) were men during the overall, pre-, and during/post-lockdown periods, respectively. A statistically significant difference was not observed between various sociodemographic, economic, and nutritional characteristics across the lockdown period ($P>0.05$) (Table 1).

Fever was the most common symptom in both the pre-lockdown (32, 62.7%) and during/post-lockdown period groups (39, 75.0%) (Table 2). Weight loss was reported twice ($P=0.02$) during/post-lockdown (26, 50.0%) compared to that pre-lockdown (14, 27.5%). No significant change was observed in the number of healthcare visits before diagnosis. Although no difference was found in the proportion of new or previously treated patients across the lockdown period, a significantly ($P=0.03$) high proportion of pulmonary TB cases were reported during/post-lockdown (43, 82.7%) compared to that pre-lockdown (32, 62.7%). Similarly, NPY registration and the payment of dues on time significantly decreased during/post-lockdown ($P<0.05$) (Table 2).

Of the patients with pulmonary TB, a high proportion of patients had diagnostic delay during/post-lockdown (35, 81.4%) with a median (IQR) delay of 33.0 (15.8, 81.3) days compared to that pre-lockdown (Table 3). Non-suspicion by healthcare providers (19, 54.3%) and nonavailability of transport (12, 34.3%) were cited as the predominant reasons for the diagnostic delay during/post-lockdown.

A total of 21 (20.4%) patients had a pretreatment delay with a median (IQR) delay of 6 (2.5, 10.5) days, and no significant change was observed across the lockdown period (Table 4). The favorable treatment outcome was lower during/post-lockdown period (42, 80.8%) compared to that in the pre-lockdown period (47, 92.2%). However, it was not statistically different ($P=0.15$). Three patients with EPTB continued treatment for >6 months due to the persistence of clinical symptoms. After adjustment of various sociodemographic and clinical characteristics, patients diagnosed during or after the lockdown period (aRR, 0.85; 95% CI, 0.73–0.98) and previously treated (aRR, 0.77; 95% CI, 0.60–0.995) had significantly lower favorable treatment outcomes compared to that of their respective groups (Table 5).

Discussion

COVID-19 disrupts the delivery of healthcare services and disease management globally[2]. The short- and long-term impacts of such disruptions on disease management are being studied. This study reported the changes in the clinical presentation, care cascade, and treatment outcomes among patients with TB pre-and during/post-lockdown periods.

A change in the number of TB cases diagnosed during the lockdown period was not observed. However, previous studies have reported that case detection and smear-positive cases peak during the second quarter of the calendar year in northern India[20]. In this context, there must have been a higher number of cases during/post-lockdown, whereas no such rise was found. Hence, there may have been a fall in the case detection rate in our study area during the lockdown. This is in line with the reported notification rate of TB in India, which fell by 59–80% due to the lockdown[7, 21]. Compared to the previous year (2019) notification in the study area based on NIKSHAY data, a 31% reduction during/post-lockdown period was noted. Similarly, low TB case detection and notification during the COVID-19 pandemic has

Table 1 Sociodemographic, economic, and nutritional characteristics of the patients with tuberculosis diagnosed and initiated on treatment pre- and during/post-lockdown periods

Characteristics	Pre-lockdown n (%)	During/post-lockdown n (%)	Total n (%)	*P* value
Total	51	52	103	
Median (IQR) age in years	36.0 (24.0, 50.0)	43.5 (30.5, 61.5)	38.0 (27.0, 56.0)	0.15
Sex				
Male	30 (58.8)	38 (73.1)	68 (66.0)	0.13
Female	21 (41.2)	14 (26.9)	35 (34.0)	
Education				
Illiterate	14 (27.5)	9 (17.3)	23 (22.3)	0.16
Upto primary	11 (21.6)	8 (15.4)	19 (18.4)	
Primary to middle	8 (15.7)	10 (19.2)	18 (17.5)	
High to senior secondary	14 (27.5)	20 (38.5)	34 (33.0)	
Graduate & above	4 (7.9)	5 (9.6)	9 (8.8)	
BPL status[a]				
Yes	14 (27.5)	12 (23.1)	26 (25.2)	0.61
No	37 (72.5)	40 (76.9)	77 (74.8)	
Socio-economic status[b]				
I (≥₹ 7,533)	0 (0)	4 (7.7)	4 (3.9)	0.34
II (₹ 3,766–7,532)	5 (9.8)	6 (11.5)	11 (10.7)	
III (₹ 2,260–3,765)	8 (15.7)	6 (11.5)	14 (13.6)	
IV (₹ 1,130–2,259)	20 (39.2)	20 (38.5)	40 (38.8)	
V (₹ <1,130)	18 (35.3)	16 (30.8)	34 (33.0)	
Median (IQR) Weight (kg)	49.0 (40.0, 55.0)	50.0 (42.0, 55.0)	50.0 (42.0, 55.0)	0.75
BMI (kg/m^2) (n–102)[c]				
Underweight (<18.5)	29 (58.0)	36 (69.2)	65 (63.7)	0.68
Normal (18.5–22.9)	13 (26.0)	10 (19.2)	23 (22.5)	
Overweight (23.0–24.9)	6 (12.0)	4 (7.7)	10 (9.8)	
Obese (≥25.0)	2 (4.0)	2 (3.8)	4 (3.9)	

Pre-lockdown: Jan. 1–Mar. 23, 2020; During/post-lockdown: Mar. 24–Jun. 30, 2020; ₹: Indian Rupee; IQR: Interquartile range; BPL: Below poverty line; BMI: Body Mass Index; kg/m^2: Kilogram per metre^2; [a]Rural Poverty line- Rs. 1128 and Urban Poverty line- Rs. 1529; [b]BG Prasad Socio-economic classification; [c]BMI of one patient diagnosed during pre-lockdown is missing.

been reported in many countries[22–25]. Other than lockdown-related reasons, the reduction of TB cases could be true due to adherence to infection prevention and control (IPC) practices, such as the use of masks, no/decreased spitting in public places, physical distancing, and other measures at the individual level. However, further studies on the adherence to IPC measures within houses in India and its impact on reduced TB transmission individually and collectively are needed.

The higher proportion of weight loss as presenting complaints during/post-lockdown may have been due to the worsened nutritional status of the population, in general, owing to the lockdown[7]. Significantly higher pulmonary TB cases after the lockdown indicated that EPTB cases were relatively underreported. This may be due to the (a) nonspecific symptoms, (b) delayed treatment seeking due to the non-debilitating symptom pattern of EPTB and poor transport facility during the lockdown period, and (c) conversion of all district hospitals as dedicated COVID care centers where a majority of EPTB are routinely diagnosed. The significantly lower registration and higher pending dues after the lockdown under the NPY, which intends to provide nutrition support for TB patients, is a serious concern. As the families were already fighting the economic crunch due to the pandemic and lockdown, this delay in the release of NPY for TB patients would have added salt to the injury over and above the OOPE incurred for diagnosis[7].

Statistical models and expert consensus predicted a significant impact on TB services due to COVID-19, such as increased delay in diagnosis, treatment, and supply of drugs[6]. Although a significantly high proportion of diagnostic delay was observed, the median number of healthcare visits remained similar and did not impact the TB treatment outcome after adjusting for other factors in our study.

Table 2 Clinical characteristics and receipt of monetary support among patients with tuberculosis diagnosed and initiated on treatment before and after the lockdown periods

Characteristics	Pre-lockdown n (%)	During/post-lockdown n (%)	Total n (%)	*P* value
Symptom profile				
Cough	31 (60.8)	37 (71.2)	68 (66.0)	0.41
Fever	32 (62.7)	39 (75.0)	71 (68.9)	0.18
Weight loss	14 (27.5)	26 (50.0)	40 (38.8)	0.02
Hemoptysis	7 (13.7)	11 (21.2)	18 (17.5)	0.32
Others[a]	20 (39.2)	16 (30.8)	36 (35.0)	0.47
Contact history				
Yes	18 (35.3)	12 (23.1)	30 (29.1)	0.17
No	33 (64.7)	40 (76.9)	73 (70.9)	
First health-related contact				
Government doctor	24 (47.1)	20 (38.5)	44 (42.7)	0.71
Private doctor	20 (39.2)	22 (42.3)	42 (40.8)	
Rural health practitioner	6 (11.8)	7 (13.5)	13 (12.6)	
Others[b]	1 (2.0)	3 (5.8)	4 (3.9)	
Median (IQR) healthcare visits before diagnosis	3 (2, 5)	3 (2, 5)	3 (2, 5)	0.73
Total OOPE until diagnosis (Rs)	2,260.0 (450.0, 4,320.0)	2,350.0 (573.8, 5,445.0)	2,300.0 (550.0, 4,800.0)	0.92
OOPE per visit until diagnosis (Rs)	500.0 (168.3, 1,376.7)	583.8 (139.5, 1,302.5)	542.5 (150.0, 1,368.3)	0.93
Type of patient				
New TB	40 (78.4)	41 (78.8)	81 (78.6)	0.96
Previously treated	11 (21.6)	11 (21.2)	22 (21.4)	
Site of TB				
Pulmonary	32 (62.7)	43 (82.7)	75 (72.8)	0.02
Extrapulmonary[c]	19 (37.3)	9 (17.3)	28 (27.2)	
Treatment category				
Drug sensitive	51 (100)	50 (98.1)	102 (99.0)	1.0
INH resistant	0 (0.0)	1 (1.9)	1 (1.0)	
NPY registration				
Yes	49 (96.1)	42 (80.8)	91 (88.5)	0.07
No	1 (2.0)	5 (9.6)	6 (5.8)	
Don't know	1 (2.0)	5 (9.6)	6 (5.8)	
NPY dues (N=91)				
No dues	30 (61.2)	15 (35.7)	45 (49.5)	0.02
Dues pending	13 (26.5)	23 (54.8)	36 (39.6)	
Don't know	6 (12.2)	4 (9.5)	10 (11.0)	
Median (IQR) months of pending NPY instalments	3.0 (2.0, 3.8)	2.0 (1.0, 4.0)	3.0 (1.0, 4.0)	0.38

Pre-lockdown: Jan. 1–Mar. 23, 2020; During/post-lockdown: Mar. 24–Jun. 30, 2020; IQR: Interquartile range; OOPE: Out of pocket expenditure; INH-Isoniazid; NPY: Nikshay Poshan Yojana; [a]Abdominal pain (5), breathlessness (5), swelling in neck (5), chest pain (4), myalgia (3), joint pain (3), pain in neck (2), weakness (2), vomiting (1), back pain (1), leg pain (1), swelling over vaginal region (1), throat pain (1), kidney problem (1), loss of appetite (1). [b]Medical shop (4). [c]Lymph node (13), abdomen (4), pleural (8), The place of TB is either abdomen or pleural (1), bone (2).

The delay could be due to (a) overlap of TB and COVID-19 symptoms and the stigma they may face if they reveal the symptoms and are found positive for COVID-19[26], (b) the primary focus of identifying and testing all suspected COVID-19 by healthcare providers and deployment of most of the health system resources in the prevention and control of COVID-19, and (c) transport-related problems. Previous studies during the pre-COVID-19 era across India have also reported a significant proportion as well as the duration of delays in the diagnosis and treatment of TB[27–29].

The lockdown independently affected TB treatment outcomes, that is, patients diagnosed during/post-lockdown had a 2–27% lower proportion of favorable outcomes compared to that in the pre-lockdown period. The same can be further proved through multicentric studies across states to reshape the NTEP. Similar observations were made in Northern Italy, where significantly higher adverse outcomes were observed during the COVID-19 pandemic[4]. Further-

Table 3 Diagnosis-related care cascade among patients with pulmonary tuberculosis diagnosed and initiated on treatment before and after the lockdown periods

Characteristics	Pre-lockdown (n=32) n (%)	During/post-lockdown (n=43) n (%)	Total (n=75) n (%)	*P* value
Median (IQR) number of healthcare visits before diagnosis	3.0 (2.0, 4.0)	3.0 (2.0, 5.0)	3.0 (2.0, 4.0)	0.50
Presence of diagnostic delay				
Yes	18 (56.3)	35 (81.4)	53 (70.7)	0.02
No	14 (43.8)	8 (18.6)	22 (29.3)	
Median (IQR) days of diagnostic delay	26.0 (14.0, 53.0)	33.0 (15.8, 81.3)	29.0 (15.5, 73.0)	0.35
Reasons for diagnostic delay[a]				
Previous doctors did not suspect TB	8 (44.4)	19 (54.3)	27 (50.9)	
Did not take illness seriously	7 (38.9)	12 (34.3)	19 (35.8)	
Non-availability of transport	2 (10.6)	10 (28.6)	12 (22.6)	
Did not know where to go	1 (5.6)	4 (11.4)	5 (9.4)	
Due to lockdown	0 (0.0)	3 (8.6)	3 (5.7)	
Others[b]	5 (27.8)	3 (8.6)	8 (15.1)	

Pre-lockdown: Jan. 1–Mar. 23, 2020; During/post-lockdown: Mar. 24–Jun. 30, 2020; Diagnostic delay: Delay (in days) from date of eligibility for sputum examination to actual diagnosis; IQR: Interquartile range; [a]More than one option may be selected by each patient; [b]no attender was available to accompany (2), afraid that it will be corona (1), due to financial issues (1), death in the family (1), migrant worker (1), patient was feeling better in between (1), took medicine from local practitioner (1).

Table 4 Treatment-related care cascade among patients with tuberculosis diagnosed and initiated on treatment before and after the lockdown periods

Characteristics	Pre-lockdown (n=51) n (%)	During/post-lockdown (n=52) n (%)	Total (n=103) n (%)	*P* value
Presence of pre-treatment delay				
Yes	12 (23.5)	9 (17.3)	21 (20.4)	0.47
No	39 (76.5)	43 (82.7)	82 (79.6)	
Median (IQR) days of pre-treatment delay	6.5 (3.3, 12.5)	4.0 (2.0, 8.5)	6.0 (2.5, 10.5)	0.19
Reasons for pre-treatment delay[a]				
Patient could not be reached	5 (41.7)	3 (33.3)	8 (38.1)	
Non-availability of transport	4 (33.3)	4 (44.4)	7 (33.3)	
Patient was not aware of the place of treatment	3 (25.0)	3 (33.3)	6 (28.6)	
Others[b]	6 (50.0)	3 (33.3)	9 (42.9)	
Treatment outcomes				
Cured/Treatment completed	47 (92.2)	42 (80.8)	89 (86.4)	0.15
Failure	0 (0.0)	6 (11.5)	6 (5.8)	
Death	2 (3.9)	1 (1.9)	3 (2.9)	
Multidrug resistant TB	1 (2.0)	1 (1.9)	2 (1.9)	
Treatment continuing	1 (2.0)	2 (3.8)	3 (2.9)	

Pre-lockdown: Jan. 1–Mar. 23, 2020; During/post-lockdown: Mar. 24–Jun. 30, 2020; IQR: Interquartile range; [a]more than one option may be selected by each patient; [b]hospital closed (3), patient forgot (2), non-availability of treatment provider (1), holiday (1), went to wrong treatment centre (1), anti-tuberculosis drug was not available (1), was given some other medicine & sent back (1).

more, the favorable treatment outcome was low among previously treated patients, which was proven through various studies in the past[30, 31].

Strengths and limitations

To our knowledge, this is the first community-based study to quantify the impact of the lockdown during the COVID-19 pandemic on the TB care cascade and treatment outcomes in rural India. An interviewer-administered tool in the community setting was used. The study included all patients diagnosed under a programmatic setting during the study period. Recall bias of the events before and during diagnosis/treatment due to the retrospective design of the study is one of the study limitations. Although the study was conducted in only one TB unit, it can be generalized to similar units in rural areas. Only drug-sensitive TB cases were

Table 5 Independent effect of the lockdown on the treatment outcome among patients with tuberculosis

Characteristic	Total n	Favorable treatment outcome n (%)	Unadjusted RR	Adjusted RR (95% CI)
Total	103	89 (86.4)		
BPL status[a]				
No	77	64 (83.1)	0.86 (0.76–0.98)	0.91 (0.80–1.04)
Yes	26	25 (96.2)	Ref	Ref
Lockdown period				
Pre–lockdown	51	47 (92.2)	Ref	
During/post lockdown	52	42 (80.8)	0.88 (0.75–1.02)	0.85 (0.73–0.98)
BMI (kg/m^2) (n-102)				
Underweight (<18.5)	65	59 (90.8)	Ref	Ref
Normal (18.5–22.9)	23	20 (87.0)	0.96 (0.80–1.14)	0.96 (0.81–1.14)
Overweight/Obese (≥23.0)	14	10 (71.4)	0.79 (0.56–1.11)	0.74 (0.55–1.01)
Type of patient				
New TB	81	74 (91.4)	Ref	Ref
Previously treated	22	15 (68.2)	0.75 (0.56–1.00)	0.77 (0.60–0.995)

Pre-lockdown: Jan. 1–Mar. 23, 2020; During/post-lockdown: Mar. 24–Jun. 30, 2020; BMI: Body Mass Index; RR: Relative risk; CI: Confidence interval; BPL: Below poverty line; kg/m^2: Kilogram per metre^2; [a]Rural Poverty line- Rs. 1128 and Urban Poverty line- Rs. 1529.

included; hence, the findings are not applicable to drug-resistant TB cases.

Conclusion

The lockdown has impacted drug-sensitive TB management services in rural northern India. Symptom and disease (PTB/EPTB) patterns changed during and after the lockdown. NPY registration and its disbursement need to be quickly revamped to improve nutritional support and treatment outcomes. The care cascade delays are still high among patients with TB, irrespective of the lockdown status. With the successive waves of COVID-19 imminent in India, studies on drug-resistant TB and privately treated patients are urgently needed.

References

1. Blanchet K, Alwan A, Antoine C, *et al*. Protecting essential health services in low-income and middle-income countries and humanitarian settings while responding to the COVID-19 pandemic. BMJ Glob Health 2020; 5: 3675. [Medline] [CrossRef]
2. World Health Organization. In WHO global pulse survey, 90% of countries report disruptions to essential health services since COVID-19 pandemic. https://www.who.int/news/item/31-08-2020-in-who-global-pulse-survey-90-of-countries-report-disruptions-to-essential-health-services-since-covid-19-pandemic. (Accessed Jan. 2021)
3. Kwak N, Hwang SS, Yim JJ. Effect of COVID-19 on tuberculosis notification, South Korea. Emerg Infect Dis 2020; 26: 2506–2508. [Medline] [CrossRef]
4. Magro P, Formenti B, Marchese V, *et al*. Impact of the SARS-CoV-2 epidemic on tuberculosis treatment outcome in Northern Italy. Eur Respir J 2020; 56: 2002665. [Medline] [CrossRef]
5. McQuaid CF, McCreesh N, Read JM, *et al*. CMMID COVID-19 Working Group The potential impact of COVID-19-related disruption on tuberculosis burden. Eur Respir J 2020; 56: 2001718. [Medline] [CrossRef]
6. Cilloni L, Fu H, Vesga JF, *et al.* The potential impact of the COVID-19 pandemic on the tuberculosis epidemic a modelling analysis. 2020; 28: 100603.
7. Bhargava A, Shewade HD. The potential impact of the COVID-19 response related lockdown on TB incidence and mortality in India. Indian J Tuberc 2020; 67(4S): S139–S146. [Medline] [CrossRef]
8. Central TB Division Ministry of Health and Family Welfare. India TB Report 2018. Annual Status Report. https://tbcindia.gov.in/showfile.php?lid=3314. (Accessed Jun. 2020)
9. Shiferaw MB, Zegeye AM. Delay in tuberculosis diagnosis and treatment in Amhara state, Ethiopia. BMC Health Serv Res 2019; 19: 232. [Medline] [CrossRef]
10. World Health organization. Diagnostic and treatment delay in tuberculosis. An in-depth analysis of the health-seeking behaviour of patients and health system response in seven countries of the Eastern Mediterranean Region. https://apps.who.int/iris/bitstream/handle/10665/116501/dsa710.pdf?sequence=1&isAllowed=y. (Accessed Apr. 2021)
11. Yadav J, John D, Menon G. Out of pocket expenditure on tuberculosis in India: do households face hardship financing? Indian J Tuberc 2019; 66: 448–460. [Medline] [CrossRef]

12. Ministry of Health and Family Welfare (Government of India). National Strategic Plan To End TB in India 2020-25. https://tbcindia.gov.in/index1.php?lang=1&level=1&sublinkid=5506&lid=3578. (Accessed Oct. 2021)
13. Central TB Division Ministry of Health and Family Welfare. Dashboard: Nikshay Reports. https://reports.nikshay.in/Reports/TBNotification. (Accessed Apri. 2021)
14. Begum J, Neelima Y, Ali S, *et al.* Utilisation of nutritional support scheme among the patients of tuberculosis: a myth or a truth. J Fam Med Prim Care 2020; 9: 6109.
15. Ministry of Health and Family Welfare (Government of India). Guidance Document: Nutritional care and support for patients with Tuberculosis in India. https://tbcindia.gov.in/WriteReadData/Guidance Document - Nutritional Care %26 Support for TB patients in India.pdf. (Accessed Oct. 2021)
16. Central TB Division, Ministry of Health and Family Welfare. Chapter 3-Case finding & diagnosis strategy. https://tbcindia.gov.in/showfile.php?lid=3216. (Accessed Apr. 2021)
17. Shewade HD, Gupta V, Satyanarayana S, *et al*. Patient characteristics, health seeking and delays among new sputum smear positive TB patients identified through active case finding when compared to passive case finding in India. PLoS One 2019; 14: e0213345. [Medline] [CrossRef]
18. Li Y, Ehiri J, Tang S, *et al*. Factors associated with patient, and diagnostic delays in Chinese TB patients: a systematic review and meta-analysis. BMC Med 2013; 11: 156. [Medline] [CrossRef]
19. Centre for Genomic Pathogen Surveillance. Epicollect5—Free and easy-to-use mobile data-gathering platform. https://five.epicollect.net/. (Accessed Apr. 2021)
20. Narula P, Sihota P, Azad S, *et al*. Analyzing seasonality of tuberculosis across Indian states and union territories. J Epidemiol Glob Health 2015; 5: 337–346. [Medline] [CrossRef]
21. Husain AA, Monaghan TM, Kashyap RS. Impact of COVID-19 pandemic on tuberculosis care in India. Clin Microbiol Infect 2021; 27: 293–294. [Medline] [CrossRef]
22. Wu Z, Chen J, Xia Z, *et al*. Impact of the COVID-19 pandemic on the detection of TB in Shanghai, China. Int J Tuberc Lung Dis 2020; 24: 1122–1124. [Medline] [CrossRef]
23. Fei H, Yinyin X, Hui C, *et al*. The impact of the COVID-19 epidemic on tuberculosis control in China. Lancet Reg Health West Pac 2020; 3: 100032. [Medline] [CrossRef]
24. Buonsenso D, Iodice F, Sorba Biala J, *et al.* COVID-19 effects on tuberculosis care in Sierra Leone. Pulmonology 2021; 27: 67–69. [Medline] [CrossRef]
25. de Souza CDF, Coutinho HS, Costa MM, *et al*. Impact of COVID-19 on TB diagnosis in Northeastern Brazil. Int J Tuberc Lung Dis 2020; 24: 1220–1222. [Medline] [CrossRef]
26. World Health Organization. Social Stigma associated with COVID-19. https://www.who.int/docs/default-source/coronaviruse/covid19-stigma-guide.pdf. (Accessed Apr. 2021)
27. Purohit MR, Purohit R, Mustafa T. Patient Health Seeking and Diagnostic Delay in Extrapulmonary Tuberculosis: A Hospital Based Study from Central India. Tuberc Res Treat 2019; 2019: 4840561. [Medline]
28. Paramasivam S, Thomas B, Chandran P, *et al*. Diagnostic delay and associated factors among patients with pulmonary tuberculosis in Kerala. J Family Med Prim Care 2017; 6: 643–648. [Medline] [CrossRef]
29. Chandra A, Kumar R, Kant S, *et al*. Diagnostic pathways and delays in initiation of treatment among newly diagnosed tuberculosis patients in Ballabgarh, India. Am J Trop Med Hyg 2021; 104: 1321–1325. [Medline] [CrossRef]
30. Reechaipichitkul W, So-Ngern A, Chaimanee P. Treatment outcomes of new and previously-treated smear positive pulmonary tuberculosis at Srinagarind Hospital, a tertiary care center in northeast Thailand. J Med Assoc Thai 2014; 97: 490–499. [Medline]
31. Ndambuki J, Nzomo J, Muregi L, *et al*. Comparison of first-line tuberculosis treatment outcomes between previously treated and new patients: a retrospective study in Machakos subcounty, Kenya. Int Health 2021; 13: 272–280. [Medline] [CrossRef]