

Improving Outcome in Post-TB Sequelae with Pulmonary Rehabilitation

Aditi Patel, Anil Badal, Swapnil Jain*, Mustafa Singapurwala, Arti Julka, JC Agrawat

Introduction: One-third of the global TB cases prevail in India and among them, 50% continue to experience persistent symptoms even after being declared cured under the NTEP and are collectively called post TB lung diseases (PTLD). These post-TB sequelae cases present in various forms with physical, mental, and functional deficits that could greatly be benefited with a rehabilitation plan.

Results: The pulmonary rehabilitation programme (PRP) with planned physical activity consisting of upper and lower limbs exercises with breathing exercise were carried out in 60 patients. The improvement was observed in almost all the parameters, e.g., spirometry, mMRC dyspnea scale, 6MWT, BODE index, Borg scale and BMI after an interval of 12 weeks. The most frequent co-morbidities observed were diabetics (25%), COPD (22%) and systemic hypertension (17%).

Discussion: Most of the PTLDs belong to the lower educational and socioeconomic classes. These cases had architectural distortion and destruction of airways and lung parenchyma, with residual fibro-cavitary/ Fibro-calcified lesions or destroyed lung and bronchiectasis, etc., and were not going to regain the required lung capacity, so they continued to suffer and live with poor functional deficit. The pulmonary rehabilitation programme (PRP), including the Yoga exercises and meditation practice, was the best option for them to improve physical endurance by developing muscle strength and self-confidence. The reassessed positive changes within a short period of 12 weeks may further boost sustained action, self-reliance, and enable to resolve cognitive illness. Patients need to be educated for protection against recurrent secondary infection and scheduled prophylactic vaccination.

Conclusion: A patient-friendly, tailored PRP should preferably be started along with anti-TB treatment. A support of a physiotherapist and a nutrition specialist, at least during hospitalization, may also be considered in the context of the underlying disease, physical, mental and socioeconomic status of the patient.

Access this article online

Website:

www.cijmr.com

DOI:

10.58999/cijmr.v5i02.423

Keywords:

Post TB lung disease, Pulmonary rehabilitation programme, National TB Elimination programme, Yoga and meditation.

Introduction

Worldwide, among the infectious diseases the pulmonary tuberculosis stands number one killer of mankind. TB is a curable and preventable disease, despite one-third of the global burden being present in India and continuing to be a major public health problem. The RNTCT/ NTEP of India led to a substantial reduction in mortality much below the initial $\leq 25\%$, and achieved a cure/success rate of $\geq 85\%$ with a reduction in the trend of pulmonary TB incidence. Nonetheless, after completing successful therapy, many TB survivors $\geq 50\%$ ¹ continue to experience persisted symptoms or lasting complications, both physically and mentally, a condition collectively referred

to as post-tuberculosis sequelae.² The patients diagnosed with post-TB lung disease (PTLD) may exhibit diverse structural and functional impairments, which could be assessed and evaluated with imaging modalities and various pulmonary function tests. The PTLD includes, but is not limited to, bronchiectasis, fibro-cavitary lesions, fungal or bacterial colonization, hemoptysis, tracheobronchial inflammation, fibrosis, scar carcinoma, interstitial lung disease, destroyed lung, empyema, pleural thickening, and pulmonary hypertension etc. The presence of co-morbidity may further put a dent in the quality of life. All such patients need to be evaluated for the type and extent of underlying pathological lesion with their baseline functional capacity to reassess a change/improvement after a rehabilitation programme in due course of time. This study is undertaken to know

Department of Respiratory Medicine, RD Gardi Medical College, Surasa, Ujjain and Medical College Ratlam, Madhya Pradesh, India.

Correspondence to: Swapnil Jain, Department of Respiratory Medicine, RD Gardi Medical College, Surasa, Ujjain and Medical College Ratlam, Madhya Pradesh, India. E-mail: drswapniljain89@gmail.com

Submitted: 07/05/2026

Revision: 09/05/2026

Accepted: 09/06/2026

Published: 15/08/2026

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

How to cite this article: Patel A, Badal A, Jain S, Singapurwala M, Julka A, Agrawat JC. Improving Outcome in Post-TB Sequelae with Pulmonary Rehabilitation. Central India Journal of Medical Research. 2026;5(2):141-145.

Table 1: Demographics & baseline findings of participants (N = 60)

Demographics	Number (%)
Age mean	40 (66.7%)
Gender: Male	60 (54.5%)
Marital status Married	59 (98.3%)
Urban	42 (70%)
BMI (kg/mm2) mean	
< 18.5	27 (45%)
Normal	28 (46.6%)
≥ 25	05 (08.3%)
Educational level	
< secondary education	Low leveled
≥ secondary education	To improve
Occupation	
Mining	00
Farming	22 (36.7)
Not significant	00
Personal History	
Smoking	29 (48.3)
Firewood exposure	18 (30%)
Alcohol	13 (21.7)
Comorbidities mean	
HIV	3
HBsAg	2
Type of Cases	
Drug Sensitive TB	53 (88 %)
Drug Resistant TB	07 (12 %)

the utility and effectiveness of Pulmonary Rehabilitation in the cases of PTLT after the baseline assessment and again at 12 weeks later.³

Material and Method

All the PTLT patients after discharge from the hospital were educated on the importance of pulmonary rehabilitation. Due consideration was given to the physical activity that consists of both *upper limbs*: includes flexion and extension of shoulder, elbow, and arm exercises with light weight of water bottles, etc., and *lower limbs*: includes squats, walking, stair-climbing and cycling or just extending & holding up positions, where minimal exercises were preferred, followed by a slower increase in intensity.⁴ Similarly, the *breathing exercises*, which included deep breathing, pursed-lip breathing, and diaphragmatic

breathing, were explained to the patient to perform in a sitting posture with an expiration of double the duration of the inspiration. The patients were also instructed to maintain proper hydration and nutrition and avoidance of dust and smoke exposure. A psychological counseling was also performed to emphasized importance of PR to all the participants to adhere to. A change in functional capacity⁵ of patients was assessed with various tools, eg., mMRC dyspnea scale, 6MWT, BODE index, Borg scale and BMI, etc., and recorded for interpretation.

Results

This study was a prospective and observational study with 60 cases (out of 200) who participated on follow up. The demographic profile of these cases is summarized in Table 1. The most common persisting symptoms observed were cough (100%), shortness of breath (98%) and expectoration in 97%, while fever as a presenting symptom was only in 58% of cases (Graph 1). The significant clinical findings, i.e., clubbing (42%), enlarged supraclavicular lymph nodes (17%), with supporting right heart failure/CCF, were also observed (Graph 2). The critical cases with septicemia (52%) and respiratory failure (32%) were admitted to RICU (Graphs 3-4). The results of rehabilitation (Table 2) were encouraging and showed improvement in respect to the nutritional status, 6MWT, Borg scale, BODE index, dyspnea mMRC grading and in spirometry with improved physical endurance, psychological boost and quality of life. Unfortunately, 140 (70%) out of 200 cases remained non-adherent or irregular to the rehabilitation programme and only 60 cases could attend the follow-up. The associated diabetes (25%), COPD (22%) and systemic hypertension (17%) remained the major co-morbidities (Graph 3). Most of the cases had bilateral fibro-cavitary or fibro-calcified lesions with a mixed pattern

Spirometry and a predominant restrictive pattern are also present in a pleural fibrosis case. A poor lung reserve was observed in unilateral destroyed lung in 11.7% of cases. Partially organized collapse-consolidation (26.7%) and bronchiectasis (18.3%) were also observed (Graph 5). An overall intermixed and overlapping clinical and radiological scenario was present in almost all the cases. Similarly, everyone who had bronchospasm, perhaps due to reactive airway disease, was advised oral and/or inhaler devises however, 19 (31.6% cases) were in need of supportive O₂ therapy and were managed accordingly. About 65% of cases agreed to the prophylactic vaccination.

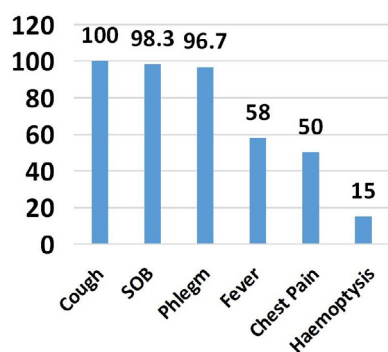
Table 2: Comparison of pre and post-test results of rehabilitation

<i>BMI</i>	<i>Pre-baseline test</i>		<i>Post-test</i>	
	<i>Number</i>	<i>%</i>	<i>Number</i>	<i>%</i>
<18.5	27	45	21	35.0
Normal	28	47	34	57
>25	03	08	05	08
<i>mMRC</i>	<i>Pre-test</i>		<i>Post-test</i>	
	<i>Number</i>	<i>%</i>	<i>Number</i>	<i>%</i>
Grade 0	0	0	3	05
Grade 1	7	12	40	67
Grade 2	22	36	16	26
Grade 3	31	52	1	02
6 MWT In Meters	<i>Pre-test</i>		<i>Post-test</i>	
	<i>Mean distance</i>		<i>Mean distance</i>	
N = 52 Participants	266 M	Base line	287 M	Improved
Significant Desaturation	33	Base line	23	Improved
Respiratory Failure	Pre-test		Post-test	
At Room Air	19	32%	5	8%
Borg Scale	Pre-test		Post-test	
Mild	03	05%	32	54%
Moderate	07	12%	14	23%
Severe	50	83%	14	23%
BODE-Index N=60	Pre-test		Post-test	
Mild	3	5%	13	22%
Moderate	12	20%	22	36%
Severe	45	75%	25	42%
<i>Spirometry N= 48</i>	<i>Pre-test</i>		<i>Post-test</i>	
	<i>Number</i>	<i>%</i>	<i>Number</i>	<i>%</i>
Obstructive	25	52	20	42
Mixed	12	25	10	21
Restrictive	06	13	05	10
Normal	05	10	13	27

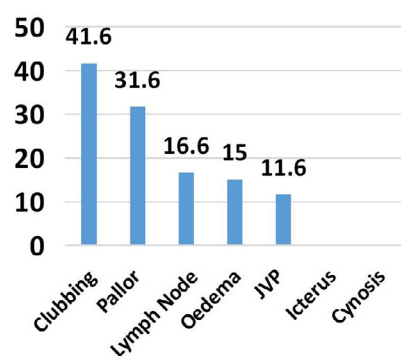
Discussion

Tuberculosis is the leading cause of morbidity and mortality during its active disease phase and even afterward. Kumar K *et al.* mentioned that the pulmonary TB patients often suffer or struggle with PTLTD sequelae even after a full regular course of successful treatment for tuberculosis or are declared cured.⁶ Gai X *et al.*,¹ Sunil Yadav *et al.*,² and an Editorial of the American Journal of Respiratory and Critical Care Medicine⁷ had mentioned that more than 50% of these post TB survival are sufferer with PTLTD. As per the annual report of India (2024), a compounded data of bacteriologic negative declared cured of PTB cases for the last 5 years commutative becomes around 3.5 million (example @ of 25 cases/Lac) and is quite significant as the magnitude of the

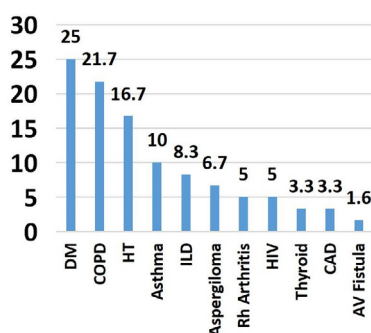
problem. This problem is worth comparing with the recent past COVID-19 pandemic, which also leads to physical, mental, and cognitive problems after recovery from the acute illness as the post covid sequelae.⁷ The NTEP had developed guidelines and a provision for follow-up of post-TB cases to diagnose and manage TB sequelae; however, it depends much upon the system for monitoring and implementation efforts. The most common symptoms of PTLTD are cough, expectoration and shortness of breath due to architectural distortion and destruction of lung parenchymal tissue and airways. The residual fibro-cavitary/Fibro-calcified lesions or destroyed lung, etc are not going to regain the required lung capacity, so the patient continues to suffer with poor functional deficit. However, a multicentric study



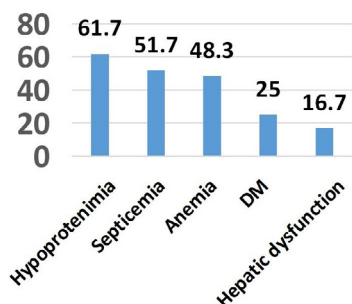
Graph 1: Symptoms %



Graph 2: Clinical signs %

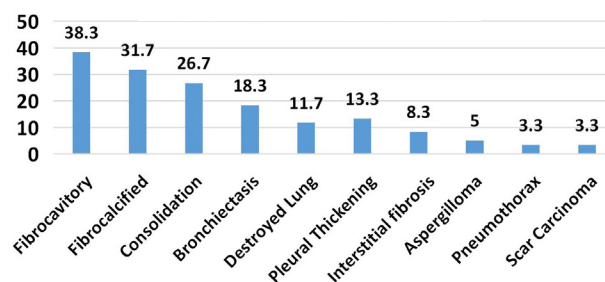


Graph 3: Comorbidities %



Graph 4: % Abnormal Investigation findings

conducted by Sanjeev Sinha *et al.*, which imparted rehabilitation training to all 260 participants on their first visit to the OPD at 5 centers in India, and found



Graph 5: % Radiological lesions

satisfactory improvement in functional capacity and quality of life.⁵ Similarly, our study also showed improvement in all the parameters (Table 2) assessed after 12 weeks of PRP, and the participants at least learned to manage physical endurance and optimization the consumption of oxygen for the day-to-day activities to live a better quality of life with improved disability adjusted life year (DALY). Mtei FJet *et al.*, in contrast, reported no change in BMI and spirometry in their series of 121 cases; however, 6 MWT and pre-existing cognitive mental problems showed improvement.⁸ Alene KA *et al.*, analyzed 25 studies involving 10,592 participants and concluded that there is a definite role of well organized rehabilitation programme to achieve optimal goals if initiated during the start of therapy and it could also be beneficial for the care of neurologic mental health and cognitive ailments.⁹ Mahler and Croitoru, too, had emphasized the components of a PR programme even during active TB (including MDR TB) with the support a family member.¹⁰

Kamal *et al.*, mentioned abnormal spirometry in >80% cases of PTLT and among them, obstructive >54%, Restrictive >13% and mixed pattern in >15% were observed. She also observed that the restrictive pattern was more common in females, and the mixed pattern coexists with a higher mMRC scale.¹¹ Our study revealed spirometry data of 52, 13, and 25% for obstructive, restrictive and mixed patterns, respectively with an overall improvement in 17% of cases after 12 weeks of inhaler therapy and rehabilitation plan. Lenora C. Fernandez & Gina B. Cairme¹² reported that, despite robust gains in walking distance (6MWT), the FEV1 and FVC values did not improve following a six-week outpatient rehabilitation intervention in post-tuberculous bronchiectasis patients. In contrast, Visca *et al.* found that the Italian tuberculosis survivors achieved significant reductions in dyspnoea, fatigue and increased functional capacity after a six-week rehabilitation program.¹³ However, an improvement in FEV1, FVC,

and 6 MWT was observed by most of the studies after a sustained rehabilitation. Pulmonary rehabilitation cannot reverse collagen deposition or restore destroyed alveolar architecture; instead, the primary benefits derive from the adaptations of neuromuscular and ventilatory efficiency. The strengthened respiratory and peripheral muscles optimize breathing mechanics, thus boost patient's confidence in a better quality of life. A control clinical trial of integrated 45 minutes of yoga as an adjuvant to scheduled NTEP medication was conducted by Srinivas M *et al.* on 72 TB patients with promising improved physical, mental and social change assessed with WHO quality of life questionnaire.¹⁴ Similarly, the patients may also be educated for cough etiquette, techniques to mobilize lung secretions, and postural drainage.¹⁵

Conclusion

The infectious diseases and their control are the problem of not only the individual but the state and society too. The residual untoward effect or complication with socioeconomic impact has to be borne by the patient and his family. In recent years, the PTLTD has definitely and deservedly gained attention. Nonetheless, a result-oriented programme started right at the beginning of ATT needs to be propagated and implemented. A patient-friendly, tailored rehabilitation programme with the support of a physiotherapist and a nutrition specialist is needed with consideration of the underlying disease, physical, mental and social status of the patient.

Ethical Approval

Ethical approval was taken from the institutional ethical review board IEC-RDGM (IEC Ref no. PG/RESPIRATORY MEDICINE/81)

References

- Gai X, Allwood B, Sun Y. Post-tuberculosis lung disease and chronic obstructive pulmonary disease. *Chin Med J (Engl)*. 2023 Aug 20;136(16):1923-1928. doi: 10.1097/CM9.0000000000002771. Epub 2023 Jul 14. PMID: 37455331; PMCID: PMC10431356. <https://pmc.ncbi.nlm.nih.gov/articles/PMC10431356/>
- Sunil yadav *et al.*. CLINICO-RADIOLOGICAL SEQUELAE OF PULMONARY TUBERCULOSIS: POST TB LUNG DISEASE (PTLD), *International Journal of Scientific Research; Volume - 12 | Issue - 11 | November 2023* [https://www.worldwidejournals.com/international-journal-of-scientific-research-\(IJSR\)/fileview/clinicoradiological-sequelae-of-pulmonary-tuberculosis-post-tb-lung-disease-ptld_November_2023_6693159331_6111284.pdf](https://www.worldwidejournals.com/international-journal-of-scientific-research-(IJSR)/fileview/clinicoradiological-sequelae-of-pulmonary-tuberculosis-post-tb-lung-disease-ptld_November_2023_6693159331_6111284.pdf)
- Mtei FJ, Meadows I, Msaji K, Thobias F, Liyoyo A, Kimaro A, Joseph PM, Gitige C, Kaswaga O, Matoi S, Ngoma A, Mbuya A, Mbelele P, Ritte L, Subi L, Neema P, Kisonga R, Mbwana D, Mpolya E, Drage M, Lochting LI, S K Heysell, S G Mpagama. Pulmonary rehabilitation for post-TB lung disease led by TB survivors. *Public Health Action*. 2025 Jun 4;15(2):82-87. doi: 10.5588/pha.25.0001. PMID:40487458; PMCID: PMC12143242. <https://pmc.ncbi.nlm.nih.gov/articles/PMC12143242/pdf/pha24-0001.pdf>
- Kumar K, Narasimhan M. The role of pulmonary rehabilitation in patients with tuberculosis sequelae. *Indian J Respir Care* 2022;11:11-3.
- SINHA *et al.*: Pulmonary Rehabilitation In Post-Tb Lung Disease, *Indian J Med Res* 161, May 2025, pp 540-551 https://ijmr.org.in/view-pdf/?article=fbb39f1769abe6a437ff4528eef19f3YDt4xf_ezp3B6Dw==
- Kumar K, Narasimhan M. The role of pulmonary rehabilitation in patients with tuberculosis sequelae. *Indian J Respir Care* 2022;11:11-3. https://www.ijrc.in/doi/IJRC/pdf/10.4103/ijrc.ijrc_122_21
- EDITORIALS: Post-tuberculosis Sequelae and the Burden of "Long TB" Continuing TB Care after Treatment Completion, *American Journal of Respiratory and Critical Care Medicine* Volume 211 Number 6 | June 2025 <https://www.atsjournals.org/doi/pdf/10.1164/rccm.202502-0442ED>
- Mtei FJ, Meadows I, Msaji K, Thobias F, Liyoyo A, Kimaro A, Joseph PM, Gitige C, Kaswaga O, Matoi S, Ngoma A, Mbuya A, Mbelele P, Ritte L, Subi L, Neema P, Kisonga R, Mbwana D, Mpolya E, Drage M, Lochting LI, S K Heysell, S G Mpagama. Pulmonary rehabilitation for post-TB lung disease led by TB survivors. *Public Health Action*. 2025 Jun 4;15(2):82-87. doi: 10.5588/pha.25.0001. PMID: 40487458; PMCID: PMC12143242. <https://pmc.ncbi.nlm.nih.gov/articles/PMC12143242/pdf/pha24-0001.pdf>
- Alene KA, Hertzog L, Gilmour B, Clements ACA, Murray MB. Interventions to prevent post-tuberculosis sequelae: a systematic review and meta-analysis. *EClinicalMedicine*. 2024 Feb 26;70:102511. doi: 10.1016/j.eclinm.2024.102511. PMID: 38434448; PMCID: PMC10907188. <https://pmc.ncbi.nlm.nih.gov/articles/PMC10907188/pdf/main.pdf>
- Mahler and Croitoru: Pulmonary rehabilitation and tuberculosis: a new approach for an old disease. https://www.researchgate.net/publication/337866847_Pulmonary_rehabilitation_a_new_approach_for_an_old_disease
- Kamal *et al.*. Silent aftermath: Lung impairment in cured pulmonary tuberculosis cases spirometry in post-tuberculosis rural patients / *IP Indian Journal of Immunology and Respiratory Medicine* 2025;10(4):203-209 <https://ijirm.org/archive/volume/10/issue/4/article/25614/pdf>
- Fernandez LC, Cairme GB. The benefits of pulmonary rehabilitation program on post-tuberculosis bronchiectasis. *Int J Clin Med*. 2022;13(12):561-570.
- Visca, D., Zampogna, E., Sotgiu, G., *et al.*. (2022). Pulmonary rehabilitation in patients with chronic respiratory impairment due to tuberculosis: A multicenter study. *Archives of Bronconeumology*, 58(5), 321-328. <https://doi.org/10.1016/j.arbres.2021.06.014>
- Srinivas M, Patil NJ, Prabhakar K, Jagmohan SV. Effect of yoga on quality of life in patients with pulmonary tuberculosis: A randomized control trial. *Int J Yoga* 2023;16:185-91. <https://pmc.ncbi.nlm.nih.gov/articles/PMC10919413/pdf/IJY-16-185.pdf>
- Wellness Activity for TB Patient <https://ntep.in/node/683/CP-wellness-activity-tb-patients>