ORIGINAL RESEARCH PAPER
Volume - 13 | Issue - 09 | September - 2024 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

ASSESSMENT OF LUNG PHYSIOLOGICAL CHANGES IN PREVIOUSLY TREATED PLEURO PULMONARY TUBERCULOSIS PATIENTS: TYPE AND DEGREE EVALUATION

Respiratory Medicine

Dr. Vihar Lodhiya
Prof Dr G . N Srivastava
Dr Vinod Kumar

ABSTRACT

Introduction: Tuberculosis (TB), caused by Mycobacterium tuberculosis (MTB), remains one of the most significant global health challenges, infecting a third of the world's population. Despite the effectiveness of TB treatment, a substantial proportion of patients who recover from pulmonary TB continue to experience persistent pulmonary dysfunction, which can contribute to the growing burden of chronic obstructive pulmonary disease (COPD). Post-tuberculosis lung disease (PTLD) is characterized by a wide range of pulmonary pathologies, including cavitation, fibrosis, bronchiectasis, and other structural lung changes. These complications result from a complex interplay between the pathogen, host immune responses, and environmental factors. **Aim:** This study aims to determine the type and degree of lung physiological changes in previously treated pleuro-pulmonary tuberculosis patients, focusing on the heterogeneity of pulmonary function and the underlying immunological and genetic factors that may contribute to these changes. **Methodology:** A comprehensive review of the literature was conducted, including studies on the epidemiology of post-tuberculosis lung disease (PTLD), TB-associated lung pathology, and the immunological and genetic correlates of lung tissue damage. The review also included an examination of diagnostic tools such as the six-minute walk test and spirometry, which are used to assess lung function and the extent of pulmonary impairment in TB survivors. **Results:** The review highlights the significant variability in pulmonary function among TB survivors, ranging from no impairment to severe dysfunction. The study identifies multiple forms of lung damage, such as cavitation, fibrosis, and bronchiectasis, which collectively contribute to lung remodeling in TB patients. Additionally, the study discusses the role of immune pathways and genetic risk factors in the development of TB-associated lung injury. These findings emphasize the need for targeted therapies that address the specific immunological factors responsible for lung injury in TB patients. **Conclusion:** This study underscores the critical need for ongoing monitoring and management of pulmonary function in TB survivors, as well as the importance of understanding the underlying immunological and genetic factors that contribute to post-tuberculosis lung disease (PTLD). By elucidating these factors, healthcare providers can develop more effective strategies to mitigate the long-term impact of TB on lung health, ultimately improving the quality of life for those affected by this persistent and complex disease.

KEYWORDS

INTRODUCTION

Tuberculosis (TB), caused by Mycobacterium tuberculosis (MTB), continues to be a significant global health concern, affecting nearly a third of the world's population and resulting in over 9 million new cases annually[1]. Despite the availability of highly effective treatment for drug-susceptible pulmonary TB—with a reported treatment success rate of 85% between 1995 and 2015[2]—a substantial proportion of TB survivors continue to experience persistent pulmonary dysfunction even after microbiological cure.[3] This dysfunction, which can range from minor abnormalities to severe breathlessness, increases the risk of death from respiratory causes and significantly contributes to the global burden of chronic obstructive pulmonary disease (COPD).[4]

One of the striking features of pulmonary TB is the heterogeneity in lung involvement, reflected in the wide variability in pulmonary function observed among TB survivors. This variability includes different types of ventilatory defects and the presence of diverse pulmonary pathologies such as cavitation, fibrosis, and nodular infiltrates.[5] The heterogeneity in lung damage may be influenced by host-pathogen interactions and the diverse immunological responses triggered by the infection. Additionally, genetic factors regulating host immune responses may contribute to the observed variability in lung injury among TB patients.[6] Understanding these immune pathways and genetic risk factors is crucial for developing targeted therapies that can mitigate lung injury and improve the quality of life for TB survivors.[6]

The need for addressing pulmonary impairment after TB (PIAT)[7] is critical, as treated TB patients appear to contribute substantially to the growing burden of chronic lung diseases globally. Post tuberculosis lung disease (PTLD) results from a complex interplay between organism, host and environmental factors and affects long term respiratory health.[8] Risk factor for PTLD include multiple episodes of drug-resistant tuberculosis, delays in diagnosis, and possibly smoking.[9] PTLD is an important contributor to the global burden of chronic lung disease. Advocacy is needed to increase recognition for PTLD and its associated economic, social, psychological consequences and to better understand how PTLD sequelae could be mitigated. PTLD may result in a number of symptoms and a change in pulmonary function. These individual typically exhibit symptoms such as dyspnoea, coughing up sputum, wheezing, fever, loss of appetite and haemoptysis.[10]

MATERIALS AND METHODS

The cross-sectional study, conducted from November 2022 to May 2024 at the Heritage Institute of Medical Sciences, Varanasi, assessed lung function in 150 patients treated for pleuro-pulmonary tuberculosis. Patients were selected from the outpatient department based on post-treatment respiratory symptoms, following NTEP guidelines. The sample size of 143 was calculated with an 8% margin of error and a 95% confidence interval, anticipating a 38.7% functional impairment. Ethical approval and informed consent were obtained. Participants underwent a thorough clinical evaluation, including spirometry using the RMS Helios 702 model, a 6-minute walk test as per ATS guidelines, and chest X-rays (PA view). Data were analyzed using IBM SPSS version 23.0, with results presented as mean ± SD for quantitative data and frequencies for qualitative data. The chi-square test was used for comparing categorical variables, with significance set at $p < 0.05$.

RESULTS

Table 1:

Characteristics	Frequency (N)	Percentage (%)
Age Group (in Years)		
18-30	6	4
31-40	15	10
41-50	57	38
51-60	53	35
≥60	19	12.7
Total	150	100
Gender		
Male	78	52
Female	72	48
Total	150	100
Religion		
Hindu	127	84.7
Muslim	23	15.3

Total	150	100
Residence		
Urban	58	38.7
Rural	92	61.3
Total	150	100
OCCUPATION		
Professional	16	10.7
Semi-Professional	11	7.3
Shop-Keeper/Clerk	34	22.7
Skilled	14	9.3
Semi-Skilled	22	14.7
Un-Skilled/Agriculture	19	12.7
Unemployed/Housewife	34	22.7
Total	150	100

Table 1 provides socio-demographic profile of the study participants, reveals a diverse distribution across various parameters. The age group most represented is 41-50 years (38%), followed closely by those aged 51-60 years (35%), indicating a predominance of middle-aged adults in the study. The gender distribution is nearly balanced, with males slightly outnumbering females (52% vs. 48%). The majority of participants identify as Hindu (84.7%), with a smaller proportion being Muslim (15.3%). A significant number of participants reside in rural areas (61.3%), highlighting a rural-urban divide. Occupationally, the cohort is diverse, with shopkeepers/clerks and those unemployed or homemakers being the largest groups (22.7% each). Professionals and semi-professionals make up a smaller segment (10.7% and 7.3%, respectively), while a notable portion is engaged in skilled, semi-skilled, and unskilled/agricultural work, collectively representing 36.7% of the participants. These findings underscore the varied socio-economic backgrounds of the study population, providing a comprehensive understanding of the demographic factors influencing the study's outcomes.

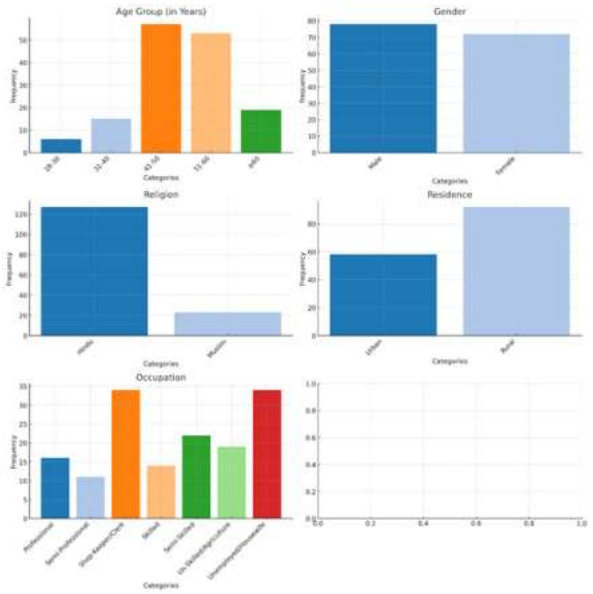


Table 2:

SYMPTOMS	Yes (N)	No (N)
COUGH	93 (62.0%)	57 (38.0%)
EXPECTORATION	78 (52.0%)	72 (48.0%)
DYSPNEA	127 (84.7%)	23 (15.3%)
WHEEZE	52 (35.0%)	98 (65.0%)
CHEST PAIN	79 (52.7%)	71 (47.3%)
FEVER	42 (28.0%)	108 (72.0%)
HEMOPTYSIS	21 (14.0%)	129 (86.0%)
LOSS OF APPETITE	84 (56.0%)	66 (44.0%)
LOSS OF WEIGHT	46 (30.6%)	104 (69.4%)
TOTAL	150 (100%)	150 (100%)
TUBERCULOSIS		
PULMONARY	137 (91.3%)	_
PLEURAL	13 (8.7%)	_
TOTAL	150 (100%)	_

Table 2 presents the distribution of symptoms among 150 tuberculosis patients, with pulmonary and pleural forms constituting 91.3% and 8.7% of the cases, respectively. Cough was the most common symptom, observed in 62% of patients, followed by dyspnea in 84.7%, highlighting respiratory involvement in TB.

Expectoration and chest pain were noted in 52% and 52.7% of cases, respectively, indicating significant respiratory distress. Loss of appetite and weight were present in 56% and 30.6% of patients, respectively, reflecting the systemic impact of TB. Fever and hemoptysis were less frequent, reported in 28% and 14% of cases, respectively, suggesting variability in symptom manifestation. The data underscores the predominance of pulmonary TB and the varied clinical presentations that can complicate early diagnosis and treatment.

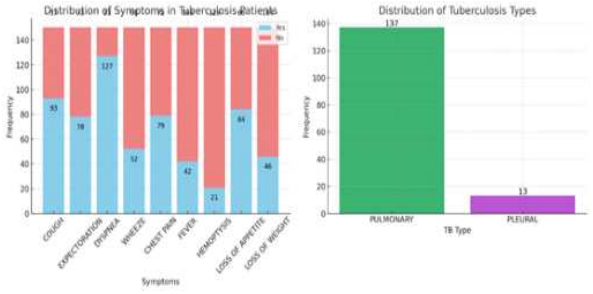


Table 3:

Variables	Frequency (N)	Percentage (%)
Radio-logical findings		
Hyper-inflation	40	27
Normal lung	33	22
Fibrosis	21	14
Bronchiectasis	16	11
Pleural thickening	13	9
Calcification	12	7
Fibrocavitatory	8	5
Destroyed lung	7	5
Type of lung physiology		
Obstructive lung	63	42
Restrictive lung	12	8
Mixed blockage	30	20
Normal lung	45	30
Severity of lung physiology		
Mild Obstructive	27	18
Moderate Obstructive	18	12
Severe Obstructive	12	8
Very Severe Obstructive	6	4
Mild Restrictive	6	4
Moderate Restrictive	4	3
Severe Restrictive	2	1
Mixed blockage	30	20
Normal lung	45	30
Total	150	100

Table 3 presents a comprehensive overview of radiological findings, lung physiology types, and the severity of lung conditions in a study population of 150 patients. Hyper-inflation was observed in 27% of cases, indicating a prevalent abnormality, while normal lung appearance was seen in 22%. Significant findings included fibrosis (14%), bronchiectasis (11%), and pleural thickening (9%), with calcification and fibrocavitatory changes being less common.

Among lung physiology types, obstructive lung disease was predominant, affecting 42% of patients, followed by mixed blockage in 20% and restrictive lung patterns in 8%. Severity analysis of obstructive lung conditions showed that mild obstruction was most frequent (18%), followed by moderate (12%), severe (8%), and very severe obstruction (4%). Restrictive lung disease was less common, with mild cases at 4%, moderate at 3%, and severe at 1%.

The presence of mixed blockage (20%) and normal lung physiology (30%) highlights the diversity in lung pathology among the patients. The distribution of these findings underscores the complexity of lung diseases, necessitating tailored approaches to diagnosis and treatment.

PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr

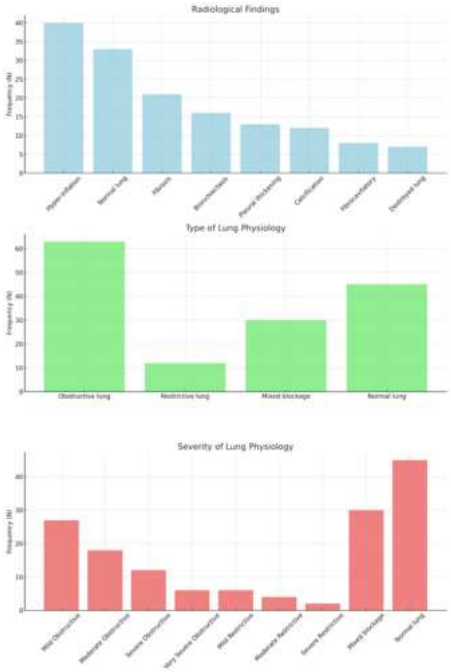


Table 4:

Walk distance severity	Severity	Percentage (%)
>350 meter	0	48
250-300 meter	1	29
150-250 meter	2	16
<150 meter	3	7
SGRQ SCORE	**Mean**	**SD**
Symptom score	50.7	7.5
Activity score	48.4	9.8
Impact score	42.5	7.8
Overall score	46.8	6.6

Table 4 outlines the relationship between walk distance severity and health impact as measured by the SGRQ score among patients. A majority (48%) of patients could walk over 350 meters, indicating no or minimal severity, while 29% had moderate severity, covering 250-300 meters. Severe limitations were noted in 16% of patients who could only manage 150-250 meters, and the most severe group (7%) walked less than 150 meters. The SGRQ scores further reflect the impact of lung disease on patients' quality of life, with a mean symptom score of 50.7 (SD = 7.5) suggesting significant respiratory symptoms. The activity score (mean = 48.4, SD = 9.8) indicates considerable impairment in daily activities, while the impact score (mean = 42.5, SD = 7.8) highlights the overall effect on the patient's well-being. The overall SGRQ score of 46.8 (SD = 6.6) underscores the substantial burden of disease on this population, correlating well with the walk distance severity, and emphasizes the need for targeted interventions to improve functional capacity and quality of life in these patients.

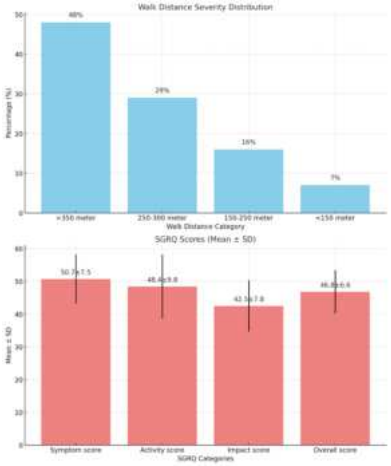
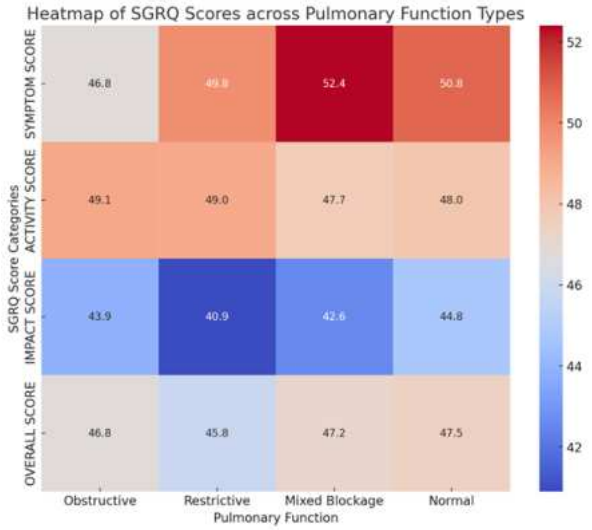


Table 5:

SGRQ SCORE	PULMONARY FUNCTION				P-VALUE
	Obstructive	Restrictive	Mixed Blockage	Normal	
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	
SYMPTOM SCORE	46.8 ± 5.9	49.8 ± 7.1	52.4 ± 7.5	50.8 ± 8.9	0.01
ACTIVITY SCORE	49.1 ± 10.1	49.0 ± 10.5	47.7 ± 9.1	48.0 ± 11.0	0.89
IMPACT SCORE	43.9 ± 8.1	40.9 ± 7.7	42.6 ± 7.4	44.8 ± 9.9	0.29
OVERALL SCORE	46.8 ± 4.6	45.8 ± 7.4	47.2 ± 6.2	47.5 ± 8.7	0.67

Table 5 provides analysis of SGRQ scores across different pulmonary function types, including obstructive, restrictive, mixed blockage, and normal, reveals notable differences in symptom, activity, impact, and overall scores. The Symptom Score exhibited a significant difference (p=0.01) with higher values in mixed blockage (52.4 ± 7.5) compared to the other categories, suggesting more severe symptoms in patients with mixed pulmonary impairments. In contrast, the Activity Score (p=0.89) and Impact Score (p=0.29) showed no significant differences among the groups, indicating a consistent functional impact and activity limitation across different pulmonary function statuses. The Overall Score (p=0.67) also demonstrated uniformity, reflecting the global health impact irrespective of the underlying pulmonary condition. These findings highlight the varying degrees of symptom severity associated with specific pulmonary dysfunctions, particularly in mixed blockage cases, while the overall health impact remains comparable across different groups.



DISCUSSION

Our study aimed to evaluate post-tuberculosis lung function impairment among 150 microbiologically cured pleuro-pulmonary tuberculosis patients. The participants were mostly aged 41-50 years (38%) and 51-60 years (35%), with a slight male predominance (52%). A similar study by **Musafiri S et al**[11] (2015) reported a mean age of 48.6 years, with 54.9% of participants being above 40 years. In our cohort, the majority were Hindus (84.7%) and resided in rural areas (61.3%), reflecting regional demographics. Sinha et al. (2012) also noted a diverse socio-demographic profile, with a slightly urban majority (52.2%) and a Hindu majority (55.9%). Occupationally, our participants were mainly shopkeepers/clerks and unemployed/housewives, each constituting 22.7% of the sample. This contrasts with **Sinha R et al.,**[12], who found a predominance of unskilled labor (38.3%).

Symptomatically, cough (62%), expectoration (52%), and dyspnea (84.7%) were prevalent in our study, aligning with findings by **Thoker ZA et al**[13] (2023), who also noted that cough, expectoration, and dyspnea were common in 59% of their patients. Pulmonary TB was the dominant form (91.3%) in our study, consistent with global trends, while pleural TB accounted for 8.7%. The most common chest X-ray finding was hyperinflation (27%), similar to the 40% reported by **Menon et al.**[14] (2015) in their study on post-primary tuberculosis. **Ivanova et al.**[15](2023) reviewed 54 studies and found a mean FEV1 of

76.6% and FVC of 81.8% among former TB patients, which aligns with our findings where mild to severe impairments were observed in lung function. Our study also highlighted the relationship between walk distance and severity, with 48% of participants walking more than 350 meters, suggesting better functional outcomes.

Spirometry revealed that 42% of participants had obstructive lung patterns, with varying degrees of severity, while 30% had normal lung function. **Patil et al** [16] (2018) reported similar findings, with a 42% prevalence of obstructive spirometry patterns in symptomatic post-TB cases. Our study also highlighted the relationship between walk distance and severity, with 48% of participants walking more than 350 meters, suggesting better functional outcomes. **Hanekom et al.**[17] (2019) found that 48% of their sample had abnormal lung function, which impacted their walk distance.

Using the St. George's Respiratory Questionnaire (SGRQ), we observed significant improvements in symptoms, activity, and impact scores, indicating better quality of life post-treatment. **Agrawal et al.** [18] (2021) similarly noted that symptoms were the most affected domain in their study, with an average SGRQ score of 42.3.

Our findings emphasize the importance of early detection, targeted treatment, and ongoing assessment of pulmonary function and quality of life in post-TB patients.

CONCLUSIONS

The study highlights significant variability in lung function among post-tuberculosis patients, with a notable prevalence of obstructive lung patterns, alongside mixed and restrictive types. Patients with mixed blockage reported the highest severity of respiratory symptoms, as indicated by SGRQ scores. Despite the variation in lung function, the overall impact on quality of life was consistently substantial across different pulmonary impairment types. These findings emphasize the need for personalized clinical management to address specific lung impairments and improve the well-being of patients post-TB. Regular monitoring and early intervention are essential to mitigate long-term lung health issues.

REFERENCES

1. World Health Organization. Global tuberculosis report 2018. Geneva: World Health Organization; 2018. Available from: [Google Scholar].
2. World Health Organization. Global tuberculosis report 2013. Geneva: World Health Organization; 2013.
3. Hnizdo E, Singh T, Churchyard G. Chronic pulmonary function impairment caused by initial and recurrent pulmonary tuberculosis following treatment. Thorax. 2000 Jan 1;55(1):32-8.
4. Amaral AF, Coton S, Kato B, Tan WC, Studnicka M, Janson C, et al. Tuberculosis associates with both airflow obstruction and low lung function: BOLD results. Eur Respir J. 2015 Oct 1;46(4):1104-12.
5. Hunter RL. Pathology of post-primary tuberculosis of the lung: an illustrated critical review. Tuberculosis. 2011 Nov 1;91(6):497-509.
6. Ravimohan S, Kornfeld H, Weissman D, Bisson GP. Tuberculosis and lung damage: from epidemiology to pathophysiology. Eur Respir Rev. 2018 Mar 31;27(147).
7. Amaral AF, Coton S, Kato B, Tan WC, Studnicka M, Janson C, et al. Tuberculosis associates with both airflow obstruction and low lung function: BOLD results. Eur Respir J. 2015 Oct 1;46(4):1104-12.
8. Stek C, Allwood B, Walker NF, Wilkinson RJ, Lynen L, Meintjes G. The immune mechanisms of lung parenchymal damage in tuberculosis and the role of host-directed therapy. Front Microbiol. 2018 Oct 30;9:2603.
9. Narasimhan P, Wood J, MacIntyre CR, Mathai D. Risk factors for tuberculosis. Pulm Med. 2013;2013(1):828939.
10. Dowdy DW, Israel G, Vellozo V, Saraceni V, Cohn S, Cavalcante S. Health-related quality of life among people treated for tuberculosis and human immunodeficiency virus in Rio de Janeiro, Brazil. Int J Tuberc Lung Dis. 2013 Mar;17(3):345-7.
11. Musafiri S, Dusabejambo V, Munganyinka B, Manzi O, Kalisa L, Rutayisire P. The aftermath of pulmonary tuberculosis: predictors of severe pulmonary sequelae and quality of life of patients visiting a tertiary level of care in Rwanda, East Africa. Austin J Pulm Respir Med. 2015;2(2):1027.
12. Sinha R, Nathavitharana RR, Satyanarayana S, Pai M, Thomas BE, Chadha VK. The tuberculosis cascade of care in India's public sector: a systematic review and meta-analysis. PLoS Med. 2016 Oct;13(10). Available from: [PMC free article] [PubMed] [Google Scholar].
13. Thoker ZA, Madan K, Mittal S, Tiwari P, Shah TH, Mohan A, et al. Clinical profile and quality of life of patients with post-pulmonary tuberculosis sequelae presenting to a tertiary care hospital. Cureus. 2023 Mar;15(3).
14. Menon B, Nima G, Dogra V, Jha S. Evaluation of the radiological sequelae after treatment completion in new cases of pulmonary, pleural, and mediastinal tuberculosis. Lung India. 2015 May-Jun;32(3):241-5.
15. Ivanova O, Hoffmann VS, Lange C, Hoelscher M, Rachow A. Post-tuberculosis lung impairment: systematic review and meta-analysis of spirometry data from 14,621 people. Eur Respir Rev. 2023 Jun 30;32(168).
16. Patil S, Patil R, Jadhav A. Pulmonary functions' assessment in post-tuberculosis cases by spirometry: obstructive pattern is predominant and needs cautious evaluation in all treated cases irrespective of symptoms. Int J Mycobacteriol. 2018 Apr-Jun;7(2):128-33.
17. Hanekom S, Pharaoh H, Irusen E, Daniels KJ. Post-tuberculosis health-related quality of life, lung function and exercise capacity in a cured pulmonary tuberculosis population in the Breede Valley District, South Africa. S Afr J Physiother. 2019 Jan 1;75(1):1-8.
18. Aggarwal N, Ghosh T, Bhan M, Dwarakanathan V, Sethi P, Meena VP, et al. Post-tuberculosis sequelae and their correlation with quality of life: an observational study at a tertiary care center of north India. medRxiv. 2021 Oct 5;2021-10.