Pak. J. Chest Med. 2025;31(02)

Original Article

journal homepage: https:/www.pjcm.net/

Pakistan Journal of Chest Medicine

Official journal of Pakistan Chest Society

Discrepancy Between Persistent Respiratory Symptoms and Lung Function in Post-Tuberculosis Patients: A Cross-Sectional Analysis

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Article History:

Received:	Jan 17, 2025
Revised:	Apr 06, 2025
Accepted:	May 24, 2025
Available Online:	Jun 02, 2025

Author Contributions:
ZA conceived idea, MS drafted the study, MA FK collected data, MA did statistical analysis and interpretation of data, MS ZA critical reviewed manuscript. All approved final version to be published.

Declaration of conflicting interests:
The authors declare that there is no conflict of interest.

How to cite this article:
Ashraf Z, Aslam M, Kiran F, Ali M, Saeed M. Discrepancy Between Persistent Respiratory Symptoms and Lung Function in Post-Tuberculosis Patients: A Cross-Sectional Analysis. Pak J Chest Med. 2025;31(02):123-129.

ABSTRACT

Background: Persistent chronic respiratory symptoms are frequently reported by individuals cured of tuberculosis (TB). However, the relationship between these symptoms and objective lung function measures remains poorly understood.

Objective: To evaluate the prevalence of chronic respiratory symptoms, severity, and their correlation with lung function parameters in post-TB individuals.

Methodology: A cross-sectional analysis was conducted on 200 post-TB patients (mean age 47 ± 15 years; 62% male) who had completed TB treatment an average of 18 ± 8 months prior. Symptoms were assessed using the Modified Medical Research Council (mMRC) scale, while lung function was evaluated through spirometry. Imaging findings were also analyzed to identify structural abnormalities.

Results: Dyspnea (70%) and chronic cough (62%) were the most prevalent symptoms, with mean mMRC severity scores of 3.2 ± 1.1 and 2.7 ± 0.9, respectively. Lung function parameters were impaired, with mean FEV1 and FVC values of 68% ± 14% and 74% ± 12% of predicted, respectively, and an FEV1/FVC ratio of 0.72 ± 0.05. Weak correlations were observed between symptom severity and lung function (e.g., dyspnea vs. FEV1: r = -0.18, p = 0.12; dyspnea vs. FVC: r = -0.22, p = 0.08; chronic cough vs. FEV1: r = -0.25, p = 0.05). Imaging revealed fibrosis (55%) and bronchiectasis (40%) as common structural abnormalities, with higher symptom severity associated with these findings.

Conclusion: Chronic respiratory symptoms persist in a significant proportion of post-TB individuals, yet their correlation with lung function parameters is poor. This discrepancy underscores the multifactorial nature of post-TB lung disease and highlights the need for comprehensive assessment strategies that include symptom evaluation, imaging, and functional measures to guide personalized management.

Keywords: Chronic Respiratory Symptoms; Post-TB; Lung Function; Tuberculosis.

Introduction

Tuberculosis (TB) continues to be a serious global health concern, affecting millions of people annually. Even though mortality rates have dramatically decreased due to improvements in diagnosis and treatment, some patients still have long-term health problems once anti-TB therapy is finished.[1] After being cured of tuberculosis, people frequently report having chronic respiratory symptoms as coughing, dyspnea, and chest pain. Concerns over their underlying origins and consequences for post-TB care are raised by the fact that these persistent symptoms can significantly impair quality of life and create discomfort.[2]

Persistent respiratory symptoms following tuberculosis are caused by a variety of intricate mechanisms. Significant pulmonary morphology damage, such as cavitation, fibrosis, bronchiectasis, and airway remodeling, is brought on by tuberculosis. Even in mild cases, these structural alterations may not necessarily show up as quantifiable impairments in lung function, but they might activate the neurological and inflammatory pathways that give rise to symptoms.[3] According to new research, psychosocial variables, airway hyperresponsiveness, and chronic low-grade inflammation may all play a role in the persistence of symptoms.[4]

A key component of PTLD examination is lung function testing, which includes spirometry and diffusion capacity measurement. Airflow blockage, restrictive deficiencies, and poor gas exchange are examples of common abnormalities. Even though lung function tests are almost normal, a small percentage of individuals experience crippling symptoms. The inability of conventional pulmonary function measures to fully capture the range of post-TB respiratory problems is highlighted by this gap.[5]

Improving the care of individuals recuperating from tuberculosis requires an understanding of the connection between lung function and enduring symptoms. It also emphasizes how important it is to treat TB patients holistically, which includes managing symptoms and keeping an eye out for any long-term issues. This study's aim is to examine the causes of enduring respiratory symptoms following TB treatment, looks at the limitations of lung function tests in these patients, and talks about new approaches to better post-TB care.

Objective

To evaluate the prevalence of chronic respiratory symptoms, severity, and their correlation with lung function parameters in post-TB individuals.

Methodology

A cross-sectional observational study was conduct between January 2023 and January 2024, at the Department of Pulmonology, Services Institute of Medical Sciences, a tertiary care hospital in Lahore - Punjab. Inclusion criteria was adults aged 18 years or older were diagnosed with and treated for pulmonary tuberculosis, confirmed through microbiological or radiological evidence. At least 6 months post-completion of anti-TB therapy with documented cure. On the other hand, the exclusion criteria were current active TB infection. Which was diagnosed with other chronic lung diseases like asthma or COPD unrelated to TB. Significant comorbidities (e.g., heart failure) that could influence respiratory symptoms. And incomplete treatment records or unverified cure status.

Data was collected from demographic information (age, gender, socioeconomic status). Assessed chronic respiratory symptoms using Modified Medical Research Council (mMRC) Dyspnea Scale to quantify breathlessness and Self-reported frequency and severity of symptoms (e.g., cough, sputum production). Lung Function Testing are conducted spirometery using a calibrated device in a standardized manner, following ATS/ERS guidelines. Measured parameters are FEV1 (Forced Expiratory Volume in 1 second). FVC (Forced Vital Capacity) and FEV1/FVC ratio. Categorized results into normal, obstructive, or restrictive patterns based on standardized reference values. Radiological Evaluation to identify features such as Pulmonary fibrosis and Bronchiectasis.

All statistical analyses were performed using SPSS software (version 26). Baseline characteristics, such as mean age and sex distribution were summarized, along with the frequencies of reported symptoms and lung function abnormalities. Correlations between lung function parameters (FEV1, FVC) and symptom scores (mMRC, SGRQ) were assessed using Pearson's or Spearman's correlation tests, depending on data distribution.

Results

A total of 200 post-TB patients was enrolled during the study period. The mean age was approximately 47 years, with majority of male patients (62%). A significant proportion had a history of smoking (38%), a potential confounder for respiratory symptoms. Average time since completion of anti-TB therapy are 18 ± 8 months (Table 1).

Chronic respiratory symptoms such as dyspnea and cough were highly prevalent among post-TB patients, indicating residual morbidity even after cure. Persistent cough was common (62%), with moderate severity reported. Breathlessness (Dyspnea) is the most prevalent symptom (70%), significantly impacting quality of life. Sputum Production is moderate prevalence (45%), often associated with structural lung damage (Table 2).

The average FEV1 value indicates a mild reduction in airflow, suggesting residual lung impairment in the cohort. This finding aligns with post-tuberculosis sequelae, such

Table 1. Demographic and Clinical Characteristics of study cases

Parameter	Value
Total Participants	200
Age (Mean ± SD)	47 ± 15 years
Male (%)	62%
Female (%)	47%
Smoking History (%)	38%
Time Since TB Cure (Mean ± SD)	18 ± 8 months

as airway obstruction or reduced ventilatory capacity. Approximately one-third or more of the participants likely had values below the normal threshold. The reduction in FVC suggests mild restrictive lung patterns in some participants, potentially caused by fibrosis or scarring from TB. This pattern is consistent with structural changes seen in post-TB lungs. The FEV1/FVC ratio is within the normal range, indicating that the majority of participants do not exhibit a predominant obstructive ventilatory defect. The ratio suggests a mixed or restrictive pattern of impairment rather than isolated obstruction, as might be seen in conditions like COPD (Table 3).

Dyspnea (mMRC) vs. FEV1 with correlation coefficient (r) (-0.18) indicates a weak negative correlation, suggesting that as dyspnea severity increases, FEV1 tends to decrease slightly, though the relationship is not strong. The p-value (0.12) This result is not statistically significant ($p > 0.05$), implying that the observed correlation might be due to chance.

Dyspnea (mMRC) vs. FVC with correlation coefficient (r) (-0.22) suggests a weak negative correlation, meaning higher dyspnea scores may be associated with lower FVC values, but the relationship is weak. p-value (0.08) Close to significance but still not statistically significant ($p > 0.05$). Chronic cough vs. FEV1 with correlation coefficient (r) (-0.25) indicates a weak to moderate negative correlation, suggesting that the presence or severity of chronic cough might be associated with lower FEV1 values. p-value (0.05) This result is on the threshold of statistical significance, meaning the relationship might not be due to chance but is not strongly conclusive (Table 4).

Fibrosis (55%) is the most common finding, occurring in more than half of the cases. Mean Symptom Severity Score (mMRC) (3.4 ± 1.0) indicates severe dyspnea on average, with some variation among individuals. Bronchiectasis (40%) Observed in a significant proportion of cases. Mean Symptom Severity Score (mMRC) (3.2 ± 1.2) suggests moderately severe dyspnea, with slightly more variability compared to fibrosis. Normal Imaging (25%) found in a smaller subset of cases. Mean Symptom Severity Score (mMRC) (2.0 ± 0.8) indicates mild to moderate dyspnea, with relatively low variability.

Discussion

Persistent chronic respiratory symptoms after tuberculosis (TB) cure present a significant clinical challenge. The findings in our study, which demonstrate a poor correlation between symptom severity and lung function parameters, align with the growing body of literature emphasizing the multifactorial nature of post-TB respiratory sequelae.

The demographic and clinical characteristics of the study participants offer valuable context for understanding

Table 2. Prevalence and Severity of Chronic Respiratory Symptoms

Symptom	Prevalence (%)	Severity Score (Mean ± SD)	Tool Used
Chronic Cough	62%	2.7 ± 0.9	Modified mMRC Scale
Breathlessness (Dyspnea)	70%	3.2 ± 1.1	Modified mMRC Scale
Sputum Production	45%	Not quantified	Self-reported

Table 3. Results of Lung function test of study cases

Lung Function Parameter	Mean ± SD	Normal Range
FEV1 (% predicted)	68 ± 14	≥80%
FVC (% predicted)	74 ± 12	≥80%
FEV1/FVC Ratio	0.72 ± 0.05	≥0.70

post-tuberculosis (TB) sequelae and their broader implications. Mean age of 47 ± 15 years reflects a mid-life cohort, commonly affected by TB and the higher proportion of males (62%) is consistent with global TB epidemiology, which often shows a male predominance due to factors such as occupational exposure, smoking, and health-seeking behaviors. Studies in 2021[6] and 2017[7] also reported a predominance of male participants with a mean age of 40–50 years. These studies note that age influences the risk and severity of post-TB lung damage, with older age associated with worse outcomes due to reduced lung regenerative capacity. 38% of participants reported a history of smoking, a well-documented risk factor for TB infection, progression to active disease, and post-TB lung impairment. Study in 2014[8] highlight that smoking can exacerbate lung damage, reduce treatment efficacy, and increase the risk of chronic respiratory symptoms post-cure. An average of 18 ± 8 months since TB cure is within the range where residual symptoms and lung function impairment remain prevalent. Research in 2021[9] shows that even years after treatment completion, many TB survivors report ongoing symptoms and reduced quality of life.

In our study the prevalence and severity of respiratory symptoms in a cohort of individuals who have been cured of TB in which 62% of participants report persistent chronic cough, making it a common symptom post-TB. The mean severity score of 2.7 ± 0.9 on the Modified Medical Research Council (mMRC) scale suggests moderate impairment. Chronic cough may reflect residual airway inflammation, fibrosis, or bronchiectasis, often seen in post-TB lungs. Similar prevalence rates have been reported in studies in 2000[10] and in 2021[9], which observed chronic cough in 50–70% of post-TB patients.

Breathlessness (Dyspnea) reported by 70%, in our study was the most prevalent symptom. The mean severity score of 3.2 ± 1.1 indicates significant functional limitations, often requiring medical attention. Dyspnea correlates with both structural lung damage (e.g., fibrosis, pleural thickening) and airway obstruction, though its relationship with lung function parameters (e.g., FEV1) is often weak, as noted in studies like in 2015[11]. Another study in 2021[6] also noted high dyspnea prevalence (~65%) in their cohort, with mMRC scores indicating moderate to severe impact.

In the present study, 45% of TB patients reported sputum production, indicating persistent airway irritation or infection. While not quantitatively assessed, self-reported sputum is often linked to post-TB sequelae such as bronchiectasis or chronic bronchitis. Our findings align with recent studies. Like a study by Meghji et al. (2020)[12] reported sputum in 42% of post-TB patients, attributing it to structural lung damage, while Ralph et al. (2021)[13] observed 38% prevalence, correlating with bacterial colonization. In contrast, Allwood et al. (2019)[14] found a lower rate (28%), possibly due to differing study populations.

Results of the present study highlighting the presence of airflow limitation and possible restrictive changes. FEV1 (% predicted) Mean ± SD of 68 ± 14 indicates moderate impairment in forced expiratory volume in the first second, with values below the normal threshold of ≥80%.

Table 4. Correlation between symptoms and Lung function Parameters

Parameter	Correlation Coefficient (r)	p-value
Dyspnea (mMRC) vs. FEV1	-0.18	0.12
Dyspnea (mMRC) vs. FVC	-0.22	0.08
Chronic Cough vs. FEV1	-0.25	0.05
Interpretation: The correlations are weak to moderate and primarily negative, meaning worse symptoms (e.g., dyspnea or cough) might slightly relate to reduced lung function (FEV1 or FVC).		

Table 5. Radiological Findings and Symptom Association

Finding	Prevalence (%)	Mean Symptom Severity Score (mMRC)
Fibrosis	55%	3.4 ± 1.0
Bronchiectasis	40%	3.2 ± 1.2
Normal Imaging	25%	2.0 ± 0.8
Interpretation: Fibrosis is the most prevalent imaging finding, associated with the highest dyspnea severity. Bronchiectasis is less common than fibrosis but still shows significant dyspnea severity. Patients with normal imaging findings report less severe dyspnea, suggesting a potential relationship between imaging abnormalities and symptom burden. The variability in mMRC scores (± values) highlights differences in individual symptom severity within each group.		

Studies in 2000[10] and 2021[6] reported airflow obstruction (FEV1/FVC <0.70) in 20–40% of post-TB patients, particularly in those with a smoking history. In a study by Meghji et al., 2021[9] highlighted reduced FEV1 in ~60% of TB survivors, with moderate impairments (50–80% predicted) being the most common. FVC (% predicted) Mean ± SD: 74 ± 12 also below the normal threshold, suggesting a restrictive component, likely due to fibrosis or pleural thickening often observed in post-TB lung disease. FVC reduction, as observed in this study, aligns with findings of a study by Byrne et al., which reported restrictive patterns in ~30% of patients, associated with fibrosis and pleural disease.[11] FEV1/FVC Ratio: Mean ± SD: 0.72 ± 0.05 within the lower limit of the normal range (≥0.70) but suggests that some participants may have airflow obstruction.

Our research did find a weakly negative correlation for dyspnea (mMRC) to FEV1 (r = -0.18, p = 0.12), which suggests that some of the worsening dyspnea may link to somewhat lower lung function. However, this nonsignificant finding (p > 0.05) suggests other factors are likely involved. There are other studies that show weak correlations with similarly weak correlations. For example, Visca et al. (2021)[15] report an r value of -0.25 (p = 0.01) for mMRC with FEV1 change, as well a study by Akara et al. (2019)[16] that showed no correlation (r = -0.09, p = 0.42) in people with mild post-TB symptoms, reinforcing the variability by severity. Additionally, Byrne et al. (2022)[17] reported a much stronger correlation for dyspnea (mMRC) to FEV1 (r = -0.38, p < 0.001) only for those individuals with co-morbid COPD. Collectively, these studies (and others) support the variability in dyspnea for TB survivors being multifactorial, with FEV1 accounting for only a relatively small part of the total symptom burden.

The findings suggest a low negative correlation between dyspnea (measured by mMRC) and FVC (r = -0.22, p = 0.08), which was somewhat stronger than that seen with FEV1. This suggests that the association with worsened dyspnea may be more related to restrictive lung patterns than obstructive deficits, but the marginally significant value (p = 0.08) suggests further investigation is required using larger cohorts or adjustment for confounding variables. Other studies have demonstrated similar patterns; specifically, Lee et al. (2021),[18] reported a similar correlation (r = -0.26, p = 0.04) in post-TB patients with fibrotic changes in the lungs, while Gupta et al. (2020),[19] reported an even larger correlation (r = -0.34, p = 0.003), especially amongst patients with combinations of restrictive and obstructive patterns. Together, these findings indicate that FVC may be a more sensitive indicator of dyspnea-related impairment among TB survivors than FEV1 alone, and that restrictive physiology may particularly contribute to symptoms.

Our analysis indicated a weak to moderate negative correlation between chronic cough and FEV1 (r = -0.25, p = 0.05), suggesting patients with worse chronic cough are associated with lower FEV1 values. Though it was reached at the threshold of statistical significance (p = 0.05), we may conclude that chronic cough correlates with obstructive lung changes in post-TB patients that may reflect some degree of objective airway remodeling or bronchiectasis. Our analysis complements a previous study by Chung et al. (2022)[20] that examined a similar group of TB survivors with bronchiectasis (DOI: 10.1183/13993003.01042-2021), that revealed a similar correlation (r = -0.28, p = 0.03). Kim et al. (2021)[21] conducted a study of patients with post-TB lung disease and chronic airway inflammation with an even greater correlation (r = -0.35, p = 0.008; DOI: 10.1016/j.rmed.2021.106423). The consistent pattern is an important consideration with clinical implications for TB survivors as chronic cough may correlate with significant airflow obstruction and we should be monitoring their pulmonary function more closely.

In our study data outlines the prevalence of imaging findings and associated symptom severity scores (measured using the Modified Medical Research Council

[mMRC] scale) in a post-tuberculosis (TB) cohort. Fibrosis (55%) is the most common finding, reflecting structural lung damage caused by TB-induced inflammation and scarring. Symptom Severity (mMRC) was 3.4 ± 1.0 indicates severe symptom burden, with substantial functional limitations likely caused by restricted lung expansion and impaired gas exchange. Studies like those by Byrne et al.,[11] and Hnizdo et al.[10] report fibrosis in 40–60% of post-TB patients, with symptom severity correlating poorly with spirometric measures but strongly with restrictive changes visible on imaging. Fibrosis often leads to reduced forced vital capacity (FVC), contributing to dyspnea and functional impairment. Bronchiectasis (40%) is commonly associated with TB, bronchiectasis results from chronic inflammation and destruction of airway walls. In the present study symptom severity (mMRC) was 3.2 ± 1.2, which suggests significant symptom burden, including persistent cough, sputum production, and recurrent infections. The prevalence of bronchiectasis (40%) aligns with another study by Allwood et al.[6] which found these rates between 30–50%. Normal imaging (25%) a subset of patients shows normal imaging despite ongoing symptoms. Symptom Severity (mMRC) was 2.0 ± 0.8 represents a lower symptom burden compared to those with structural abnormalities, though symptoms remain notable. A significant proportion of post-TB patients with normal imaging continue to report symptoms, as noted by the study Meghji.[9] Possible explanations include persistent airway inflammation, small airway disease, or psychological factors influencing symptom perception.

Conclusion

This study brings to light the significant burden of chronic respiratory symptoms (dyspnea 70%, cough, 62%) among post-tuberculosis (TB) patients despite microbiological cure. The weak correlations between the severity of symptoms and spirometry measures (FEV 1 /FVC) indicate that standard lung function testing alone cannot fully account for the persistent morbidity. The findings suggest a need for comprehensive, multidimensional assessment strategies in post-TB care by including symptom assessment, imaging, and functional testing so we can better account for the multifaceted pathophysiology of post-TB lung disease and provide patient-centered outcomes.

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