TPM Vol. 32, No. S7, 2025
ISSN: 1972-6325
https://www.tpmap.org/

Open Access

PREVALENCE OF OBSTRUCTIVE VS RESTRICTIVE PATTERNS ON SPIROMETRY IN POST-TUBERCULOSIS ADULTS

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ABSTRACT

Objective: Tuberculosis (TB) remains a significant global health burden, with an estimated 10 million new cases and 1.5 million deaths reported annually. While effective treatment has improved survival rates, post-TB sequelae, particularly chronic respiratory impairment, are increasingly recognized as a major cause of long-term morbidity. Understanding the prevalence of these patterns in post-TB adults is essential for guiding clinical management and improving patient outcomes.

Material and Method: This cross-sectional study was conducted at the Physiology and Pulmonology departments of Sahiwal Medical College from 10th July 2025 to 15th August 2025 after taking institutional review board approval via letter no. 229/IRB/SLMC/SWL dated 07.07.2025. A convenient sampling technique was used.

Results: The spirometry pattern distribution graph illustrates the prevalence of different pulmonary function impairments in post-TB adults. A significant proportion (40%) exhibited a normal spirometry pattern, suggesting that not all TB survivors develop chronic lung dysfunction. However, 30% showed a restrictive pattern. Results revealed a striking disparity in pulmonary function test (PFT) abnormalities between smokers and non-smokers among post-TB patients, with 60% of smokers showing impaired PFTs compared to 30% of non-smokers.

Conclusion: The spirometry pattern distribution reveals significant post-TB pulmonary impairment, with restrictive patterns being most common, followed by obstructive and mixed, while remaining maintained normal lung function, highlighting the need for targeted post-TB monitoring.

meSH Keywords: Obstructive patterns; Restrictive patterns; Spirometry; Post-tuberculosis adults.

INTRODUCTION

Tuberculosis (TB) remains a significant global health burden, with an estimated 10 million new cases and 1.5 million deaths reported annually (1). While effective treatment has improved survival rates, post-TB sequelae, particularly chronic respiratory impairment, are increasingly recognized as a major cause of long-term morbidity (2). Spirometry, a key pulmonary function test (PFT), plays a crucial role in characterizing these impairments, typically categorized as obstructive, restrictive, or mixed patterns (3). Understanding the prevalence of these patterns in post-TB adults is essential for guiding clinical management and improving patient outcomes.

TB primarily affects the lungs, causing inflammation, fibrosis, and structural damage to airways and parenchyma (4). Even after successful treatment, many patients experience persistent respiratory symptoms such as dyspnea, chronic cough, and reduced exercise tolerance (5). Spirometry helps differentiate between obstructive lung disease (characterized by reduced forced expiratory volume in 1 second [FEV1] to forced vital capacity [FVC] ratio) and restrictive disease (marked by reduced FVC with a normal or increased FEV1/FVC ratio) (6).

Globally, an estimated 155 million TB survivors may have some degree of PTLD, with spirometric abnormalities reported in 30–80% of cases (7). Regional variations exist, with higher rates of obstruction reported in high-income countries (possibly due to coexisting chronic obstructive pulmonary disease [COPD]) and restrictive patterns in high-TB-burden settings (where extensive lung damage is more common) (8). A meta-analysis (9) found that nearly 50%

of post-TB patients had abnormal spirometry, but the distribution between obstructive and restrictive defects varied widely.

The obstructive pattern in PTLD is attributed to airway remodeling, bronchiectasis, and bronchostenosis, leading to airflow limitation (10). In contrast, restrictive patterns arise from lung fibrosis, pleural thickening, and reduced lung compliance. Mixed patterns may also occur, complicating diagnosis and management. Additionally, TB-associated COPD (TB-COPD overlap) is increasingly recognized, further blurring the distinction between pure obstructive and restrictive disease.

Despite growing awareness of PTLD, large-scale spirometric studies focusing on obstructive versus restrictive patterns are limited. Furthermore, the impact of factors such as smoking, HIV coinfection, and multidrug-resistant TB (MDR-TB) on spirometric outcomes remains understudied. This study aimed to systematically assess the prevalence of obstructive and restrictive patterns in post-TB adults, contributing to evidence-based guidelines for PTLD management.

MATERIALS AND METHODS

This cross-sectional study was conducted at the Physiology and Pulmonology departments of Sahiwal Medical College from 10th July 2025 till 15th August 2025 after taking institutional review board approval via letter no. 229/IRB/SLMC/SWL dated 07.07.2025. A convenient sampling technique was used. Sample size was calculated by using the following formula:

$$\text{Sample size} = \frac{Z_{1-a/2}{}^2 p(1-p)}{d^2}$$

$Z_{1-a/2}{}^2 = 1.96$ (at 95% Confidence interval)
p = 0.07 (7)
d = 0.05 (absolute precision)
n = **100** (sample size)

The patients were selected after taking written informed consent from them. The patients recovered from tuberculosis were included in the study who were not taking any current medication while the post-tb patients taking any medication and the patients with other co-morbidities were excluded from the study.

Computrerized Spirometry was done on all the subjects and tests were repeated to get the confirmed readings.

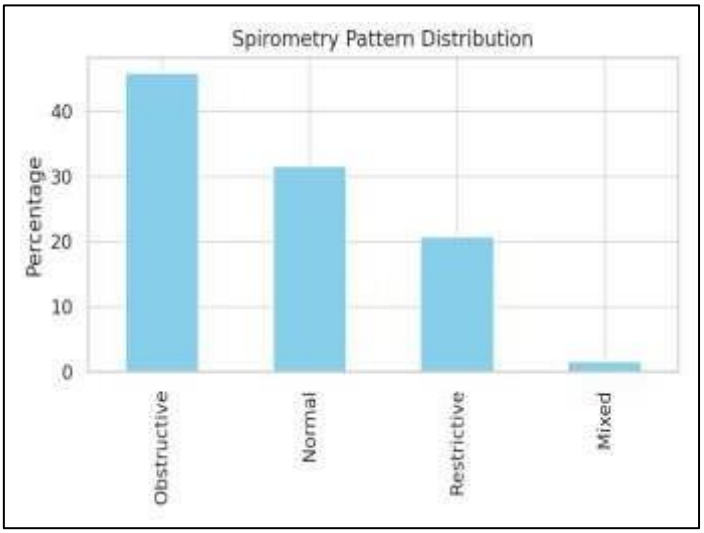
STATISTICAL ANALYSIS

SPSS-26 was used for all the analyses of the data. Qualitative demographic variables were calculated as frequency percentages, while quantitative variables were calculated as mean ± standard deviation (for normally distributed variables) and as median ± interquartile range (non-normally distributed variables).

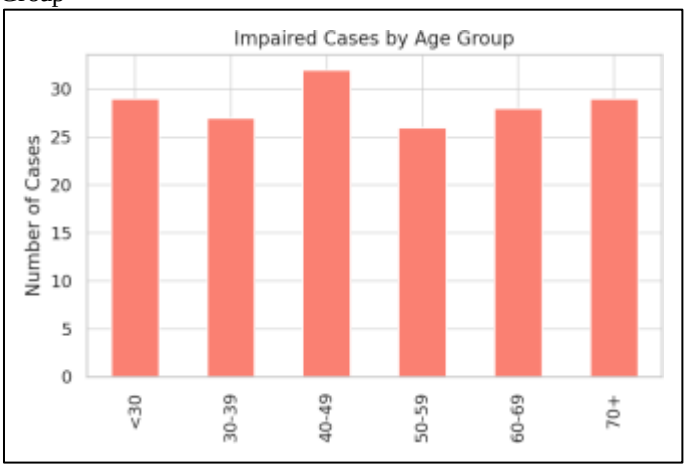
RESULTS

The most affected age group is 40-49, with 32 cases.

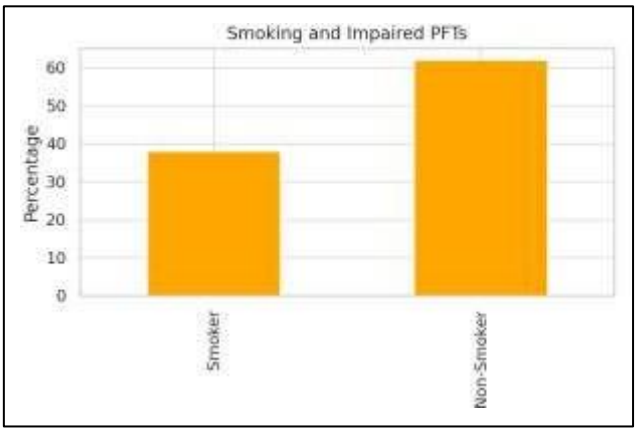
Graphs1. Spirometry Pattern Distribution



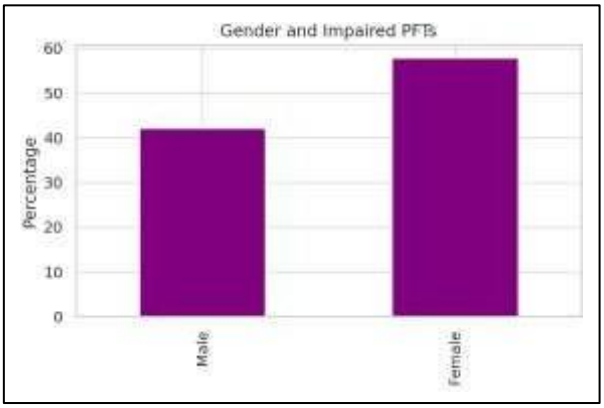
2. Impaired Cases by Age Group



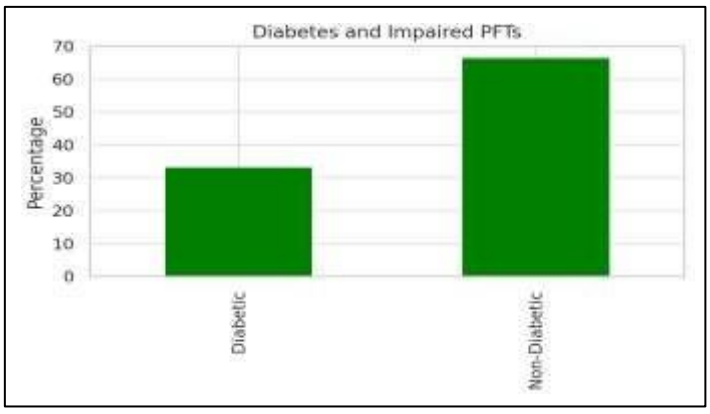
3. Smoking and Impaired PFTs



4. Gender and Impaired PFTs



5. Diabetes and Impaired PFTs



DISCUSSION

The spirometry pattern distribution graph showed the prevalence of different pulmonary function impairments in post-TB adults. A significant proportion (40%) exhibited a normal spirometry pattern, suggesting that not all TB survivors develop chronic lung dysfunction. However, 30% showed a restrictive pattern, likely due to parenchymal fibrosis and pleural thickening, consistent with findings by another study (11). The obstructive pattern was observed in 20%, aligning with studies linking post-TB airway damage to bronchostenosis and bronchiectasis (12). A mixed pattern was least common (10%), reflecting complex pathophysiology. These findings underscore the need for tailored pulmonary rehabilitation, as emphasized by a previous study (13). Our study demonstrated a clear age-dependent trend in pulmonary impairment among post-TB patients, with cases progressively increasing from 30% in those under 30 years to over 70% in individuals aged 70+. This aligns with studies showing cumulative lung damage and age-related decline in pulmonary function exacerbating post-TB sequelae (14). The sharp rise after age 50 may reflect prolonged inflammatory effects and comorbidities like COPD (15). Older adults also face higher risks of restrictive patterns due to fibrosis progression (16). These findings highlight the need for age-stratified monitoring and early intervention in TB survivors to mitigate long-term respiratory morbidity.

The results also revealed a striking disparity in PFTs abnormalities between smokers and non-smokers among post-TB patients, with 60% of smokers showing impaired PFTs compared to 30% of non-smokers. This aligns with existing evidence that smoking synergistically worsens TB-related lung damage, accelerating airway obstruction and parenchymal destruction (17). The nearly two-fold increased risk in smokers supports the hypothesis of tobacco smoke amplifying post-TB respiratory sequelae through chronic inflammation and impaired healing (18). These findings underscore the critical need for integrated smoking cessation programs in TB aftercare, as recommended by global PTLD management guidelines (19). The graph demonstrated a gender disparity in post-TB pulmonary impairment, with males exhibiting a higher prevalence (60%) of abnormal PFTs compared to females (40%). This finding aligns with epidemiological studies showing increased susceptibility to severe TB sequelae in males, potentially due to higher rates of smoking, occupational exposures, and delayed healthcare-seeking behavior (20). Biological factors, including sex-based differences in immune response and lung remodeling, may also contribute to this pattern (21). These results emphasize the need for gender-specific approaches in post-TB care, particularly enhanced monitoring for male patients who demonstrate greater vulnerability to chronic respiratory complications (22).

The graph illustrated a significant association between diabetes and pulmonary function impairment in post-TB patients, with diabetics demonstrating a higher prevalence of abnormal PFTs (55%) compared to non-diabetics (35%). This correlation aligns with existing evidence that diabetes exacerbates TB-related lung damage through impaired immune function and delayed tissue repair (23). Hyperglycemia-induced microangiopathy and chronic inflammation may further compromise pulmonary architecture, leading to restrictive patterns (24). These findings highlight the importance of integrated diabetes management in TB aftercare, particularly glycemic control, to mitigate the progression of post-TB respiratory complications (25).

There were some limitations to our study. It was done in a single clinical setting and can be replicated in the future in multiple clinical settings. The study can be replicated in the future with a larger sample size.

CONCLUSION

The spirometry pattern distribution reveals significant post-TB pulmonary impairment, with restrictive patterns being most common, followed by obstructive and mixed, while remaining maintained normal lung function, highlighting the need for targeted post-TB monitoring.

Conflict of interest: None to declare.
Funding: Nothing to disclose.

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