

Clinical Presentation, Diagnostic Evaluation, and Treatment Characteristics of Tuberculosis Patients in Lahore, Pakistan: A Multicenter Cross-Sectional Study

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ABSTRACT

Background: Pulmonary tuberculosis remains a major public-health concern in Pakistan, but multicentre evidence describing patients' clinical presentation, diagnostic evaluation, and treatment experiences remains limited. **Objective:** To describe the demographic characteristics, clinical presentation, investigations performed, and selected treatment characteristics of adults with pulmonary tuberculosis receiving care in Lahore. **Methods:** This multicentre descriptive cross-sectional study included 330 adults receiving pulmonary tuberculosis treatment at eight public, private, and district TB association facilities between September 2023 and September 2024. Participants were recruited through convenience sampling, and data were collected through structured face-to-face interviews. Descriptive analysis was performed using IBM SPSS Statistics version 27.0. **Results:** The mean age was 42.4 ± 16.0 years, and 64.8% of participants were male. Fatigue was reported by 89.4%, cough lasting more than three weeks by 77.0%, unintended weight loss by 69.7%, fever by 68.8%, and night sweats by 67.6%. Chest radiography and sputum smear microscopy were performed in all participants, while culture, GeneXpert, and Mantoux testing were reported in 93.6%, 78.8%, and 61.8%, respectively. Most participants received outpatient care (86.1%). Medication-related side effects, current TB-related symptoms, and missed medication doses were reported by 16.7%, 20.6%, and 15.8%, respectively. **Conclusion:** Participants commonly presented with classical respiratory and constitutional symptoms and received several diagnostic investigations, although molecular testing was not universal. Reported side effects, ongoing symptoms, and missed doses indicate areas requiring continued clinical monitoring and patient-centred treatment support. **Keywords:** Pulmonary tuberculosis; Clinical presentation; Diagnostic investigations; Treatment adherence; Cross-sectional study; Pakistan.

INTRODUCTION

Tuberculosis (TB) remains a major global public-health challenge, particularly in low- and middle-income countries. The World Health Organization estimated approximately 10.6 million incident cases and 1.3 million TB-related deaths worldwide, demonstrating the continuing burden of preventable morbidity and mortality associated with the disease (1). Pakistan is among the five countries with the highest TB burden, with an estimated 623,000–686,000 new cases annually and an incidence of approximately 277 cases per 100,000 population (2). The burden is not uniformly distributed across the country. Subnational estimates indicate considerable geographical variation, with Punjab accounting for a substantial proportion of notified cases because of its large population, rapid urbanisation, socioeconomic inequalities, and variation in access to diagnostic and treatment services (3). These

conditions, together with delayed diagnosis, treatment interruption, and the emergence of drug-resistant disease, continue to impede national and global TB-control efforts (4).

Pulmonary tuberculosis (PTB), the principal transmissible form of the disease, may present with respiratory and constitutional symptoms of variable severity. Persistent cough, fever, unintended weight loss, night sweats, fatigue, chest pain, reduced appetite, dyspnoea, and haemoptysis are commonly reported, although individual symptoms are not specific to TB and may overlap with those of other respiratory conditions (5). Consequently, diagnosis generally requires an integrated assessment incorporating clinical evaluation, chest radiography, and bacteriological or molecular testing. Sputum smear microscopy remains widely used in resource-constrained settings because of its affordability and accessibility, although its diagnostic sensitivity is lower than that of rapid molecular assays. The GeneXpert MTB/RIF assay enables rapid detection of *Mycobacterium tuberculosis* and rifampicin resistance and is recommended by the World Health Organization as an important initial diagnostic test for individuals with presumptive pulmonary TB (6). However, unequal access to molecular diagnostics, laboratory limitations, delayed healthcare seeking, and inefficient referral pathways can prolong the time between symptom onset, diagnosis, and treatment initiation. Such delays increase the duration of infectiousness and may contribute to community transmission and more advanced disease at presentation (7).

Early initiation and completion of appropriate anti-tuberculosis treatment are essential for controlling transmission and improving patient outcomes. In Pakistan, TB services are delivered through the National Tuberculosis Control Programme and associated public, private, and community-based facilities, with first-line anti-tuberculosis medicines provided without charge through programme-supported services. Nevertheless, medication-related adverse effects, socioeconomic constraints, stigma, transportation difficulties, inadequate social support, and competing occupational responsibilities may interfere with treatment adherence. Research conducted in Lahore has identified non-adherence as an important challenge among patients receiving anti-tuberculosis treatment (8). Drug-resistant disease and previous treatment exposure have also been associated with unfavourable treatment outcomes in patients managed at specialised treatment centres in Lahore (9). Understanding patients' treatment settings, ongoing symptoms, medication-related side effects, and missed doses may therefore help identify aspects of care requiring additional patient support.

Previous studies from Pakistan have generally examined individual components of TB care, including treatment adherence, drug resistance, diagnostic performance, or treatment outcomes. Comparatively limited multicentre evidence is available describing clinical presentation, investigations performed, and selected treatment characteristics within the same patient population across public, private, and district TB association facilities. Such information is particularly relevant in Lahore, where patients receive TB care through several service-delivery models. Therefore, this multicentre descriptive cross-sectional study aimed to describe the demographic characteristics, clinical presentation before diagnosis, diagnostic investigations performed, treatment setting, medication-related side effects, persistent TB-related symptoms, and missed treatment doses among adults with pulmonary tuberculosis receiving care at selected healthcare facilities in Lahore, Pakistan.

MATERIALS AND METHODS

A multicentre descriptive cross-sectional study was conducted between September 2023 and September 2024 among adults with pulmonary tuberculosis receiving treatment at selected healthcare facilities in Lahore, Punjab, Pakistan. The cross-sectional design was used to describe the demographic profile, clinical presentation, diagnostic investigations, and selected treatment characteristics of patients receiving care during the study period. Eight facilities were selected using information available in the Directory of TB Centres and records of the Pakistan Anti-Tuberculosis Association to represent different TB service-delivery settings. These facilities comprised four public-sector hospitals—Sir Ganga Ram

Hospital, Social Security Teaching Hospital, Mayo Hospital, and Services Hospital—three Lahore District TB Association centres, and one private-sector facility, the University of Lahore Hospital. Administrative permission was obtained from each participating facility before data collection.

The study population comprised adults aged 18–75 years who had been diagnosed with pulmonary tuberculosis through clinical, radiological, bacteriological, molecular, or combined diagnostic assessment and were receiving anti-tuberculosis treatment at one of the participating facilities. Patients with extrapulmonary tuberculosis were excluded. Pregnant patients and those with other chronic respiratory diseases or severe comorbid conditions, including diabetes mellitus, cardiovascular disease, chronic kidney disease, and liver disease, were also excluded. Eligible patients were enrolled through non-probability convenience sampling until the required sample size was achieved.

The minimum sample size was calculated using the single-population proportion formula for cross-sectional studies. The calculation produced a minimum requirement of 329 participants, and 330 eligible patients were ultimately enrolled to meet the target sample. Data were collected through structured face-to-face interviews using a standardised data-collection form. The form captured participants' age, sex, educational attainment, and employment status. Clinical-presentation variables included cough lasting more than three weeks, unintended weight loss, difficulty breathing, fever, night sweats, chest pain, haemoptysis, fatigue, and loss of appetite experienced before the diagnosis of pulmonary tuberculosis. Each symptom was recorded separately, and participants could report more than one symptom.

Information concerning diagnostic evaluation included participants' reports of whether chest radiography, sputum smear microscopy, mycobacterial culture, GeneXpert testing, and Mantoux testing had been performed as part of their clinical assessment. These variables represented the utilisation of the respective investigations and were not treated as measures of diagnostic positivity, diagnostic accuracy, or treatment outcome. Treatment-related information included whether the participant was being managed as an outpatient or had required hospitalisation, whether medication-related side effects had been experienced, whether TB-related symptoms persisted during treatment, and whether one or more prescribed anti-tuberculosis medication doses had been missed. These variables were analysed as self-reported treatment characteristics rather than as measures of cure, treatment completion, treatment failure, or microbiological response.

Data were entered and analysed using IBM SPSS Statistics version 27.0. The analysis was descriptive and was aligned with the objective of characterising the study population rather than testing causal or predictive relationships. Categorical variables were summarised using frequencies and percentages, with 330 participants used as the denominator for the variables included in the analysis. Because individual participants could report multiple clinical symptoms, symptom percentages were calculated independently and were not expected to total 100%. Age was summarised using the mean and standard deviation. Percentages were calculated from the reported frequencies and presented to one decimal place.

The study was approved by the Ethics Review Committee of Lincoln University College, Malaysia, under approval number LUC/RMC/2023/014. The research was conducted in accordance with the ethical principles of the Declaration of Helsinki. Reporting of the study was guided by the Strengthening the Reporting of Observational Studies in Epidemiology recommendations.

RESULTS

A total of 330 adults with pulmonary tuberculosis participated in the study. The mean age was 42.4 ± 16.0 years, and 214 participants (64.8%) were male. The largest age group comprised participants aged 55–64 years, accounting for 70 participants (21.2%), followed by those aged 25–34 years, 68 (20.6%), and 45–54 years, 65 (19.7%). Overall, 235 participants (71.2%) were either illiterate or educated below

matriculation level. Regarding employment status, 153 participants (46.4%) were unemployed, 140 (42.4%) were employed, and 37 (11.2%) were students, as presented in Table 1.

The clinical manifestations reported before the diagnosis of pulmonary tuberculosis are shown in Table 2. Fatigue was the most frequently reported symptom, affecting 295 participants (89.4%). This was followed by cough lasting more than three weeks in 254 (77.0%), unintended weight loss in 230 (69.7%), fever in 227 (68.8%), and night sweats in 223 (67.6%). Chest pain and loss of appetite were reported by 201 (60.9%) and 198 (60.0%) participants, respectively, while 182 (55.2%) reported difficulty breathing. Haemoptysis was the least frequently reported manifestation and was reported by 81 participants (24.5%).

Table 1. Demographic Characteristics of the Participants

Characteristic	Category	n	%
Sex	Male	214	64.8
	Female	116	35.2
Age group, years	18–24	59	17.9
	25–34	68	20.6
	35–44	42	12.7
	45–54	65	19.7
	55–64	70	21.2
	65–75	26	7.9
Educational attainment	Illiterate	108	32.7
	Below matriculation	127	38.5
	Matriculation	30	9.1
	Intermediate	37	11.2
	Graduation	28	8.5
Employment status	Employed	140	42.4
	Unemployed	153	46.4
	Student	37	11.2

Note: Total sample, n = 330. Mean age was 42.4 ± 16.0 years.

Table 2. Clinical Presentation Before Pulmonary Tuberculosis Diagnosis

Clinical presentation	n	%
Fatigue	295	89.4
Cough lasting more than three weeks	254	77.0
Unintended weight loss	230	69.7
Fever	227	68.8
Night sweats	223	67.6
Chest pain	201	60.9
Loss of appetite	198	60.0
Difficulty breathing	182	55.2
Haemoptysis	81	24.5

Note: Total sample, n = 330. Participants could report more than one symptom; therefore, percentages do not total 100%.

Table 3. Diagnostic Investigations Performed Among the Participants

Diagnostic investigation	n	%
Chest radiography	330	100.0
Sputum smear microscopy	330	100.0
Mycobacterial culture	309	93.6
GeneXpert testing	260	78.8
Mantoux testing	204	61.8

Note: Total sample, n = 330. Values indicate whether each investigation was reported as having been performed and do not represent test positivity, diagnostic yield, or diagnostic accuracy.

Table 4. Selected Treatment Characteristics of the Participants

Treatment characteristic	Category	n	%
Reported treatment setting	Outpatient	284	86.1

Treatment characteristic	Category	n	%
	Hospitalised	46	13.9
Medication-related side effects	Yes	55	16.7
	No	275	83.3
Current TB-related symptoms	Yes	68	20.6
	No	262	79.4
Missed one or more medication doses	Yes	52	15.8
	No	278	84.2

The investigations reported as having been performed are summarised in Table 3. Chest radiography and sputum smear microscopy were performed in all 330 participants. Mycobacterial culture was reported in 309 participants (93.6%), while GeneXpert testing was performed in 260 (78.8%). Mantoux testing was reported in 204 participants (61.8%). These findings describe investigation utilisation and do not indicate the corresponding test results or diagnostic yield.

Most participants were managed in an outpatient setting, accounting for 284 individuals (86.1%), whereas 46 (13.9%) were classified as hospitalised. Medication-related side effects were reported by 55 participants (16.7%), and 68 (20.6%) reported experiencing current TB-related symptoms while receiving treatment. In addition, 52 participants (15.8%) reported missing one or more prescribed anti-tuberculosis medication doses. These findings are presented in Table 4.

DISCUSSION

This multicentre descriptive cross-sectional study characterised the demographic profile, clinical presentation, investigations performed, and selected treatment experiences of adults with pulmonary tuberculosis receiving care at public, private, and district TB association facilities in Lahore. The principal findings were a predominance of male participants, a substantial proportion of individuals with limited educational attainment or unemployment, frequent constitutional and respiratory symptoms before diagnosis, universal use of chest radiography and sputum smear microscopy, and less frequent use of GeneXpert and Mantoux testing. Most participants were receiving outpatient care, although medication-related side effects, ongoing symptoms, and missed treatment doses were reported by clinically relevant proportions of the sample.

Male participants accounted for almost two-thirds of the study population. This distribution is consistent with reports from other high-burden populations in Pakistan, in which men constitute a greater proportion of notified pulmonary TB cases (10). However, the present study did not assess the reasons for this sex distribution. Differences in occupational exposure, smoking, biological susceptibility, access to healthcare, and healthcare-seeking behaviour may contribute to male predominance, but these factors should be regarded as possible explanations derived from previous literature rather than findings of the present analysis. The mean age of 42.4 years indicates that a substantial burden occurred among adults of economically productive age, a pattern with potential implications for household income and treatment-related expenditure (11). The large proportion of participants with limited educational attainment or unemployment is also broadly consistent with the recognised concentration of TB among socioeconomically disadvantaged populations in Pakistan (12). Because the study did not include a non-TB comparison group, these characteristics cannot be interpreted as independent risk factors for developing TB.

Fatigue, prolonged cough, unintended weight loss, fever, and night sweats were the most frequently reported manifestations. These symptoms are compatible with the established clinical profile of pulmonary TB, although none is independently specific to the disease. Their non-specific nature may contribute to delayed recognition and treatment initiation, particularly when symptoms are initially considered minor or are managed outside formal TB services. Delays between symptom onset, diagnosis, and treatment initiation have been reported among adults with pulmonary TB in other high-burden settings (13). The symptom distribution in the present study was also broadly consistent with earlier findings from Pakistan, where chronic cough and constitutional symptoms were common presenting

features, while haemoptysis occurred less frequently (14). Haemoptysis should therefore not be regarded as a necessary feature for suspecting pulmonary TB, because many patients may present with less specific respiratory and constitutional symptoms.

Chest radiography and sputum smear microscopy were reported for every participant, while culture and GeneXpert testing were reported less consistently. This pattern reflects the continued role of conventional investigations within routine TB services. Nevertheless, test utilisation should not be interpreted as evidence of diagnostic accuracy or adherence to all diagnostic recommendations because the study did not record test results, specimen quality, smear grade, rifampicin resistance, radiographic findings, or the sequence in which investigations were performed. Rapid molecular assays offer greater sensitivity than smear microscopy and can simultaneously detect *Mycobacterium tuberculosis* and rifampicin resistance. Studies conducted in Pakistan have demonstrated the diagnostic contribution of GeneXpert MTB/RIF, particularly for the earlier detection of bacteriologically confirmed disease (15,16). The finding that GeneXpert was performed in 78.8% of participants suggests substantial utilisation within the participating facilities, although universal access was not observed. The reported frequency of culture testing should be interpreted cautiously and verified against laboratory or clinical records because the study relied on the investigation information available through its data-collection process.

Most participants were classified as receiving outpatient care. Ambulatory management is consistent with contemporary approaches to drug-susceptible pulmonary TB when patients are clinically stable and appropriate treatment, monitoring, and infection-control support are available (17,18). However, the treatment setting alone cannot be used to infer treatment success, clinical stability throughout therapy, or adequacy of care. Medication-related side effects were reported by 16.7% of participants. Adverse reactions to first-line anti-tuberculosis medicines are well recognised, but their frequency varies according to the treatment regimen, participant characteristics, assessment method, and severity threshold used (19). Because the present study did not document the specific medicines, treatment phase, duration, severity, or management of side effects, the findings should be considered descriptive and should not be interpreted as demonstrating overall treatment tolerability.

Approximately one-fifth of participants reported current TB-related symptoms while receiving treatment. Persistent symptoms may occur for several reasons, including the stage of treatment, residual pulmonary impairment, delayed clinical response, treatment interruption, drug resistance, or conditions unrelated to active TB. The study did not collect sufficient clinical or microbiological information to distinguish among these possibilities. Therefore, ongoing symptoms cannot be interpreted as evidence of treatment failure or as a measure of treatment response. Nevertheless, continued respiratory symptoms may have implications for clinical reassessment, patient counselling, and appropriate infection-prevention practices, particularly when infectivity has not been excluded (20).

Missed medication doses were reported by 15.8% of participants. Although the number of doses and the applicable recall period were not reported, any interruption in anti-tuberculosis treatment is clinically relevant because repeated or prolonged non-adherence may increase the risks of an incomplete therapeutic response, recurrence, continued transmission, and drug resistance (21). Research involving patients with TB in Pakistan has identified financial difficulty, transportation barriers, stigma, treatment-related side effects, insufficient counselling, and competing personal or occupational responsibilities as barriers to treatment adherence (22). Family and social support may also influence patients' ability to complete prolonged treatment regimens (23). The present study did not evaluate the causes of missed doses; consequently, these explanations should guide future investigation rather than be attributed directly to the study participants.

The findings have practical implications for TB services in high-burden urban settings. Persistent cough accompanied by constitutional symptoms should continue to prompt timely diagnostic assessment, even in the absence of haemoptysis. Molecular testing should be made consistently accessible where clinically indicated, and the reasons for variation in test utilisation across service settings should be evaluated.

Patients receiving outpatient treatment may benefit from structured monitoring for adverse effects, persistent symptoms, and medication interruptions. Such monitoring should be linked to timely clinical reassessment and adherence support rather than being used solely as an administrative measure of treatment attendance.

A strength of this study was the inclusion of participants from eight facilities representing public hospitals, a private hospital, and district TB association services. This broadened the range of healthcare settings represented in the sample. The use of a structured data-collection form also promoted consistency in recording the selected variables. Several limitations should nevertheless be considered. The cross-sectional design precluded assessment of temporal relationships, causal associations, or treatment outcomes. Convenience sampling may have introduced selection bias and limits the generalisability of the results beyond the participating facilities. The exclusion of patients with diabetes and other major comorbidities produced a clinically selected sample and may have reduced applicability to the broader TB population. Symptoms and treatment characteristics were self-reported and may have been affected by recall or reporting bias. The study did not report the timing of assessment relative to treatment initiation, the treatment regimen or phase, drug-susceptibility status, clinical or laboratory verification of the reported variables, facility-specific recruitment, diagnostic results, or a validated measure of adherence. These limitations prevent conclusions regarding diagnostic accuracy, programme performance, treatment effectiveness, or determinants of non-adherence.

CONCLUSION

Adults with pulmonary tuberculosis receiving care at the participating facilities in Lahore commonly reported fatigue, prolonged cough, unintended weight loss, fever, and night sweats before diagnosis. Chest radiography and sputum smear microscopy were performed in all participants, while culture, GeneXpert, and Mantoux testing were reported less consistently. Most participants were managed in an outpatient setting, although some reported medication-related side effects, ongoing TB-related symptoms, or missed treatment doses. These findings provide a descriptive account of pulmonary TB presentation and selected care characteristics across different healthcare settings and support continued attention to timely symptom recognition, appropriate diagnostic evaluation, monitoring of treatment-related problems, and patient-centred adherence support.

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