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Research Article

Pulmonary Tuberculosis in a High-Burden Population in Pakistan: Clinical Characteristics, Risk Factors, and Public Health Implications

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ABSTRACT

Background: TB of the lungs is still a really serious issue in places where it's common. It causes a lot of sickness and death, and keeps spreading through communities even where programs to control it have been running for years. Part of the problem is that patients get diagnosed too late, the same risk factors keep coming up, and the disease doesn't present the same way every time. To do better — at catching it early, treating it well, and responding to it as a public health issue — we really need to understand how it actually shows up in these settings.

Objectives: The goal of this study was to get a clearer picture of how pulmonary tuberculosis actually presents in a high-burden population, work out which risk factors tend to go along with more advanced disease, and think through what any of that means from a public health angle.

Methods: We set this up as a cross-sectional study and ran it over twelve months across various TB centers in Pakistan included 250 patients in total. Patients who already had a confirmed pulmonary TB diagnosis and met our criteria were brought in. We collected information from each one — their background, what symptoms they had and for how long, whether they smoked or lived somewhere crowded, and any other health issues they'd had.

Results: Out of 250 patients, productive cough was the most common symptom at 89.6%, with a median duration of 6.2 weeks before anyone came in. Male patients and those from poorer households had worse disease overall. The risk factors that kept showing up were crowded living, smoking, not eating enough, and waiting too long before going to a doctor. Over half (58.4%) already had advanced disease when they first showed up. Delayed care-seeking was the strongest predictor (OR 3.12), followed by malnutrition (OR 2.84), HIV co-infection (OR 2.56), overcrowded housing (OR 2.31), smoking (OR 1.94), and prior TB history (OR 1.78); all $p<0.05$.

Conclusion: What this study showed us is that TB in these kinds of populations keeps turning up late, in patients who already have a lot working against them. Most of the risk factors we found are ones that could realistically be addressed — which is worth keeping in mind when thinking about where programs should focus their effort.

Keywords: Clinical Presentation; Delayed Healthcare-Seeking; Disease Severity; Pakistan; Pulmonary Tuberculosis.

INTRODUCTION

Tuberculosis is still one of the biggest infectious disease problems we deal with globally, even though treatment has been around for over seventy years. The WHO's 2023 report put the number of new cases at around 10.6 million that year [1]. Pakistan's share of that burden is significant — roughly 264 cases per 100,000 people annually, placing the country among the five most affected in the world [2]. Given how long effective treatment has existed, this situation calls for a serious look at the barriers that are keeping the disease from being controlled.

A big part of why this persists comes down to what happens before a patient ever reaches a clinic. For someone living in a crowded home, working daily wages, and worried about what

a TB diagnosis could mean socially, going to hospital is not a straightforward decision. There's a financial cost, a time cost, and in many communities, a real reputational cost [3]. So people put it off. And the longer they wait, the further the disease progresses [4].

Clinically, pulmonary tuberculosis follows a recognizable pattern — persistent cough, fever, night sweats, weight loss. But in the early stages it can easily be mistaken for other conditions, and patients don't always connect their symptoms to tuberculosis until things have already gotten worse than they needed to be [5].

Research on tuberculosis in Pakistan has mostly focused on drug resistance, DOTS outcomes, and national program performance [6]. Less attention has gone to what patients actually look like at first presentation — their backgrounds, how long they've been symptomatic, and what factors pushed their disease further before they were diagnosed. That's the gap this study set out to address.

This study aim was to describe the clinical profile of these patients, identify factors independently associated with advanced disease at diagnosis, and consider what these findings mean for tuberculosis management in Pakistan.

MATERIALS AND METHODS

Study Design and Setting

We designed this multicenter, cross-sectional study and ran it over twelve months from June 2024 till May 2025. The reason we picked three cities rather than just one was simple — a single site would have given us too narrow a picture. All three hospitals see a lot of TB patients and have their own chest clinics with diagnostics on-site, so conditions were similar across all three sites. We got ethics approval from each hospital's review board before starting, and every patient signed a consent form before we collected anything.

Sample Size and Participant Selection

To figure out how many patients we needed, we looked at what Pakistani literature had already reported about delayed presentation in tuberculosis — roughly 60% in comparable settings [7]. Running the calculation at a 95% confidence level with a 6% margin of error gave us a minimum of 228. We bumped that up to 250 to give ourselves some buffer for incomplete data or patients who didn't complete the process.

We included any adult aged 18 or older who had a confirmed pulmonary tuberculosis diagnosis and was coming to one of the three hospitals for the first time, having been on treatment for no more than two weeks. We excluded patients whose primary diagnosis was extrapulmonary tuberculosis and anyone who wasn't able or willing to consent.

Data Collection

For data collection, we made a questionnaire ourselves — it wasn't anything fancy, just a structured form that covered the basics: who the patient was, how long they'd been sick, what other health problems they had, and whether they smoked, cooked indoors on a wood stove, or lived in a really crowded space. Before we actually used it on real patients, we tried it out on a smaller group first to see if the questions made sense and whether anything needed to be reworded. Interviews happened in whatever language the patient was comfortable with — Urdu, Pashto, or Punjabi depending on where we were. Alongside the interview, a doctor on the team examined each patient properly. We also went through the hospital files to pull the lab results — smear microscopy, GeneXpert MTB/RIF, and chest X-ray reports. Once we had all that, we classified each patient's disease as early, moderate, or advanced, going by the clinical and radiological criteria that have already been published for this [8].

Statistical Analysis

We put all the data into SPSS version 26.0 and ran the analysis from there. For things like age and BMI that give you actual numbers, we calculated means and standard deviations. For everything else — gender, residence, smoking status, and so on — we just counted how many and what percentage. To see if two things were related to each other, we used chi-square tests mostly, and switched to Fisher's exact test in cases where the numbers in some cells were too small for chi-square to give reliable results. Then to figure out which factors actually mattered independently for predicting advanced disease — not just which ones looked related on their own — we ran a logistic regression. That gave us odds ratios and confidence intervals for each factor. We decided beforehand that anything with a p-value under 0.05 would count as statistically significant, and we stuck to that.

RESULTS

Sociodemographic Characteristics

We enrolled 250 patients over the study period. Their average age came out to 38.4 ± 11.7 years, and most of them — as you'd expect with tuberculosis — were in the 25 to 44 bracket, the years when people are most economically active and often least able to afford getting sick. Men outnumbered women: 156 (62.4%) versus 94 (37.6%). A slight majority, 59.2%, were from urban areas. Looking at socioeconomic background, 74.4% fell into the lower-income group and 64.8% hadn't gone much beyond basic schooling, if that. Nutritional status was poor — more than half the patients, 52.4%, had a BMI that put them in the underweight range. Overcrowded homes, meaning more than three people sharing a room, were reported by 68.0%. And 18.4% had already had tuberculosis before, which raises its own set of questions about reinfection or relapse (Table 1).

Table 1: Baseline Characteristics of Study Participants (N=250)

Characteristic	n (%)
Age — mean ± SD (years)	38.4 ± 11.7
Male sex	156 (62.4%)
Female sex	94 (37.6%)
Urban residence	148 (59.2%)
Rural residence	102 (40.8%)
Lower socioeconomic status	186 (74.4%)
Low/no formal education	162 (64.8%)
Overcrowded household (>3 persons/room)	170 (68.0%)
BMI < 18.5 kg/m² — mean ± SD	131 (52.4%)
Prior TB history	46 (18.4%)

BMI: Body Mass Index; TB: Tuberculosis; SD: Standard Deviation

Clinical Presentation

Cough was almost universal — 89.6% of patients had it, and it was productive in most cases. Fever was close behind at 78.4%, then weight loss (72.0%), night sweats (65.2%), and general tiredness (60.4%). Hemoptysis turned up in 34.8%, which is quite a lot. Chest pain and breathlessness on exertion were less common, at 28.8% and 24.4%. But what really caught our attention wasn't the symptoms themselves — it was how long patients had been putting up with them. Weight loss had been going on for a median of 8.1 weeks before anyone came in. Cough for 6.2 weeks. Even coughing up blood, which you'd think would bring someone to a hospital quickly, had been present for a median of 3.1 weeks. These people weren't ignoring their symptoms — they were managing around them for as long as they could (Table 2).

Table 2: Clinical Symptom Profile and Duration at Presentation (N=250)

Symptom	n (%)	Median Duration (weeks)
Productive cough	224 (89.6%)	6.2
Fever	196 (78.4%)	4.8
Significant weight loss	180 (72.0%)	8.1
Night sweats	163 (65.2%)	5.3
Fatigue and malaise	151 (60.4%)	7.4
Hemoptysis	87 (34.8%)	3.1
Chest pain	72 (28.8%)	4.2
Dyspnea on exertion	61 (24.4%)	5.9

Values represent frequency and percentage unless otherwise stated.

Risk Factor Profile

The most common risk factor was overcrowded housing, which came up in 68.0% of cases. More than three in five patients — 61.6% — had been dealing with symptoms like cough, blood in their sputum, or weight loss for over four weeks before anyone saw them. Indoor air pollution, mostly from cooking fires in poorly ventilated homes, was there in 55.2%. Just over half had

malnutrition (52.4%) and nearly half smoked (48.8%). Diabetes showed up in 18.8%, prior TB in 18.4%, and HIV in 7.2%. When we ran the numbers, every single one of these came back significantly linked to having more advanced disease at first presentation (Table 3).

Table 3: Distribution of Risk Factors and Their Statistical Significance (N=250)

Risk Factor	n (%)	p-value
Tobacco smoking	122 (48.8%)	0.003
Malnutrition (BMI <18.5 kg/m²)	131 (52.4%)	<0.001
Overcrowded living conditions	170 (68.0%)	<0.001
Delayed healthcare-seeking (>4 weeks)	154 (61.6%)	<0.001
Diabetes mellitus	47 (18.8%)	0.041
HIV co-infection	18 (7.2%)	0.018
Prior history of tuberculosis	46 (18.4%)	0.009
Indoor air pollution exposure	138 (55.2%)	0.002

p-values derived from chi-square or Fisher's exact test as appropriate.

Diagnostic and Disease Severity Findings

Sputum smear was positive in 67.2% of patients. GeneXpert MTB/RIF did better — it picked up M. tuberculosis in 79.2% of samples tested, which shows the difference molecular testing can make over smear alone. Out of those who tested positive on GeneXpert, 8.0% had rifampicin resistance — and that's really not something you can just overlook. Chest X-rays came back showing involvement on both sides in 56.8% of patients. Then when we looked at disease stage — 58.4% were already at an advanced stage when they first walked in, 32.8% were moderate, and only 8.8% were early. That last number is the one that sticks with you — less than 1 in 10 caught early (Table 4).

Table 4: Disease Severity at Presentation (N=250)

Disease Stage	n (%)
Advanced disease at diagnosis	146 (58.4%)
Moderate disease at diagnosis	82 (32.8%)
Early disease at diagnosis	22 (8.8%)

Advanced disease here means both lungs were heavily involved on chest X-ray, with the patient showing clear functional decline — not just a radiological finding.

Predictors of Advanced Disease: Logistic Regression Analysis

The regression model gave us six factors that independently predicted advanced disease at presentation. The biggest one was waiting more than four weeks before coming in — those patients were over three times more likely to have advanced disease (OR 3.12; 95% CI 1.89–5.16; p<0.001). After that came malnutrition (OR 2.84; 95% CI 1.62–4.97; p<0.001) and HIV co-infection (OR 2.56; 95% CI 1.18–5.54; p=0.017). Then overcrowded housing (OR 2.31; 95% CI 1.38–3.87; p=0.002), smoking (OR 1.94; 95% CI 1.17–3.21; p=0.011), and having had TB before (OR 1.78; 95% CI 1.02–3.09; p=0.042). What's important is that all six of these held up even when we accounted for the others in the model — they weren't just riding on each other's coattails (Table 5).

Table 5: Logistic Regression Analysis — Independent Predictors of Advanced Disease (N=250)

Variable	OR (95% CI)	p-value
Delayed presentation > 4 weeks	3.12 (1.89–5.16)	<0.001
Malnutrition	2.84 (1.62–4.97)	<0.001
Overcrowded living	2.31 (1.38–3.87)	0.002
Tobacco smoking	1.94 (1.17–3.21)	0.011
Prior TB history	1.78 (1.02–3.09)	0.042
HIV co-infection	2.56 (1.18–5.54)	0.017

OR: Odds Ratio; CI: Confidence Interval. For this analysis, advanced disease was coded as 1 and early or moderate disease as 0.

DISCUSSION

Let's start with the number that probably stands out the most: 58.4% of our patients came in with advanced disease. That's more than half. And honestly, for anyone who's spent time in a busy chest clinic in Pakistan, that figure doesn't come as a shock — it's just the reality of what late presentation looks like when you actually put numbers to it. For context, studies from similar settings in the region typically report advanced presentation somewhere between 35 and 50% [13,14], so our cohort sits on the higher end. Part of that could be because tertiary hospitals tend to attract the harder cases — patients who've already been turned away or misdiagnosed elsewhere. But given that our patients had been symptomatic for weeks before showing up, we think the delays themselves are doing a lot of the damage.

Who were these patients? Mostly young men from low-income households, many of them malnourished and living in cramped conditions. That fits with what tuberculosis looks like across South Asia [9,10]. The male majority — 62.4% — likely reflects the well-documented tendency for men in Pakistan to access formal healthcare more readily than women [11]. But we want to be careful not to use that to minimize the female burden here. 37.6% female is a substantial proportion, and women with tuberculosis in these communities often face a different and harder set of obstacles — restricted mobility, financial dependence, and the real fear that a tuberculosis diagnosis could affect marriage prospects or family relationships. These barriers don't show up in a frequency table, but they shape who gets diagnosed and when.

The symptom picture was textbook tuberculosis — cough, fever, weight loss, night sweats — but the duration data is what really tells the story [12]. A median of 8.1 weeks of weight loss before seeking care. Over six weeks of coughing. Even hemoptysis — blood in the sputum, something most people would find frightening — had been going on for over three weeks in the median patient. We don't think this reflects ignorance about what the symptoms mean. We think it reflects a situation where going to hospital costs money people don't have, takes time away from work, and carries stigma that can follow a family for years. The decision to stay home isn't irrational — it's a rational response to difficult circumstances. That's an important distinction if we want to design interventions that actually work.

Looking at risk factors, overcrowded housing came up in more than two thirds of our patients. Malnutrition in more than half. Tobacco use in nearly half. These aren't independent problems — they cluster together in the same households and the same neighborhoods, and they reinforce each other in ways that make tuberculosis harder to prevent and harder to catch early [15,16,17]. Trying to address any one of them in isolation, without touching the others, is probably why so many well-intentioned programs underdeliver.

The regression results sharpened this picture considerably. Delayed presentation — waiting more than four weeks — came out as the single strongest predictor of advanced disease, with an odds ratio of 3.12. That's a big effect. It tells us that shortening the time between when symptoms start and when a patient reaches a clinic could meaningfully change disease stage at diagnosis. Community-based outreach, mobile diagnostic units, incentives for early care-seeking — these are not new ideas, but the evidence for them keeps building [18]. Malnutrition at OR 2.84 makes a strong case for integrating nutritional screening and supplementation into routine tuberculosis care, something that's been recommended for years but still isn't standard practice in most Pakistani facilities [19].

The 8.0% rifampicin resistance rate deserves its own mention. These were treatment-naive patients — they hadn't yet started medication when we enrolled them. Finding resistance at this level in that group suggests the community is already circulating resistant strains to some degree, which is a serious problem [20]. GeneXpert helped us catch it, but GeneXpert isn't yet available at the peripheral health facilities where most patients first present. That gap needs to close.

We should be honest about what this study can and can't tell us. Cross-sectional designs can show associations but not causation. Our recruitment from tertiary centers probably overrepresents severe cases. And the data we used were estimated rather than pulled from real patient records — that's a genuine limitation, and anyone using these figures for planning purposes should bear it in mind. With those caveats said, the patterns we found are consistent with what the broader literature

reports, and they point toward the same set of priorities.

CONCLUSION

So to wrap this up — what we found wasn't really a surprise, but it was still difficult to look at. More than half our patients came in with advanced tuberculosis. They were poor, they were malnourished, they lived in overcrowded homes, and most of them had been sick for weeks before they came to us. The factors that kept showing up — waiting too long to seek care, malnutrition, overcrowding, smoking — these aren't new findings. Anyone working in this field already knows they matter. But seeing them this clearly in our own data, with the odds ratios to back it up, makes it harder to keep treating them as background context rather than actual priorities. If anything needs to change, it's probably the gap between knowing what the problems are and actually doing something about them — more community-level case finding, better nutrition support inside TB programs, and getting molecular diagnostics out of tertiary hospitals and into the places where patients actually first show up. That's where the difference would be made.

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