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Sociodemographic and Clinical Characteristics of Tuberculosis Positivity and Rifampicin Resistance among Presumptive Patients in Southern Punjab, Pakistan: A Cross-Sectional Study

Rashda Shabbir,[1] Sumera Malik,[2] Javairia Saeed,[3] Saadia Latif,[4] Qurat Ul Ain Ayaz,[5] Arifa zia Hashmi[6]

ABSTRACT

BACKGROUND & OBJECTIVE: In Pakistan, drug-resistant forms of tuberculosis (TB) continue to be a significant public health concern. Targeted control techniques depend on the identification of clinical and sociodemographic factors of TB and rifampicin resistance.The objective of this study was to describe the clinical and sociodemographic characteristics of presumptive tuberculosis patients and to characterise the pattern of TB positivity and rifampicin resistance among them.

METHODOLOGY: The Provincial Reference TB Laboratory at Nishtar Medical University in Multan was the site of this cross-sectional analytical investigation. A total of 210 suspected TB patients were enrolled using a non-probability convenience sampling technique. Data regarding demographic characteristics, comorbidities, and laboratory findings were collected. Rifampicin resistance and Mycobacterium tuberculosis were detected using the GeneXpert MTB/RIF assay. SPSS version 25 was used to analyse the data, and the findings were displayed as frequencies, percentages, and mean ± standard deviation.

RESULTS: The mean age of 210 patients was 36.81±16.22 years, with 53.8% of them being men and 46.2% being women. The age group of 18 to 24 years old had the largest percentage (30%). A majority of patients (81%) were illiterate. Diabetes mellitus was present in 11% of cases. Of the 210 suspected patients, 194 (92.4%) were positive for Mycobacterium tuberculosis on GeneXpert MTB/RIF assay; among these MTB-positive patients, 21 (10.8%) showed rifampicin resistance. Most samples were taken from the lungs (95.2%).

CONCLUSION: In this study, tuberculosis positivity was most frequently observed among young adults and individuals with low educational attainment, a pattern consistent with the known sociodemographic distribution of tuberculosis in similar settings. The proportion of rifampicin resistance identified among MTB-positive patients also indicates an emerging drug-resistance problem in this population. Diabetes mellitus, a comorbidity recognised in the literature as increasing susceptibility to tuberculosis, was noted in a notable proportion of patients, underscoring the need for early identification, targeted screening and integrated care management strategies.

KEY WORDS: Tuberculosis, Multidrug-Resistant, Mycobacterium tuberculosis, Risk Factors, Socioeconomic Factors, Diagnostic Tests, Routine, Pakistan

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INTRODUCTION

Tuberculosis (TB) is caused by species belonging to the Mycobacterium tuberculosis complex (MTBC) and remains one of the leading causes of death worldwide. It is the leading cause of death from a single infectious agent, having surpassed human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/-AIDS).[1] MTBC infection most commonly affects the lungs, resulting in pulmonary tuberculosis (PTB); however, it may involve other organs and cause extrapulmonary tuberculosis (EPTB).[2]

Approximately 90% of the global TB burden occurs in 30 high-burden countries. The disease is closely associated with poverty, socioeconomic hardship, vulnerability, marginalization, discrimination and stigma. According to the most recent World Health Organization estimates, approximately 10.7 million people—uncertainty interval, 9.9–11.5 million—developed TB in 2024, corresponding to an incidence of 131 cases per 100,000 population. Children and young adolescents accounted for approximately 12% of these cases, while men and women aged ≥15 years constituted 55% and 33%, respectively.[3]

Pakistan remains the fifth highest TB-burden country globally, accounting for approximately 6.3% of all incident TB cases, after India (26%), Indonesia (10%), China (6.8%), and the Philippines (6.8%). It also contributes the largest proportion of the TB burden within the WHO Eastern Mediterranean Region. An estimated 1.23 million TB-related deaths occurred worldwide in 2024, placing TB once again among the leading infectious causes of mortality and above COVID-19. In Pakistan, more than 669,000 people develop TB annually, and approximately 51,000 deaths are attributed to the disease each year.[4]

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Pulmonary TB is transmitted through infectious airborne particles released when individuals with bacteriologically confirmed pulmonary disease cough, sneeze, speak, or laugh.[3] Individuals at increased risk of developing TB can broadly be divided into two groups. The first comprises people with recent exposure to M. tuberculosis, including close contacts of infectious patients, immigrants from high-prevalence regions, young children with a positive tuberculin skin test, and vulnerable populations such as people experiencing homelessness, people who inject drugs, and people living with HIV. Individuals living or working in congregate or crowded environments, including hostels, hospitals, correctional facilities, and nursing homes—are also at increased risk. The second group includes individuals with impaired immunity or medical conditions that increase the likelihood of progression from TB infection to active disease, such as HIV/AIDS, diabetes mellitus, chronic kidney disease, silicosis, malignancy, low body mass index, and the use of corticosteroids or other immunosuppressive treatments.[5]

Drug-resistant tuberculosis represents a major global public-health challenge. Multidrug-resistant tuberculosis (MDR-TB) is caused by strains resistant to at least isoniazid and rifampicin, the two most important first-line anti-TB medicines.[5] In January 2021, the WHO revised the definitions of pre-extensively drug-resistant and extensively drug-resistant tuberculosis. Pre-XDR-TB is defined as MDR/RR-TB with additional resistance to any fluoroquinolone, whereas XDR-TB refers to MDR/RR-TB with resistance to any fluoroquinolone and at least one additional Group A medicine, namely bedaquiline or linezolid. This definition replaced the previous criterion based on resistance to second-line injectable agents such as amikacin, kanamycin, and capreomycin.[6]

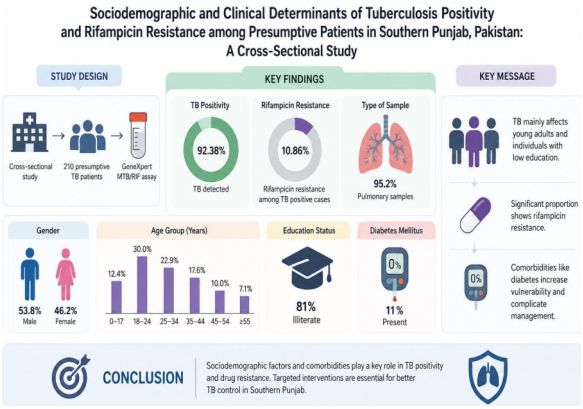

Figure 1: Sociodemographic and clinical determinants of Tuberculosis positivity

Prompt diagnosis and early detection of drug resistance are essential for reducing TB-associated morbidity, mortality, and transmission. Current priorities extend beyond establishing a diagnosis to identifying the populations most affected by TB, individuals at risk of drug-resistant disease, and groups requiring targeted screening and intervention.[7] Hospital-based evidence regarding the sociodemographic and clinical characteristics of presumptive TB patients and the burden of rifampicin resistance is therefore needed to inform local screening and prevention strategies. However, evidence addressing these factors in South Punjab remains limited. The present study was consequently designed to describe the sociodemographic and clinical profile of presumptive TB patients in South Punjab and to characterize TB positivity and rifampicin resistance detected using the GeneXpert MTB/RIF assay.

METHODOLOGY

At the Provincial Reference TB Laboratory at Nishtar Medical University in Multan, a cross-sectional analytical analysis was carried out from 28th April 2025 to 30th May 2026. The standard formula was used to get the projected sample size while maintaining a 95% confidence interval and a 5% margin of error.

$$n = \frac{z^2 \times SN \times (1-SN)}{d^2}$$

With a Z value of 1.96, a margin of error (d) of 5%, and an expected sensitivity (SN) of 84% for the Gene Xpert MTB/RIF test, the calculated sample size was

$$n = \frac{1.96^2 \times 84 \times (100-84)}{25}$$

It yielded a final sample size of approximately 210. The sensitivity of the GeneXpert MTB/RIF assay was used as the expected proportion parameter because GeneXpert was the primary diagnostic test on which the study outcomes (TB positivity and rifampicin resistance) were based, and using its reported sensitivity ensured that the sample was large enough to estimate the diagnostic yield of this test with acceptable precision. As a result, the study had 210 people in total. A non-probability convenience sampling strategy was used to enroll these 210 patients who were suspected of having tuberculosis based on clinical and radiological data. In order to reduce confounding, patients who had received anti-tuberculous therapy within the previous three months or who had serious comorbid conditions like HIV infection and renal failure were excluded from the study. Only adult patients (>18 years) and tuberculous suspects who had clinical symptoms (productive cough >2 weeks, persistent low-grade fever, night sweats, weight loss >3 kg) and radiological findings suggestive of TB were included. Separate samples of sputum from pulmonary suspects and other clinical samples (fluids, pus urine etc) from extra-pulmonary suspects were collected in sterile containers after taking informed consent. These patients were referred from Nishtar Hospital Multan as inpatients or outpatients. Demographic data, background information, and other necessary data were gathered using a pre-made questionnaire.

Detailed data were collected using a structured proforma, including sociodemographic variables (age, gender, education), clinical characteristics (smoking status, diabetes mellitus, hypertension), and laboratory findings. Smoking status was recorded as current/ever smoker versus never smoker based on patient self-report. Diabetes mellitus and hypertension were recorded as present if the patient had a prior physician diagnosis and/or was currently on treatment for the condition, based on self-report and available medical records; for diabetes mellitus, the duration since diagnosis was additionally recorded. Rifampicin resistance was detected using the GeneXpert MTB/RIF assay as part of the diagnostic evaluation. In order to detect tuberculosis, samples were processed for the GeneXpert MTB Rif assay. Rifampicin susceptibility was assessed by adding roughly twice as much lysing reagent (which comes with the kit) as the sample for inactivation and liquefaction. Following a 15-minute incubation period at room temperature, 2 millilitres of this liquefied sample were transferred to a GeneXpert cartridge and put inside the GeneXpert machine. The sample was properly identified and entered using software, which processed the sample automatically and produced a result in less than two hours. SPSS version 25 was used to enter and analyse all of the data. Frequency and percentages were used to display qualitative factors such as gender, smoking history, addiction, signs and symptoms, and other chronic conditions. Age and other quantitative factors were displayed as mean ± standard deviation. All enrolled patients had complete data for the sociodemographic and clinical variables analysed in this study; therefore, no missing-data imputation or sensitivity analysis was required.

RESULTS

A total of 210 patients participated, with a female-to-male ratio of 1:1.17, comprising 113 (53.8%) males and 97 (46.2%) females. The mean age of patients was 36.81±16.22 years, although the mean ages of male and female patients were 39.35±16.10 and 33.36±15.94 years, respectively. A comparative view of mean and standard deviation (SD) is depicted in Figure 2. An independent sample t-test was applied to compare the mean ages of both genders; female patients were numerically younger than male patients, but this difference was not statistically significant (p-value = 0.14).

Gender-based patient segregation was also noted, with the youngest age group (18–24 years old) having the highest frequency of patients (30.0%) and the older age groups showing a progressive decline in patient frequency (Figure 3).

Additionally, as Table I illustrates, the frequency of female patients (39.2%) in the youngest age group of 18–24 years remained significantly greater than that of male patients (22.1%) in the same age group.

The level of education was also noted and revealed that most of 81.0% patients were illiterate, while only 11.0% had completed primary education, and only 8.0% had an education level of secondary or above, as presented in Figure 4.

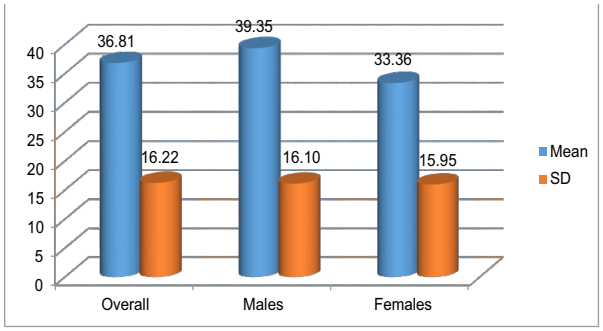

Figure 2: Mean Ages of Male and Female Patients (In years)

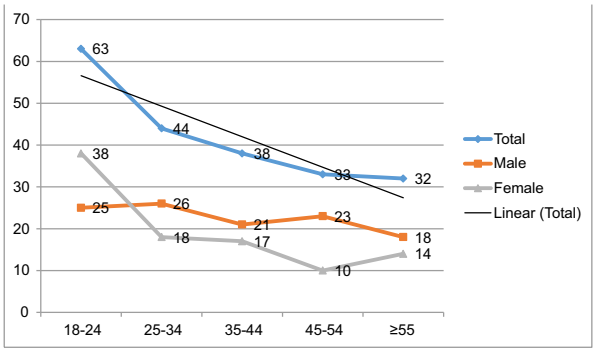

Figure 3: Mean Ages of Male and Female Patients (In years)

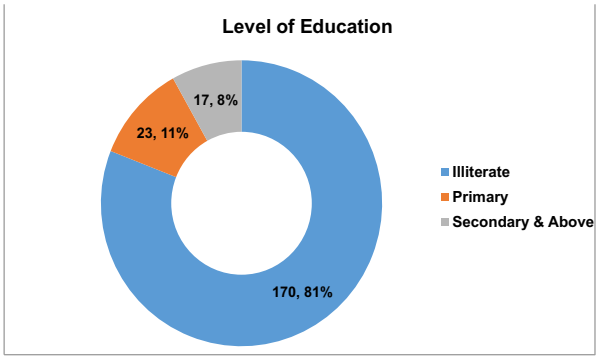

Figure 4: Distribution of the level of Education

No major difference in educational level was observed regarding gender, as presented in Table II. Similarly, the mean family size of patients remained 5.33±1.51 persons with a range of at least 2 and a maximum of 10 persons in each family.

Histories of smoking, hypertension (HTN), and diabetes mellitus (DM) were also noted, which remained to be 1.4%, 1.0% and 11.0%, respectively. The mean duration of DM among patients remained 4.0±2.61 years. Gender wise segregation is also presented in Table III.

Table I: **Patient Distribution by Age Range**

Age Range (Years)	Gender					
	Male (n=113)		Female (n=97)		Overall (n=210)	
	n	%	n	%	n	%
18-24	25	22.1	38	39.2	63	30
25-34	26	23	18	18.6	44	21
35-44	21	18.6	17	17.5	38	18.1
45-54	23	20.4	10	10.3	33	15.7
≥55	18	15.9	14	14.4	32	15.2

Values are numbers (n) and percentages (%) within each gender column and the overall column

Table II: **Level of Education of Patients**

Education	Gender					
	Male (n=113)		Female (n=97)		Overall (n=210)	
	n	%	n	%	n	%
Illiterate	92	81.4	78	80.4	170	81
Primary	12	10.6	11	11.3	23	11
Secondary & above	9	8	8	8.2	17	8

Values are numbers (n) and percentages (%) within each gender column and the overall column

Table III: **History of Comorbidities**

Histories		Gender					
		Male (n=113)		Female (n=97)		Overall (n=210)	
		N	%	n	%	N	%
Smoking	Present	1	0.9	2	2.1	3	1.4
	Absent	112	99	95	98	207	99
HTN	Present	0	0	2	2.1	2	1
	Absent	113	100	95	98	208	99
DM	Present	12	11	11	11	23	11
	Absent	101	89	86	89	187	89

DM = diabetes mellitus; HTN = hypertension. Values are numbers (n) and percentages (%) within each gender column and the overall column

Only 7 (3.4%) of the samples were pus samples, and 3 (1.4%) were from other sources. The majority of the samples (95.2%) came from a pulmonary source and sputum was supplied for examination. Distribution of samples by type and gender is presented in Figure 5.

GeneXpert detected MTB in 194 of 210 specimens (92.4%). Rifampicin susceptibility is complementary outcome of the GeneXpert MTB/RIF assay; among the 194 MTB-positive specimens, 21 (10.8%) were found to be rifampicin resistant.

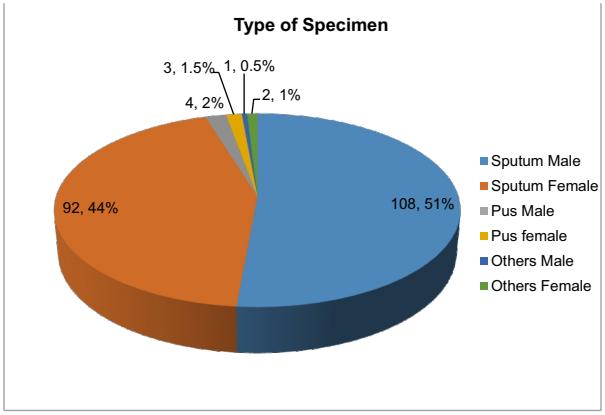

Figure 5: Gender-wise Distribution of Type of Specimen

DISCUSSION

This study described the sociodemographic and clinical characteristics of tuberculosis (TB) positivity and rifampicin resistance among suspected patients in Multan, Pakistan. The findings highlight important population-level trends that are more relevant for public health planning than mere diagnostic comparisons. A meta-analysis evaluated the GeneXpert MTB/RIF assay's accuracy in diagnosing rifampicin resistance and pulmonary tuberculosis. The data came from 22 research publications with 9008 study participants. The GeneXpert test demonstrated a pooled sensitivity of 88% and specificity of 99% when employed as a primary diagnostic method in place of smear microscopy. The accuracy of the GeneXpert test in detecting rifampicin resistance was then evaluated in 24 investigations with 2969 study participants; the results showed a pooled sensitivity of 95% and specificity of 98%. The proof of the accuracy of the GeneXpert MTB/RIF Assay was produced using high-quality research.[7] Presently, a total of 194 cases were detected through GeneXpert, of which 21/194 (10.8%) were rifampicin resistant in this study; this proportion is not comparable with the former findings, which presented a 16.2% proportion of drug-resistant TB.[8] According to the WHO, the proportion of rifampicin resistance among new TB cases is 3.3%, and in previously treated cases, it is 17.7% globally. Countries belonging to the former Soviet Union had the highest proportions of >50% drug resistance cases among overall TB cases.[9] The best estimates presented for Pakistan include a proportion of 4.2% rifampicin resistance among recent TB cases, 7.3% in previously treated cases, and an incidence of 25000 rifampicin-resistant cases during 2019, with a frequency of MDR as 89% among rifampicin-resistant cases.[9] Although the present study did not differentiate the new and previously treated TB cases, even then, a rifampicin resistance of around 11% in the present study is justified in accordance with the current report of the WHO.

The highest proportion of patients (30.0%) was observed in the youngest age group (18–24 years old), and a progressive decline in patient frequency was noted in older age groups. Additionally, it is noteworthy that in the youngest age group of 18 to 24 years, the frequency of female patients (39.2%) remained much greater than that of male patients (22.1%). Findings are thus comparable with the study, which presented the highest proportion of 33.6% patients in the age groups of <25 years, and other groups also showed agreeable values with this study.[10] This finding is also consistent with a study that reported a comparable mean age of 36.9±14.99 years, but is not consistent with other studies that reported a lower mean age (32.9±12.6) and higher age 39·34±15·06years.[11] Thus, the concentration of TB cases in the young, economically productive age groups observed in this study is noteworthy, as illness in this age group can increase the economic burden on families through loss of daily wages. According to this study, men comprised a higher proportion of participants (53.8%) than women (46.2%). A greater percentage of 62% males and 38% females has already been reported in a recent study. Comparable results were presented in a study showing a proportion for males as 51.2% and for females as 48.8%. Thus, the higher proportion of male participants observed in this study is broadly consistent with the gender distribution reported in comparable settings, although this cross-sectional design cannot establish whether male sex is itself a determinant of acquiring infection.[12]

Other factors involved in the higher burden of TB, including poverty, overcrowding, and illiteracy, have been comprehensively studied previously. The present study is in agreement with the above-mentioned and presented 81% patients as illiterate and 11% had only primary level education. Similarly, the mean family size of patients in the present study also remained 5.33±1.51 persons with a range of at least 2 and a maximum of 10 persons in each family, supporting the above statement.

Diabetes is also recognised in the literature as a major risk factor for TB, and its co-occurrence adds to the treatment burden and economic cost of care. Evidence showed a two-to threefold higher risk of TB and related complications among diabetics, who further need to be hospitalized during earlier phases of treatment.[12] Not only are these risks, but diabetics have also been shown to be at increased risk of developing TB in an Australian nationwide cohort study, and there is a trend for TB patients with diabetes to take more time for smear and culture conversion compared to non-diabetic TB patients.[13,14] Co-existence of DM with TB in this study was reported to be in 11.0% patients; however, further follow-up on the effects of treatment was not explored. Furthermore only 7 (3.4%) of specimens submitted were pus samples and 3(1.4%) specimens were from other source; the remaining samples were from pulmonary source (95.2%) and sputum was submitted for study. Given that pulmonary TB is the most infectious form, this has significant implications for public health interventions aimed at controlling disease spread.[15]

Rather than evaluating diagnostic accuracy, this study offers a descriptive profile of the groups most frequently represented among presumptive TB patients in this setting. Young people, patients with a low level of education, and people with comorbid diagnoses such as diabetes made up the largest proportions in this study, consistent with the vulnerable groups described in the wider literature; individual-level risk assessment in these groups would need to be confirmed through analytical studies.

Nevertheless, the current study has a significant number of limitations that need to be discussed when interpreting the results. The sample size selected in the study was not randomized, and the research was conducted in a single-center environment, which may affect the accuracy of results in cases where an extended sample frame needs to be analyzed. Moreover, the number of patients who tested positive for TB was limited, which complicates the comparison of the studied groups. This study was also descriptive in nature, and formal statistical testing of associations between sociodemographic/clinical variables and TB positivity or rifampicin resistance (e.g. adjusted effect estimates with confidence intervals) was not performed; consequently, the reported patterns should be interpreted as descriptive observations rather than confirmed determinants. However, the results presented in the study allow the researchers and local authorities to improve their understanding of TB dissemination and address the problem more efficiently.

CONCLUSION

In this study, tuberculosis was most frequently observed among young people and individuals with a low level of education, an observation that reflects the descriptive profile of this study population rather than a formally tested causal relationship. In addition, a considerable proportion of patients presented with comorbid diagnoses, including diabetes. Furthermore, the proportion of rifampicin resistance among patients indicates a significant problem of healthcare in the region. Therefore, it is essential for local authorities to implement screening and monitoring measures to detect cases of TB in the early stages and prevent the further spread of the disease.

Ethical approval

The Institutional Ethical Review Board of Nishtar Medical University Multan approved the study protocol bearing Reference No: 9038, Dated: 13-05-2026.

Conflict of Interest:

Authors declare no conflict of interest.

Financial Disclosure:

None

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Authors' Contributions:

RS & JS: Conceptualization and study design

SM, SL & QUA: Data Collection and manuscript drafting.

AZH, RS & JS: Data Analysis and critical review.

SM, FL & QUA: Supervision & Manuscript drafting & proof reading.

All authors have read and approved the final version of the manuscript and are responsible and accountable for the accuracy and integrity of the work

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