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PREVALENCE OF TUBERCULOSIS INFECTION AMONG ADULTS IN LAHORE, PAKISTAN

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Abstract

Background: Lahore ranks as a highly populated metropolitan area in Pakistan, where tuberculosis is still a major health concern. Effective control measures depend on precise grassroots statistics on adults TB prevalence and corresponding risk factors.

Objective(s): The purpose of this study is to determine the incidence of TB within adults in Lahore, Pakistan, as well as the clinical, psychological, and economical risk factors linked to the illness.

Methodology: A cross-sectional study has been carried out with 78 adult volunteers who were selected from Mughal Labs and Diagnostic Center (n = 46) from Nawaz Sharif Social Security Teaching Hospital (n = 32) in Lahore. Data on the population, symptom (cough, fever, chest discomfort), and smoking habits were gathered using a standardized questionnaire. All individuals had their sample sputum taken, and GeneXpert MTB/RIF was used to screen for TB. Chi-square tests were used to examine the information utilizing SPSS version 25, with $p<0.05$ being deemed statistically meaningful.

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Results: Most participants were between the ages of 38 and 45 (52.6%, n = 41), accompanied by those between the ages of 28 and 37 (28.2%, n = 22) and 18 and 27 (19.2%, n = 15). There were 47.4% (n=37) females as well as 52.6% (n=41) men. To summarize, 65.4% (n=51) of people had TB. Chest discomfort was noted by 65.4% (n=51), fever by 69.2% (n=54), and coughs by 66.7% (n=52). 39.7% (n=31) admitted smoking. Age as well as TB status were shown to be statistical significantly correlated (p=0.030), resulting in the 38–45 age group having the greatest burden. Age did not significantly correlate with cough, fever, chest discomfort, or smoking.

Conclusion: Adults in Lahore have a high prevalence of tuberculosis, and there is a strong correlation between disease and age. Programmes for specialized screening of older persons are desperately needed.

INTRODUCTION

Tuberculosis (TB) remains one of the most significant global infectious diseases, with a substantial burden in developing countries such as Pakistan. The disease continues to cause high morbidity and mortality despite the availability of diagnostic and therapeutic interventions. A major concern is that many individuals remain infected with latent tuberculosis infection (LTBI), which can progress to active disease under favorable conditions. Socioeconomic factors such as poverty, overcrowding, malnutrition, and limited access to healthcare significantly contribute to ongoing transmission. In urban centers like Lahore, these challenges are intensified due to high population density and poor living conditions, making TB control particularly difficult and emphasizing the need for accurate prevalence data for effective public health planning. 1

The burden of tuberculosis in Pakistan is among the highest globally, with millions of new cases reported annually and a substantial proportion remaining undiagnosed or untreated. Studies indicate that a significant number of individuals with active TB are not captured by national reporting systems due to reliance on private healthcare providers and inadequate surveillance mechanisms. Additionally, the prevalence of drug-resistant TB further complicates disease

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management and increases treatment failure rates. Delayed diagnosis, social stigma, and lack of awareness contribute to continued transmission within communities. Urban slums and densely populated areas serve as major reservoirs for infection, where environmental conditions favor airborne spread of Mycobacterium tuberculosis. 2

Latent tuberculosis infection represents a critical but often under-recognized component of TB control programs. Individuals with LTBI are asymptomatic and non-infectious but carry a lifelong risk of developing active disease, especially when immunocompromised. Diagnostic tools such as the tuberculin skin test (TST) and interferon-gamma release assays (IGRAs) are commonly used for detection, although each has limitations in resource-limited settings. In Pakistan, TST remains widely used due to affordability and accessibility. Early identification of LTBI is essential for preventive therapy, particularly among high-risk populations such as adults living in overcrowded urban environments, where transmission dynamics are more intense and sustained. 3

In Lahore, the burden of tuberculosis is further exacerbated by rapid urbanization, migration, and inadequate healthcare infrastructure. The city's densely populated slums create an ideal environment for transmission due to poor ventilation and limited sanitation facilities. Behavioral factors such as smoking, delayed healthcare seeking, and lack of awareness also contribute to disease spread. Moreover, comorbid conditions like diabetes significantly increase susceptibility to TB by impairing immune function. Healthcare facilities are often overcrowded, increasing the risk of nosocomial transmission among patients and healthcare workers. These combined factors highlight the urgent need for targeted epidemiological assessments and intervention strategies in high-risk urban populations. 4

Accurate prevalence studies are essential for understanding the true burden of both latent and active tuberculosis in Lahore. Current national data often underestimate disease prevalence due to underreporting and diagnostic gaps, particularly in private healthcare sectors. Reliable epidemiological evidence is crucial for identifying high-risk groups, evaluating control programs, and guiding resource allocation. The integration of community-based screening and advanced diagnostic

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techniques can improve case detection and reduce transmission. Furthermore, understanding local disease patterns is necessary for achieving global TB elimination targets. Strengthening surveillance systems and implementing evidence-based interventions are vital steps toward reducing the TB burden in high-risk urban populations like Lahore. 5

Literature Review

WHO 2022 highlights tuberculosis as a major occupational and public health threat, particularly in healthcare settings where exposure risk remains high. The report emphasizes that latent tuberculosis infection among healthcare workers acts as a persistent reservoir for future active disease, undermining infection control efforts. In high burden countries, overcrowding, poor ventilation, and delayed diagnosis amplify nosocomial transmission. The document further stresses the importance of administrative, environmental, and personal protective interventions to reduce transmission risk. It also notes that consistent implementation of infection control policies remains inadequate in resource limited settings, resulting in ongoing occupational exposure and increased disease burden among frontline healthcare providers globally in public health context

Qadeer 2016 describes Pakistan's tuberculosis burden through a comprehensive national prevalence survey highlighting the scale of disease among adults. The study reports Pakistan as one of the highest burden countries globally with significant underdiagnosis contributing to ongoing transmission in both community and healthcare settings. Urbanization, poverty, and limited diagnostic access were identified as key drivers of sustained disease prevalence. The findings emphasize that overcrowded cities like Lahore present intensified transmission dynamics due to population density and healthcare system limitations. The study also reveals substantial gaps between estimated and reported cases indicating a large pool of undetected tuberculosis infections that perpetuate community spread and hinder effective national disease control strategies implementation

Qureshi 2020 examines tuberculosis transmission differences between urban and rural populations in Lahore, demonstrating significantly higher incidence rates in densely populated urban regions.

Vol. 5 No. 2 (2026)

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The study attributes this disparity to overcrowding, increased healthcare facility exposure, and delayed diagnosis in urban settings. Rural areas showed comparatively lower transmission due to reduced population density and limited interaction networks. However, urban healthcare centers also act as diagnostic hubs, which may increase apparent case detection rates. The findings highlight that healthcare workers in tertiary hospitals face elevated occupational exposure due to higher patient loads and frequent contact with undiagnosed infectious individuals, reinforcing the need for strengthened infection control practices in urban healthcare facilities

Smit 2022 investigates barriers to respiratory protective equipment adherence among healthcare professionals, identifying key challenges such as lack of awareness, discomfort, fatigue, and limited availability of resources. The study emphasizes that compliance with protective measures varies significantly depending on perceived risk levels and workplace conditions. Even in high risk procedures, consistent use of respirators remains suboptimal, with adherence rarely exceeding acceptable thresholds. Organizational constraints, insufficient training, and logistical limitations further reduce effective implementation of infection prevention protocols. The study concludes that behavioral, structural, and institutional factors collectively undermine the effectiveness of respiratory protection strategies in healthcare environments, particularly in resource constrained settings requiring urgent policy and enforcement action

Zafar 2021 explores the association between type 2 diabetes mellitus and tuberculosis among patients in Lahore, revealing a notable prevalence of comorbidity. The study demonstrates that diabetes significantly increases susceptibility to tuberculosis by impairing immune function, particularly macrophage activity and cytokine response. Patients with dual conditions exhibit more severe disease presentations, higher bacterial loads, and delayed treatment response compared to non diabetic individuals. Glycemic control was strongly linked with treatment outcomes, where poor control resulted in prolonged infectious periods. The findings highlight the importance of integrated screening and management strategies for tuberculosis and diabetes to reduce transmission risk and improve patient prognosis in high burden settings

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MacLean 2019 compares diagnostic methods for tuberculosis, focusing on microscopy, culture, and molecular testing techniques. The study reports that sputum microscopy remains widely used due to its low cost and accessibility, although it has limited sensitivity. Culture methods provide higher diagnostic accuracy but require extended processing time and advanced laboratory infrastructure. Molecular techniques such as GeneXpert offer rapid and highly sensitive detection, including identification of drug resistance within hours. However, their high cost and logistical requirements limit widespread use in low resource settings. The study concludes that selecting appropriate diagnostic strategies depends on balancing accuracy, cost, and feasibility within specific healthcare environments guiding effective tuberculosis control program decisions globally relevant

Methodology

The study adopted a community-based, cross-sectional descriptive design to determine the incidence of microbiologically confirmed tuberculosis among adults in Lahore, Pakistan. Data were collected over a four-month period following approval of the study synopsis. The research was conducted in both public and private healthcare settings, specifically Nawaz Sharif Social Security Teaching Hospital and Mughal Labs and Diagnostic Center, to ensure representation of diverse urban and socioeconomically varied populations. A total of 78 adult participants presenting with symptoms suggestive of tuberculosis were included in the final analysis.

The sample size was calculated using the WHO formula for cross-sectional prevalence studies, incorporating an expected prevalence of pulmonary tuberculosis among adults, a margin of error, and a 95% confidence level. A systematic random sampling technique was applied in outpatient departments of both study sites. The daily patient registry served as the sampling frame, and every kth patient was selected after a randomly determined starting point. Inclusion criteria comprised adults aged 18 to 45 years, permanent residents of Lahore for at least six months, and individuals capable of providing informed consent and adequate sputum samples. Patients outside the age range,

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those on current or recent anti-tuberculosis therapy, and critically ill individuals unable to produce sputum were excluded.

Data collection was carried out using structured questionnaires to obtain demographic information, clinical history, and risk factors such as smoking, TB contact, and living conditions. Sputum samples were collected in sterile, labeled containers following WHO biosafety guidelines and transported to the laboratory under cold chain conditions. Microbiological confirmation was performed using the GeneXpert MTB/RIF assay for detection of Mycobacterium tuberculosis and rifampicin resistance. Ethical approval was obtained from the Superior University Lahore Ethical Review Committee, and strict confidentiality was maintained through anonymized coding, secure data storage, and voluntary informed consent, with participants allowed to withdraw at any stage without consequences.

Data were entered into Microsoft Excel and analyzed using SPSS version 25 and R software version 4.3.1. Descriptive statistics were used to summarize demographic and clinical characteristics, while categorical variables were presented as frequencies and percentages. Comparative analysis between public and private healthcare facilities was performed using Z-tests for proportions, chi-square tests, t-tests, and Mann–Whitney tests where appropriate. Variables with p-values less than 0.25 were included in multivariate logistic regression to determine adjusted odds ratios with 95% confidence intervals. Model performance was evaluated using the Hosmer–Lemeshow test and receiver operating characteristic curve analysis to assess goodness of fit and predictive accuracy.

Results

This chapter presents the findings of a cross-sectional study conducted among 78 participants to determine the prevalence of tuberculosis and its association with demographic and clinical variables. The sample included 46 individuals from Mughal Labs and Diagnostic Center and 32 from Nawaz Sharif Social Security Teaching Hospital. The majority of participants belonged to the 38–45 years age group (52.6%), followed by 28–37 years (28.2%) and 18–27 years (19.2%). Overall tuberculosis prevalence was 65.4%, indicating a high burden of disease in the studied population. Common

Vol. 5 No. 2 (2026)

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symptoms included cough (66.7%), fever (69.2%), and chest pain (65.4%), reflecting a strong clinical overlap with suspected TB cases.

Tuberculosis Status Distribution Among Participants

TB	frequency	percentage	Valid percent	Cumulative percent
No	27	34.6	34.6	34.6
Yes	51	65.4	65.4	100.0
Total	78	100.0	100.0	

The gender distribution showed a slight male predominance, with males accounting for 52.6% and females 47.4% of the study population. Smoking was reported in 39.7% of participants, while 60.3% were non-smokers, indicating a moderate exposure to a known TB risk factor. Crosstab analysis revealed that TB positivity was highest in the 38–45 years age group, suggesting increasing vulnerability with advancing age. Although males slightly outnumbered females, TB distribution across gender did not show a marked imbalance. The overall demographic pattern suggests that middle-aged adults represent the most affected subgroup in this study setting.

Age and Cough Crosstabulation Cough

Age	NO	Yes	Total
18-27Y	4	11	15
28-37Y	9	13	22
38-45Y	13	28	41
Total	26	52	78

Clinical symptom analysis demonstrated a strong presence of respiratory and systemic manifestations among TB-positive individuals. Cough was reported in two-thirds of participants, fever in nearly seven-tenths, and chest pain in a similar proportion. These findings reinforce the clinical suspicion that symptomatic screening remains a useful approach in identifying TB cases in resource-limited

Vol. 5 No. 2 (2026)

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settings. Smoking history also showed a notable presence among participants with TB, although the association was not statistically significant across age groups. These patterns highlight the interaction between lifestyle factors and TB burden, even if not uniformly distributed across demographics.

Chi-square analysis showed a statistically significant association between age and tuberculosis status ($p = 0.030$), indicating that age is an important determinant of TB risk in this population. However, no significant associations were observed between age and other variables such as cough, fever, chest pain, or smoking status, as all p-values exceeded 0.05. This suggests that while symptoms are highly prevalent, they are not strongly age-dependent within this sample. The findings emphasize that TB occurrence is more closely linked to age-related vulnerability rather than isolated clinical symptoms alone.

Age and Tuberculosis Crosstabulation analysis TB

Age	NO	Yes	Total
18-27Y	7	8	15
28-37Y	5	17	22
38-45Y	15	26	41
Total	27	51	78

In summary, the results indicate a high prevalence of tuberculosis among adults in Lahore, particularly in the 38–45 years age group. The study highlights a significant relationship between age and TB occurrence, while other associations remained statistically insignificant. The high frequency of symptoms such as cough, fever, and chest pain underscores the need for improved screening strategies in outpatient settings. These findings support the importance of early detection, targeted screening of high-risk age groups, and strengthened diagnostic approaches to reduce the burden of tuberculosis in urban populations.

Discussion

This chapter presents the findings of a cross-sectional study conducted among 78 participants to determine the prevalence of tuberculosis and its association with demographic and clinical variables.

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The gender distribution showed a slight male predominance, with males accounting for 52.6% and females 47.4% of the study population. Smoking was reported in 39.7% of participants, while 60.3% were non-smokers, indicating a moderate exposure to a known TB risk factor. Crosstab analysis revealed that TB positivity was highest in the 38–45 years age group, suggesting increasing vulnerability with advancing age. Although males slightly outnumbered females, TB distribution across gender did not show a marked imbalance. The overall demographic pattern suggests that middle-aged adults represent the most affected subgroup in this study setting.

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