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FREQUENCY OF HUMAN IMMUNODEFICIENCY VIRUS IN DIAGNOSED CASES OF PULMONARY TUBERCULOSIS

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ABSTRACT

BACKGROUND: Pulmonary tuberculosis remains a major public health concern, particularly in resource-limited settings, and co-infection with HIV worsens disease outcomes. In Peshawar, where TB is common and HIV risk is increasing, local data on TB–HIV co-infection are limited, underscoring the need to determine HIV prevalence among TB patients to inform integrated management strategies.

OBJECTIVE: To determine the frequency of human immunodeficiency virus in diagnosed cases of pulmonary tuberculosis.

METHODOLOGY: This descriptive cross sectional study was conducted at the Pulmonology Department, Northwest General Hospital Peshawar from July 2025 to December 2025, including a total of 110 patients with confirmed pulmonary tuberculosis. Blood samples were analyzed for HIV ribonucleic acid, and demographic, clinical, and socioeconomic data were collected. Statistical associations between HIV positivity and demographics variables were assessed using Fisher's exact test.

RESULTS: The mean age of the patients was 37.2±8.7 years and mean BMI of 21.0±2.8 kg/m². Most participants were male (62.7%), resided in rural areas (65.5%), and belonged to a low socioeconomic status (71.8%). HIV infection was detected in 10 patients, yielding a prevalence of 9.1% (95% CI: 3.7–14.5%). Stratified analysis showed that male gender was significantly associated with HIV infection (OR = 14.65; 95% CI: 0.84–254.6; p = 0.013), whereas age, duration of tuberculosis, BMI, residence, education level, and socioeconomic status were not significantly associated (p>0.05)..

CONCLUSION: HIV co-infection is present in a notable proportion of pulmonary tuberculosis patients, particularly among males.

KEY WORDS: Human immunodeficiency virus, Pulmonary tuberculosis, Socioeconomic factors, Sex characteristics

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INTRODUCTION:

Pulmonary Tuberculosis (TB) is a chronic infectious disease caused by *Mycobacterium tuberculosis*, predominantly involving the pulmonary system but capable of hematogenous dissemination to extrapulmonary organs.[1] It persists as a major global health concern, especially in under-resourced populations where malnutrition, overcrowding, and inadequate healthcare facilities facilitate disease transmission.[2] When inhaled bacilli reach the lower respiratory tract and evade the host's immune defense, granulomatous lesions develop within the lung parenchyma.[3] The clinical manifestations include persistent productive cough, hemoptysis, pyrexia, cachexia, and nocturnal diaphoresis. Diagnosis is established through sputum smear microscopy, GeneXpert molecular assay, radiographic chest imaging, and mycobacterial culture.[4] Although effective pharmacotherapy exists, delayed case detection, multidrug resistance, and poor adherence to treatment remain major impediments to disease control.[5]

Tuberculosis co-infection has emerged as a critical clinical complication, as concurrent viral or bacterial pathogens exacerbate disease severity and hinder therapeutic outcomes.[6] Human Immunodeficiency Virus (HIV), Hepatitis B Virus, Hepatitis C Virus, and other respiratory pathogens induce immunosuppression, decrease treatment efficacy, and increase the mortality index.[7] HIV-mediated destruction of CD4+ T lymphocytes reactivates latent tuberculosis, producing disseminated pulmonary involvement.[8] In certain cases, Immune Reconstitution Inflammatory Syndrome (IRIS) develops following initiation of antiretroviral therapy, aggravating respiratory compromise.[9] Hence, integrated diagnostic screening and concurrent administration of antitubercular and antiviral regimens yield better prognostic outcomes.

Human Immunodeficiency Virus (HIV) represents the most significant comorbid infection among patients with pulmonary tuberculosis, owing to its profound immunosuppressive effect.[10] HIV-positive individuals can develop active tuberculosis even after minimal mycobacterial exposure.[7] Epidemiological surveillance in certain high burden setting demonstrates that approximately 50% of tuberculosis patients exhibit HIV seropositivity.[11] Both these pandemics put a synergistic disease load, making pharmacologic management as well as public-health measures more troublesome. Their association in cases

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highlights their epidemiologic linkage as well as predicts for early diagnostic regimens, preventive measures, and joint management therapies.

There was a need for conducting the current study in Peshawar due to high prevalence of pulmonary tuberculosis and increasing risk of Human Immunodeficiency Virus infection. Minimal local data exist on TB-HIV co infection, which is essential for early diagnosis, integrated management and effective control measures. It would be of great importance to know the prevalence of Human Immunodeficiency Virus among tuberculosis patients in such a background for ascertaining the epidemiological pattern, informing public health initiatives, and enhancing combined care facilities for Human Immunodeficiency Virus-positive patients in Peshawar.

METHODOLOGY:

This cross-sectional study was carried out in the Pulmonology Department of Northwest General Hospital, Peshawar over a period of six months, from July 2025 to December 2025. The confidentiality of participants and voluntary nature of participation were preserved throughout all stages of data collection and analysis.

A total of 110 participants were included in the study. The sample size was determined through OpenEpi sample size software, keeping 95% confidence interval, 6% margin of error, and an anticipated frequency of Human Immunodeficiency Virus as 11.6% among pulmonary tuberculosis patients.[12]

Patients enrollment was performed through a non-probability consecutive sampling approach to include every qualifying patient presenting during the study period.

Participants of either gender, aged between 18 and 60 years, with a confirmed diagnosis of pulmonary tuberculosis for at least three months, were eligible for inclusion. New TB patients were excluded because they had not yet received anti-tuberculous therapy, so their disease burden varied widely (from mild to extensive cavitary disease), therefore, natural immune response was unmodified. Including them would have introduced heterogeneity, making it harder to interpret outcomes.

Pulmonary tuberculosis was confirmed microbiologically through sputum smear microscopy for acid-fast bacilli and/or GeneXpert MTB/RIF assay in accordance with institutional and national tuberculosis control guidelines. Radiographic findings were used as supportive evidence but not as the sole diagnostic criterion. Individuals were excluded if they had received immunosuppressive medications, had other chronic pulmonary disorders, malignancies, or were pregnant at the time of evaluation.

Written informed consent was obtained from all participants following a complete explanation of the study objectives, potential risks, and anticipated benefits. The research recorded various demographic and clinical variables of age, gender, body mass index, tuberculosis duration, education, occupation, domicile, and socioeconomic status of each participant upon enrolment. The venous blood withdrawal was done by the qualified health care staff under stringent aseptic conditions. The antecubital fossa was sampled with a sterile needle to get a volume of about five to ten milliliters and the specimen aliquoted either in ethylenediaminetetraacetic acid or serum separator tubes depending on the analysis requirements.

The samples were then kept in the right place and transported to a diagnostic laboratory where serologic diagnosis of HIV was done. HIV infection was diagnosed as per the recommended protocols i.e. rapidly by use of antibody tests or ELISA according to the national screening protocols. The present study did not include measurements of CD4 counts and viral load measurements in their study.

IBM SPSS Statistics, version 27 was used to carry out data management and statistical analyses. Quantitative variables such as age, body mass index, and duration of tuberculosis were presented as means ± standard deviations. Qualitative variables included; gender, educational attainment, residential categorisation, socioeconomic class and HIV status which was in terms of absolute frequencies and percentages. The participants were classified based on the median age. The prevalence of HIV among other categorical statistics was provided with 95% confidence intervals to indicate accuracy. Analyses of relationships between categorical variables and HIV status were performed using Fisher exact test and odds ratios along with 95% confidence interval were calculated. A p-value ≤ 0.05 was considered statistically significant.

Ethical approval for this study was ibtained from Institutional review board and ethical committee of Alliance healthcare private limited, under reference no. IRB&EC/2025-GH/0241, dated 16-05-2025

RESULTS

The mean age of participants was 37.23 ± 8.72 years, with a mean duration of tuberculosis of 8.12 ± 3.23 months and a mean body mass index of 20.99 ± 2.81 kg/m². The cohort comprised 69 males (62.7%) and 41 females (37.3%). Most participants resided in rural areas (72 patients, 65.5%) compared to urban areas (38 patients, 34.5%). Regarding education level, 40 patients (36.4%) were uneducated, 26 (23.6%) had primary education, 24 (21.8%) had secondary education, and 20 (18.2%) had higher education. The majority of patients belonged to low socioeconomic status (79 patients, 71.8%), followed by middle socioeconomic status (24 patients, 21.8%) and high socioeconomic status (7 patients, 6.4%), as shown in Table-I.

Among the all patients with pulmonary tuberculosis, 10 patients (9.1%, 95% CI: 3.7%–14.5%) were HIV-positive, while 100 patients (90.9%, 95% CI: 85.5%–96.3%) were HIV-negative Table-II.

Stratified analysis of demographic and clinical factors showed that male gender was the only variable significantly associated with HIV infection (OR = 0.855; 95% CI: 0.78-0.94; p = 0.013),

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although the wide confidence interval reflects limited precision due to the small number of HIV-positive cases. No significant associations were observed between HIV status and age, duration of tuberculosis, body mass index, residential status, education level, or socioeconomic status ($p > 0.05$ for all comparisons). All statistical analyses were performed using Fischer Exact Test, as shown in Table-III.

Table-I: Patient Demographics (n=110)

Demographics	Mean ± SD
Age (years)	37.23 ± 8.72
Duration of TB (months)	8.12 ± 3.23
BMI (kg/m²)	20.99 ± 2.81
Gender	
Male n (%)	69 (62.7%)
Female n (%)	41 (37.3%)
Residence Status	
Rural n (%)	72 (65.5%)
Urban n (%)	38 (34.5%)
Education Level	
Uneducated n (%)	40 (36.4%)
Primary n (%)	26 (23.6%)
Secondary n (%)	24 (21.8%)
Higher n (%)	20 (18.2%)
Socioeconomic Status	
Low n (%)	79 (71.8%)
Middle n (%)	24 (21.8%)
High n (%)	7 (6.4%)

Table-II: Frequency of Human Immunodeficiency Virus Among Patients with Pulmonary Tuberculosis

HIV Status	Frequency	Percentage	95% CI
Yes	10	9.1%	3.7% – 14.5%
No	100	90.9%	85.5% – 96.3%
Total	110	100%	—

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Table-III: Association between demographic factors and HIV infection among pulmonary tuberculosis patients

Demographic Factors		Human Immunodeficiency Virus			p-value
		Yes n(%)	**No n(%)**	**OR (95% CI)**	
Age (years)	≤40	6 (8.6%)	64 (91.4%)	0.84 (0.22–3.20)	1.000
	>40	4 (10.0%)	36 (90.0%)	**	
Gender	Male	10 (14.5%)	59 (85.5%)	0.855 (0.78-0.94)	0.013*
	Female	0 (0.0%)	41 (100.0%)	**	
Duration of TB (months)	≤6	2 (5.1%)	37 (94.9%)	0.43 (0.08–2.29)	0.330
	>6	8 (11.3%)	63 (88.7%)	**	
BMI (kg/m²)	≤25	9 (9.2%)	89 (90.8%)	1.11 (0.13–9.36)	1.000
	>25	1 (8.3%)	11 (91.7%)	**	
Residential Status	Rural	7 (9.7%)	65 (90.3%)	1.24 (0.29–5.25)	1.000
	Urban	3 (7.9%)	35 (92.1%)	**	
Education Level	Uneducated	6 (15.0%)	34 (85.0%)	N/A	0.445
	Primary	2 (7.7%)	24 (92.3%)		
	Secondary	1 (4.2%)	23 (95.8%)		
	Higher	1 (5.0%)	19 (95.0%)		
Socioeconomic Status	Low	8 (10.1%)	71 (89.9%)	N/A	0.797
	Middle	2 (8.3%)	22 (91.7%)		
	High	0 (0.0%)	7 (100.0%)		

Fisher Exact Test was used to calculate p-value.
***P-value<0.05 was significant; **reference category.**-**

DISCUSSION

The present study investigated the frequency of Human Immunodeficiency Virus co-infection in patients diagnosed with pulmonary tuberculosis, revealing an overall HIV prevalence of 9.10% among the study population. The high rate of co-infection highlights the epidemiologic correlation between HIV and tuberculosis with immunosuppression caused by HIV creating an environment that supports the growth of Mycobacterium tuberculosis. This is done by the depletion of CD4+ T lymphocytes which are very crucial in the containment of mycobacterial infections. Subsequently, the impaired cellular immunity in HIV -positives not only increases the risk of active tuberculosis, but also allows reactivation of latent TB infection, thus explaining the high prevalence of the two diseases in clinical practice.

The correlation analysis showed a statistically significant relationship between HIV seropositivity and male sex, showing all the ten positive cases among male participants. The background of such sex distribution is out of the scope of the current data. A prevalence of HIV of 9.1% is in line with other studies in similar settings, but not in line with other regional and international investigations, highlighting differences in demographic characteristics, research design, and local epidemiology. This is significantly less than the 19.39% place of dual infection in Memon AR et al. in Karachi, Pakistan; that study specifically screened the HIV-positive population against tuberculosis, instead of taking the opposite screening approach.[13] Conversely other Pakistan-based studies have also found much lower rates of HIV-TB co-infection, such as Iqbal et al., who found 0.55 per cent HIV positive among 720 tuberculosis cases in Bahawalpur, Qadeer AS et al. who reported 1.8% among 330 patients, and Channa AA et al. who documented 1.4% prevalence among 1,257 tuberculosis patients in Karachi.[14-16] Internationally, the co-infection rate aligns more closely with findings from Iran where Mirahmadizadeh A et al. reported 3.2% prevalence, but remains considerably lower than rates observed in Indonesia where Gumilang RR et al. [17,18] found 16.93% co-infection, and Jamaica where Akpaka PE et al. reported 11.6% HIV prevalence among pulmonary tuberculosis patients.[12] These geographic variations likely reflect differences in the maturity of the HIV epidemic, healthcare infrastructure, screening practices, and the prevalence of risk factors in different populations.

The high prevalence of male gender and HIV positivity in the current study, in which all ten HIV-positive individuals were men, is supported by a literature corpus, which shows that the prevalence of HIV-TB co-infection was male-dominant. Mirahmadizadeh A et al. have found that 91.83 percent of HIV-TB co-infected patients were males and in multivariate analysis, male gender was found to be an independent risk factor (OR 1.91).[17] Akpaka PE et al. and Memon AR et al. also identified

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similar results as 76.6 per cent of HIV positive tuberculosis patients were male and 96.03 per cent of their HIV patients had illicit sexual relations mainly contracted in foreign countries.[12,13] This regular trend highlights the role of behavioral risk factors which seem to be more common amongst males. However, there are studies which have shown non-significant associations. An example is Gumilang RR et al. where there was no statistical significance in Indonesia, and Amin A et al. where HIV was found to be 6.7% of males and 3.6% of females in Lahore.[18,9] Interestingly, Qadeer et al. registered that most HIV positive cases among their tuberculosis cohort were female, and the risk factors included blood transfusion and multiple sex partners, thus demonstrating that the channels of transmission may differ significantly in different populations.[15]

The fact that the relationship between age and HIV co-infection was not statistically significant in our study is confirmed by the findings of Gumilang RR et al. and Amin A et al., who also did not find any visible difference in HIV prevalence between younger and older groups.[18,19] The average age obtained in the present study reflects those of other studies: Memon AR et al. [13] recorded a mean age of 36.8 years, Akpaka PE et al. [12] found a median age of 39 years, and Kumari GS recorded a mean age of 38.46 years.[12,13,20] These agreeable results support the thesis that HIV-TB co-infection primarily stalks victims who are in their working age. However, unlike the results by Akbulut İ et al., who have found low body mass index to be an independent risk factor for tuberculosis co-infection among HIV-positive individuals (OR 0.73), our study failed to demonstrate the statistically significant relation between body mass index (BMI) and HIV status.[21] The average BMI in our cohort was 20.99kg divided by m -2, which is much higher than the 18.22kg divided by m -2 in the case of HIV-positive tuberculosis patients. [20] Kadam M also found that low BMI was proportionately associated with worse treatment outcomes and that underweight patients were overrepresented in HIV-TB co-infection.[22] The similarity in the distribution of BMI between HIV-positive and HIV-negative patients with tuberculosis in our research can also be explained by the fact that the active tuberculosis effect affects the body more dominantly, which contributes to the fact that any differences in nutrition may be masked.

This difference with the statistically significant relationship between educational attainment and HIV seropositivity of Mirahmadizadeh et al. is supported because the latter found that illiterate or primary school educated persons living with HIV had a more than two-fold higher risk of tuberculosis (OR = 2.23).[17] This discrepancy can be explained by the heterogeneity in the quality of pedagogical instruction and curriculum orientation of health education in different schooling systems or even the fact that the knowledge of preventive action may not necessarily lead to long-term protectionary actions. Similarly, the inability to note a significant relationship between socioeconomic status and HIV co-infection indicates that economic factors are not the determinants of the risk of HIV infection. Mirahmadizadeh et al. found injection drug use as an important determinant (OR = 1.46) and Memon et al. identified that 96.03 percent of HIV-positive individuals had illicit sexual relationships, which supports the idea that risk factors of behavior can defy socioeconomic stratification.[17,13]

The study limitation includes the small sample size of the single-center tertiary care setting could have limited generalizability of the results, and selection bias because of the presence of only patients with duration of tuberculosis of at least three months. The small sample size and the inadequate number of HIV-positive individuals decrease the statistical power to reveal the relationships with demographic or clinical variables. The selection bias can also be increased by the use of non-probability consecutive sampling method. HIV status was determined solely based on serological results; no CD4 counts or viral loads were done, thus ruling out the possibility of an assessment of immunosuppression. Even though tuberculosis was microbiologically confirmed, radiographic findings should be used as an addition to the evidence to create misclassification bias.

CONCLUSION

HIV co-infection is present in a notable proportion of pulmonary tuberculosis patients, particularly among males, highlighting the importance of routine HIV screening, integrated care, and targeted interventions to reduce dual disease burden.

Conflict of interest: None

Disclaimer: None

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