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Original Research Article

OBSERVATIONAL STUDY OF CO-INFECTIONS AND COMORBIDITIES IN HOSPITALIZED PULMONARY TB PATIENTS

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ABSTRACT

Background: Pulmonary tuberculosis (PTB) remains a significant global health issue, particularly in low and middle-income countries. Hospitalized PTB patients often present with co-infections and co-morbidities, complicating clinical management and adversely affecting outcomes. Understanding their prevalence and impact is essential for improving patient care. The aim of study is to assess the prevalence and clinical implications of co-infections and comorbidities in hospitalized patients with pulmonary tuberculosis.

Materials and Methods: This prospective observational study was conducted at a tertiary care hospital and included 90 adult patients hospitalized with microbiologically confirmed PTB. Clinical, demographic, radiological, and laboratory data were collected using a structured proforma. Co-infections were diagnosed using microbiological and serological tests, while co-morbidities were identified through clinical records and investigations. Statistical analysis was performed using SPSS software, with p-values < 0.05 considered significant.

Results: The majority of patients were aged 31–50 years (40.00%) and male (64.44%). Underweight status (BMI <18.5) was observed in 54.44% of cases, and 67.78% were smear-positive. Drug-resistant TB was identified in 15.56% Comorbidities were present in 48.89% of patients, most commonly diabetes mellitus (23.33%) and HIV (13.33%). Co-infections were noted in 37.78% of cases, with bacterial pneumonia (20.00%) being the most frequent. Patients with co-infections had longer hospital stays (12.6 ± 4.1 vs. 9.3 ± 3.8 days; $p = 0.002$), higher mortality (20.59% vs. 5.36%; $p = 0.032$), and increased ICU admissions (29.41% vs. 10.71%; $p = 0.018$). Mortality was significantly associated with diabetes ($p = 0.041$) and HIV ($p = 0.012$).

Conclusion: Co-infections and co-morbidities are highly prevalent among hospitalized PTB patients and are associated with poorer clinical outcomes, including higher mortality and ICU admission rates. Early identification and integrated management strategies are vital to improving prognosis in this vulnerable group.

Keywords: Pulmonary tuberculosis, Co-infection, Co-morbidity, Hospitalization, Mortality.

INTRODUCTION

Tuberculosis (TB) continues to be a global health challenge and remains one of the top 10 causes of death worldwide. Despite advances in diagnostics, treatment, and public health infrastructure, TB persists as a leading infectious disease, especially in low- and middle-income countries (LMICs) where social, economic, and healthcare disparities are prominent.[1] The global strategy for TB control has increasingly shifted from not only preventing transmission but also addressing the complex medical and social determinants associated with TB morbidity and mortality.[1]

Pulmonary tuberculosis (PTB), caused by Mycobacterium tuberculosis, is the most common

and contagious form of TB. It primarily affects the lungs but may also present with systemic manifestations. Although the infection can affect individuals of all age but more common in reproductive age groups in specially male genders, and populations in low socio-economic groups influenced by various demographic and biological factors.[2] Several studies have shown that younger adults often represent a large portion of PTB cases due to higher exposure risks and social mobility, while elderly individuals present a distinct set of clinical and diagnostic challenges due to atypical symptoms and higher rates of co-morbid conditions.[3] In older adults, TB is often under diagnosed or diagnosed late, which contributes to increased complications and mortality.[4]

In addition to age and sex, gender-based differences in TB epidemiology have gained recognition. Females, especially in certain socio-cultural contexts, may face barriers to accessing timely TB diagnosis and treatment. This is particularly evident in South Asia, where female patients frequently present with extra -pulmonary or advanced disease due to delayed care-seeking.[5] These gender-specific disparities affect disease outcomes and highlight the need for a more nuanced understanding of TB epidemiology.

One of the growing challenges in TB care is the co-existence of TB with other communicable and non-communicable diseases—a phenomenon referred to as TB multimorbidity.[6] The burden of comorbidities such as diabetes mellitus, chronic obstructive pulmonary disease (COPD), chronic kidney disease, HIV infection, and malignancies significantly complicates the management of TB.[7] These conditions can interfere with host immunity, delay TB diagnosis, increase susceptibility to severe disease, and reduce the effectiveness of anti-tubercular therapy. In particular, diabetes mellitus has been associated with a higher bacillary burden, delayed sputum conversion, and increased risk of treatment failure.[8] Similarly, HIV remains the most potent known risk factor for TB reactivation and dissemination, altering its clinical presentation and accelerating progression to severe forms.

Beyond non-communicable diseases, co-infections are a critical but often underexplored aspect of TB morbidity. Hospitalized TB patients, particularly those with advanced disease or compromised immunity, are vulnerable to superimposed infections such as bacterial pneumonia, severe sepsis, and viral or fungal infections. These co-infections often arise from Nosocomial exposures, poor nutritional status, or concurrent immunosuppressive states, and may worsen respiratory function, prolong hospital stays, and contribute to mortality. Yet, they are frequently under-diagnosed or inadequately treated, especially in resource-limited settings.

TB co-morbidities and co-infections are not isolated phenomena; they exist within a broader context of healthcare delivery that is often fragmented and disease-specific. Traditional health systems, particularly in LMICs, are not well-equipped to handle the complexities of these co-morbidities. Health services are typically organized around single diseases, leaving little room for integrated care for comorbidities[9] As a result, patients with TB and co-morbid conditions may experience care delays, increased out-of pocket expenditures, and suboptimal treatment outcomes. This issue becomes even more critical in the context of hospitalization, where timely management of co-existing illnesses determines prognosis and overall survival.

Recent studies from high TB burden countries have documented a rising prevalence of co-morbidities and co-infections among hospitalized TB patients. For instance, a multicenter study in China reported that over 50% of newly diagnosed PTB patients had at least one co-existing medical condition.[10] In such populations, co-morbidities were significantly associated with prolonged hospitalization and increased in-hospital mortality. These findings reinforce the need for clinicians and public health practitioners to screen actively for co-morbid illnesses and secondary infections in TB patients upon admission, especially in tertiary care settings.

Despite increasing recognition of TB and comorbidies, there remains a lack of comprehensive data from many developing regions. Studies are often focused on single co-morbidities such as HIV or diabetes, and rarely address the combined impact of multiple concurrent illnesses or infections. Additionally, the effect of these conditions on short-term clinical outcomes—such as length of hospital stay, need for intensive care, and mortality—has not been thoroughly evaluated in many healthcare settings. There is a more intensive need to document the spectrum of co-morbidities and co-infections in hospitalized TB patients and to examine their clinical impact systematically.

MATERIALS AND METHODS

This is a prospective observational study conducted at a tertiary care hospital. The study aimed to evaluate the prevalence and clinical impact of co-infections and co-morbidities among patients hospitalized with pulmonary tuberculosis. A total of 90 patients diagnosed with pulmonary tuberculosis (PTB) and admitted to the hospital were enrolled consecutively during the study period. Diagnosis of PTB was based on clinical presentation, radiological findings, and microbiological confirmation by sputum smear microscopy, GeneXpert .

Inclusion Criteria

- Age ≥ 18 years
- Confirmed cases of pulmonary tuberculosis
- Hospital admission required for management of TB or associated complications
- Provided informed consent

Exclusion Criteria

- Patients with exclusively extra-pulmonary TB

- Patients unwilling or unable to provide informed consent
- Lost of follow up cases

Data Collection: Detailed clinical, demographic, and laboratory data were collected prospectively using a structured case record form. Demographic information included age, gender, and history of smoking and alcohol use. Clinical presentation was documented in terms of symptoms, their duration, and body mass index (BMI). Tuberculosis-related data encompassed the type of TB (primary or reactivation), sputum smear status, and drug sensitivity results when available. Co-morbidities were recorded based on medical history and diagnostic reports and included conditions such as diabetes mellitus, HIV infection, chronic obstructive pulmonary disease (COPD), chronic kidney disease, malignancies, liver disease, and other relevant chronic illnesses. Co-infections were identified during the hospital stay and included bacterial pneumonia, viral infections, fungal infections, and severe sepsis, confirmed through appropriate microbiological cultures and serological tests. Laboratory investigations performed at admission included complete blood count, liver and renal function tests, random blood glucose, HIV testing (after obtaining informed consent), sputum culture and imaging studies such as chest radiographs or computed tomography (CT) scans where indicated.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using SPSS version 26.0. Descriptive statistics were used to summarize baseline characteristics. Categorical variables were expressed as frequencies and percentages, while continuous variables were presented as mean ± standard deviation (SD) or median with interquartiles range (IQR), depending on data distribution. The association between co-infections/co-morbidities and clinical outcomes (e.g., duration of hospitalization, complications, mortality) was assessed using chi-square test or Fisher's exact test for categorical variables and t-test or Mann–Whitney U test for continuous variables. A p-value < 0.05 was considered statistically significant.

RESULTS

Baseline Characteristics [Table 1]: Among the 90 hospitalized patients with pulmonary tuberculosis (PTB), the majority were in the 31–50 years age group (40.00%), followed by those over 50 years (35.56%), and the youngest group aged 18–30 years (24.44%). Males constituted a higher proportion of the study population (64.44%) compared to females (35.56%). Behavioral risk factors such as smoking and alcohol use were observed in 37.78% and 31.11% of patients, respectively. A significant number of patients (54.44%) were underweight, with a body mass index (BMI) less than 18.5, reflecting a high burden of malnutrition. In terms of TB-related clinical status, 67.78% of the patients were smear-positive, indicating active pulmonary disease with a high potential for transmission. Drug-resistant tuberculosis was identified in 15.56% of the cohort, underscoring the challenge of antimicrobial in TB management.

Comorbidity Profile [Table 2]: Comorbid conditions were prevalent in nearly half (48.89%) of the patients. The most common co-morbidity was diabetes mellitus, found in 23.33% of cases, followed by HIV infection in 13.33% and chronic obstructive pulmonary disease (COPD) in 11.11%. Chronic kidney disease and liver disease were less common, present in 6.67% and 5.56% of patients, respectively. A smaller proportion (3.33%) had underlying malignancy. These findings indicate that comorbid conditions, especially diabetes and HIV, are frequent among hospitalized TB patients and may influence disease progression and outcomes.

Frequency of Co-infections [Table 3]: Co-infections were identified in 37.78% of the patients during hospitalization. Bacterial pneumonia was the most common co-infection, affecting 20.00% of patients, followed by urinary tract infections (12.22%) and severe sepsis (10.00%). Viral infections excluding HIV were noted in 7.78%, while fungal infections were diagnosed in 5.56% of patients. The presence of co-infections, particularly bacterial and systemic infections, adds a significant burden to the clinical management of PTB and is associated with increased healthcare resource utilization.

Impact of Co-infections on Clinical Outcomes [Table 4]: Patients with co-infections had significantly worse clinical outcomes compared to those without. The mean hospital stay was significantly longer in patients with co-infections (12.6 ± 4.1 days) compared to those without (9.3 ± 3.8 days), with a highly significant p-value of 0.002. In-hospital mortality was also higher in the co-infection group (20.59%) compared to those without co-infections (5.36%), and this difference was statistically significant ($p = 0.032$). Furthermore, ICU admission was more frequently required in patients with co-infections (29.41%) compared to those without (10.71%), with a significant p-value of 0.018. These findings suggest that co-infections are associated with prolonged hospitalization, higher mortality, and increased need for intensive care support.

Comorbidities and Mortality [Table 5]: The presence of comorbidities was significantly associated with higher in-hospital mortality. Among the 10 patients who died during hospitalization, 50.00 % had diabetes mellitus compared to 20.00 % among survivors, a statistically significant difference ($p = 0.041$). HIV infection was present in 40.00% of deceased patients versus only 10.00% of survivors ($p = 0.012$), indicating a strong association with mortality. Notably, only 10.00% of patients who died had no co-morbidities, while the majority of survivors (56.25%) were free from co-morbid

conditions, with this difference reaching high statistical significance (p = 0.003). These results highlight the critical impact of comorbidities—Particularly diabetes and HIV on the prognosis of hospitalized TB patients .

Table 1: Baseline Demographic and Clinical Characteristics of Study Population (n = 90)

Characteristic	Frequency (n)	Percentage (%)
Age (years)		
18–30	22	24.44%
31–50	36	40.00%
>50	32	35.56%
Gender		
Male	58	64.44%
Female	32	35.56%
Smoking History	34	37.78%
Alcohol Use	28	31.11%
BMI <18.5 (underweight)	49	54.44%
Smear Positive TB	61	67.78%
Drug-Resistant TB	14	15.56%

Table 2: Distribution of Comorbidities Among Patients with Pulmonary TB (n = 90)

Comorbidity	Frequency (n)	Percentage (%)
Diabetes Mellitus	21	23.33%
HIV	12	13.33%
COPD	10	11.11%
Chronic Kidney Disease	6	6.67%
Liver Disease	5	5.56%
Malignancy	3	3.33%
≥1 Comorbidity Present	44	48.89%

Table 3: Frequency of Co-infections in Hospitalized PTB Patients (n = 90)

Co-infection	Frequency (n)	Percentage (%)
Bacterial Pneumonia	18	20.00%
Urinary Tract Infection	11	12.22%
Sepsis	9	10.00%
Viral Infection (non-HIV)	7	7.78%
Fungal Infection	5	5.56%
≥1 Co-infection Present	34	37.78%

Table 4: Comparison of Outcomes in Patients With and Without Co-infections

Outcome	Co-infection (n = 34)	No Co-infection (n = 56)	p-value
Mean Hospital Stay (days)	12.6 ± 4.1	9.3 ± 3.8	0.002 **
In-hospital Mortality	7 (20.59%)	3 (5.36%)	0.032 *
Need for ICU Admission	10 (29.41%)	6 (10.71%)	0.018 *

* $p < 0.05$ considered statistically significant
** Highly significant

Table 5: Association of Comorbidities With In-hospital Mortality (n = 90)

Comorbidity Present	Mortality (n = 10)	Survived (n = 80)	p-value
Diabetes Mellitus	5 (50.00%)	16 (20.00%)	0.041 *
HIV	4 (40.00%)	8 (10.00%)	0.012 *
No Comorbidity	1 (10.00%)	45 (56.25%)	0.003 **

* $p < 0.05$, ** $p < 0.01$

DISCUSSION

In the present study of 90 hospitalized pulmonary tuberculosis (PTB) patients, the majority belonged to the 31–50 years age group (40.00%), followed by those above 50 years (35.56%). This age distribution reflects TB's predilection for adults in their economically productive years, which is consistent with findings from Bhattacharya et al. (2020),[11] who reported 41% of TB patients in the 30–50 years age bracket in their Northeast India cohort. Male predominance (64.44%) in our study parallels the gender distribution observed in Weldeslassie et al. (2023),[12] where 61.2% of TB patients were male. These patterns likely reflect greater occupational exposure, social behaviour (e.g., smoking, alcohol), and healthcare-seeking differences among men.

Smoking (37.78%) and alcohol use (31.11%) were relatively common in our cohort. Similar lifestyle risk factor prevalence was observed by Magwalivha et al (2025),[13] who noted smoking in 35% of TB patients, suggesting these modifiable behaviours contribute significantly to TB burden. Malnutrition was highly prevalent in our study, with 54.44% of patients being underweight (BMI < 18.5). This rate is notably higher than the 42% reported by Bhattacharya et al (2020),[11] further emphasizing

the malnutrition-TB vicious cycle in hospitalized populations. Smear positivity was present in 67.78% of our cases, similar to the 70% reported in Weldeslassie et al. (2023),[12] indicating a large burden of infective TB. Drug resistance was seen in 15.56% of patients, closely aligning with the 16.3% rate reported by Magwalivha et al. (2025),[13] suggesting an urgent need for improved diagnostic access and antimicrobial stewardship.

Comorbidities were found in 48.89% of our patients, with diabetes mellitus being the most prevalent (23.33%). This is comparable to the 25% prevalence reported by McMurry et al,[14] (2019) in their systematic review of TB-diabetes co-infection in low- and middle-income countries. Abd El-Hamid El-Kady et al,[15] (2021) found a slightly higher prevalence (29.4%) in Saudi Arabia, suggesting regional variation possibly due to differing diabetes epidemiology. HIV co-infection in our study was observed in 13.33% of patients, closely matching the 14.1% reported by Duarte et al,[16] (2018) in their global review of TB-HIV syndemics. COPD (11.11%), chronic kidney disease (6.67%), and liver disease (5.56%) were less common but clinically relevant. The link between TB and chronic kidney disease has been confirmed by Venkata et al,[17] (2007) and TB risk is elevated in cirrhosis patients as demonstrated by Lin et al,[18] (2014) consistent with our findings.

Co-infections were identified in 37.78% of patients during hospitalization. Bacterial pneumonia was the leading co-infection (20.00%), followed by urinary tract infections (12.22%) and sepsis (10.00%). These rates are broadly in line with the findings of Magwalivha et al,[13] (2025) who reported bacterial respiratory co-infections in 24% and bloodstream infections in 9% of TB patients. Fungal infections and non-HIV viral infections were found in 5.56% and 7.78% of our patients, respectively, also aligning with the co-infection burden described by Weldeslassie et al. (2023).[12] Such co-infections are known to worsen TB outcomes by compounding respiratory compromise and immunologic stress.

The clinical outcomes of co-infected patients were significantly worse. The mean hospital stay for patients with co-infections was 12.6 ± 4.1 days, notably longer than the 9.3 ± 3.8 days for those without ($p = 0.002$). This difference is consistent with Magwalivha et al. (2025),[13] who also reported prolonged hospitalization in TB patients with bacterial co-infections (mean 13.1 days vs. 9.5 days). Mortality in the co-infection group was 20.59%, compared to 5.36% in those without ($p = 0.032$), again mirroring the mortality trends reported by Weldeslassie et al. (2023),[12] who found a 3.5-fold increase in mortality among co-infected TB patients. ICU admission rates were significantly higher in co-infected individuals (29.41% vs. 10.71%, $p = 0.018$), indicating more severe disease courses and complications.

Comorbidities were also associated with significantly higher in-hospital mortality. Half of the patients who died had diabetes mellitus, compared to only 20% of survivors ($p = 0.041$). Abd El-Hamid El-Kady et al,[15] (2021) similarly reported poorer treatment outcomes and higher mortality among TB-diabetes patients. HIV was present in 40.00% of deceased patients, compared to 10.00% of survivors ($p = 0.012$), supporting the known immunosuppressive synergy of HIV in TB progression as detailed by Duarte et al (2018).[16] Importantly, only 10.00% of patients who died had no comorbidities, while the majority of survivors (56.25%) were comorbidity-free ($p = 0.003$), reinforcing the protective effect of absence of comorbidity and the need for integrated disease management.[17,18]

CONCLUSION

This study highlights the high burden of co-infections and comorbidities among hospitalized pulmonary tuberculosis patients, significantly impacting clinical outcomes. Diabetes mellitus and HIV were the most common comorbidities, while bacterial pneumonia was the leading co-infection. Both co-infections and comorbidities were associated with increased mortality, longer hospital stays, and greater ICU admissions. Early identification and integrated management of these conditions are essential to improving TB outcomes.

REFERENCES

1. Board E. Global strategy and targets for tuberculosis prevention, care and control after 2015: report by the secretariat. Geneva: World Health Organization; 2014.
2. Donald P, Marais B, Barry CE 3rd. Age and the epidemiology and pathogenesis of tuberculosis. Lancet. 2010;375:1852–4. doi:10.1016/S0140-6736(10)60580-6.
3. Zhang X, Andersen AB, Lillebaek T, et al. Effect of sex, age, and race on the clinical presentation of tuberculosis: a 15-year population-based study. Am J Trop Med Hyg. 2011;85:285–90. doi:10.4269/ajtmh.2011.10-0630.
4. Negin J, Abimbola S, Marais BJ. Tuberculosis among older adults - time to take notice. Int J Infect Dis. 2015;32:135–7. doi:10.1016/j.ijid.2014.11.018.
5. Mehraj J, Khan ZY, Saeed DK, Shakoor S, Hasan R. Extrapulmonary tuberculosis among females in South Asia-gap analysis. Int J Mycobacteriol. 2016;5:392–9. doi:10.1016/j.ijmyco.2016.09.054.
6. Siddiqi K, Stubbs B, Lin Y, Elsey H, Siddiqi N. TB multimorbidity: a global health challenge demanding urgent attention. Int J Tuberc Lung Dis. 2021;25:87–90. doi:10.5588/ijtld.20.0751.
7. Bates M, Marais BJ, Zumla A. Tuberculosis comorbidity with communicable and noncommunicable diseases. Cold Spring Harb Perspect Med. 2015;5:a017889. doi:10.1101/cshperspect.a017889.
8. Stubbs B, Siddiqi K, Elsey H, Siddiqi N, Ma R, Romano E, et al. Tuberculosis and non-communicable disease multimorbidity: an analysis of the world health survey in 48 low- and middle-income countries. Int J Environ Res Public Health. 2021;18:2439. doi:10.3390/ijerph18052439.
9. Salisbury C. Multimorbidity: redesigning health care for people who use it. Lancet. 2012;380:7–9. doi:10.1016/S0140-6736(12)60482-6.
10. Wang W, Wang X, Chen S, Li J, Cheng Q, Zhang Y, et al. Prevalence and clinical profile of comorbidity among newly diagnosed pulmonary tuberculosis patients: a multi-center

observational study in eastern China. Front Med. 2025;12:1446835. doi:10.3389/fmed.2025.1446835.
11. Bhattacharya P, Talukdar K, Barman B, Jamil M, Phukan P, Mobing H, et al. Clinical Spectrum and Medical Comorbidities in Tuberculosis: A Hospital-Based Study in Northeast India. Cureus. 2020;12(9):e10580. doi:10.7759/cureus.10580.
12. Weldeslassie M, Fru-Cho J, Iyasu E, Akumtoh N, Magha C, Diana G, et al. Assessment of Co-Infection in Tuberculosis Patients Prior to their Enrollment to the Direct Observed Treatment (Dot) Program in Buea, Limbe, and Douala Tuberculosis Treatment Centers. Asian J Health Sci. 2023;9(1):ID49. doi:10.15419/ajhs.v9i1.520.
13. Magwalivha M, Rikhotso MC, Kachienga LO, Musoliwa R, Banda NT, Mashilo MS, et al. Bacterial co-occurrence with pulmonary TB, a respiratory tract infection (RTI): A cross-sectional study in a resource-limited setting. J Clin Tuberc Other Mycobact Dis. 2025;40:100534. doi:10.1016/j.jctube.2025.100534.
14. McMurry HS, Mendenhall E, Rajendrakumar A, Nambiar L, Satyanarayana S, Shivashankar R. Coprevalence of type 2 diabetes mellitus and tuberculosis in low-income and middle-income countries: a systematic review. Diabetes Metab Res Rev. 2019;35:e3066. doi:10.1002/dmrr.3066.
15. Abd El-Hamid El-Kady R, Abdulrahman TS. The footprint of diabetes mellitus on the characteristics and response to anti-tuberculous therapy in patients with pulmonary tuberculosis from Saudi Arabia. Infect Drug Resist. 2021;14:5303–12. doi:10.2147/IDR.S344703.
16. Duarte R, Lönnroth K, Carvalho C, Lima F, Carvalho ACC, Muñoz-Torrico M, et al. Tuberculosis, social determinants and co-morbidities (including HIV). Pulmonology. 2018;24:115–9. doi:10.1016/j.rppnen.2017.11.003.
17. Venkata RK, Kumar S, Krishna RP, Kumar SB, Padmanabhan S, Kumar S. Tuberculosis in chronic kidney disease. Clin Nephrol. 2007;67:217–20. doi:10.5414/cnp67217.
18. Lin YT, Wu PH, Lin CY, et al. Cirrhosis as a risk factor for tuberculosis infection--a nationwide longitudinal study in Taiwan. Am J Epidemiol. 2014;180:103–10. doi:10.1093/aje/kwu095.