



Impact of Non-Communicable Diseases on Tuberculosis Outcomes: A Prospective Observational Study.

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Abstract

Background: Tuberculosis (TB) remains a major global public health challenge, particularly in developing countries. The increasing burden of non-communicable diseases (NCDs) such as diabetes mellitus, hypertension, chronic kidney disease, chronic obstructive pulmonary disease, and cardiovascular diseases has complicated TB management and treatment outcomes. **Objective:** To evaluate the impact of non-communicable diseases on treatment outcomes among patients diagnosed with tuberculosis. **Materials and Methods:** A prospective observational study was conducted among 220 confirmed TB patients attending a tertiary care hospital over 12 months. Patients were categorized into two groups: TB patients with NCDs and TB patients without NCDs. Demographic details, clinical characteristics, laboratory investigations, treatment adherence, complications, and outcomes were recorded and analysed. **Results:** Among 220 TB patients, 96 (43.6%) had one or more NCDs. Diabetes mellitus was the most common comorbidity (45.8%), followed by hypertension (29.1%) and COPD (15.6%). Delayed sputum conversion, prolonged hospitalization, higher complication rates, and increased mortality were significantly associated with TB patients having NCDs ($p < 0.05$). Treatment success rate was lower among patients with NCDs (68.7%) compared to those without NCDs (84.6%). **Conclusion:** Non-communicable diseases significantly influence tuberculosis outcomes by increasing morbidity, treatment failure, and mortality. Early identification and integrated management of NCDs among TB patients are essential to improve treatment outcomes and reduce disease burden.

Keywords: Tuberculosis, Non-communicable diseases, Diabetes mellitus, Hypertension, COPD, Treatment outcomes.



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INTRODUCTION

Tuberculosis (TB) is one of the leading infectious diseases worldwide caused by *Mycobacterium tuberculosis*. Despite advances in diagnosis and treatment, TB continues to contribute significantly to global morbidity and mortality, especially in low- and middle-income countries such as India. According to the World Health Organization (WHO), India accounts for a substantial proportion of the global TB burden.

In recent years, the coexistence of non-communicable diseases (NCDs) with infectious diseases has emerged as a serious healthcare concern. NCDs including diabetes mellitus (DM), hypertension (HTN), chronic kidney disease (CKD), chronic obstructive pulmonary disease (COPD), and cardiovascular diseases adversely affect immune responses and increase susceptibility to TB infection.

Diabetes mellitus is one of the strongest risk factors for active TB and is associated with delayed sputum conversion, treatment failure, relapse, and mortality. Similarly, COPD and CKD impair pulmonary and systemic immunity, worsening TB outcomes. Hypertension and cardiovascular diseases may further complicate anti-tubercular therapy due to drug interactions and systemic complications.

The dual burden of TB and NCDs poses significant challenges to healthcare systems. Limited prospective data are available regarding the influence of NCDs on TB treatment outcomes in Indian populations. Therefore, the present study was designed to evaluate the impact of non-communicable diseases on tuberculosis outcomes.

Aim and Objectives

Aim

To assess the impact of non-communicable diseases on tuberculosis treatment outcomes.

Objectives

1. To determine the prevalence of NCDs among TB patients.
2. To compare treatment outcomes between TB patients with and without NCDs.
3. To evaluate complications and mortality associated with TB-NCD comorbidity.
4. To identify major NCDs influencing TB prognosis.

MATERIALS AND METHODS

Study Design

Prospective observational study.

Study Setting

Department of Pulmonary Medicine and General Medicine in a tertiary care teaching hospital.

Study Duration

12 months.

Study Population

Patients diagnosed with pulmonary and extrapulmonary tuberculosis.

Sample Size

A total of 220 confirmed TB patients were enrolled.

Inclusion Criteria

- Patients aged ≥ 18 years.
- Confirmed diagnosis of tuberculosis.
- Patients willing to participate and provide informed consent.

Exclusion Criteria

- Pregnant women.
- HIV-positive patients.
- Patients with malignancy or immunosuppressive therapy.
- Critically ill patients unwilling to participate.

Data Collection

Detailed demographic and clinical data were recorded using a structured proforma:

- Age
- Gender
- Socioeconomic status
- Smoking and alcohol history
- Presence of NCDs
- Laboratory investigations
- Radiological findings
- Sputum status
- Treatment adherence
- Treatment outcomes

Outcome Measures

- Sputum conversion
- Treatment success
- Treatment failure
- Mortality
- Hospitalization duration
- Complications

Statistical Analysis

Data were analyzed using SPSS software version 25. Continuous variables were expressed as mean $\pm$ SD and categorical variables as percentages. Chi-square test and Student's t-test were applied. P-value <0.05 was considered statistically significant.

RESULTS

A total of 220 tuberculosis (TB) patients were included in the study, of whom 96 patients had one or more non-communicable diseases (NCDs) and 124 patients had TB without any associated NCDs.

Table 1: Demographic Characteristics of Study Participants

Variable	TB with NCDs (n=96)	TB without NCDs (n=124)
Mean age (years)	51.2 $\pm$ 11.4	39.8 $\pm$ 13.2
Male	61 (63.5%)	77 (62.1%)
Smokers	38 (39.5%)	32 (25.8%)
Alcohol use	29 (30.2%)	24 (19.4%)

The demographic analysis revealed that patients with TB and NCDs were considerably older than those without NCDs, with a mean age of 51.2 $\pm$ 11.4 years compared to 39.8 $\pm$ 13.2 years. The proportion of males was similar in both groups, accounting for 63.5% of TB patients with NCDs and 62.1% of those without NCDs. Smoking was more common among patients with NCDs (39.5%) than among those without NCDs (25.8%). Similarly, alcohol consumption was reported more frequently in the TB with NCDs group (30.2%) compared to the TB without NCDs group (19.4%). These findings suggest that older age and lifestyle-related risk factors were more prevalent among TB patients with coexisting NCDs.

Table 2: Distribution of Non-Communicable Diseases

NCD	Frequency (%)
Diabetes Mellitus	44 (45.8%)
Hypertension	28 (29.1%)
COPD	15 (15.6%)
Chronic Kidney Disease	6 (6.2%)
Cardiovascular Disease	3 (3.1%)

Among the 96 TB patients with NCDs, diabetes mellitus was the most prevalent comorbidity, affecting 44 patients (45.8%). Hypertension was the second most common NCD, observed in 28 patients (29.1%). Chronic obstructive pulmonary disease (COPD) was present in 15 patients (15.6%), while chronic kidney disease (CKD) and cardiovascular disease (CVD) were identified in 6 (6.2%) and 3 (3.1%) patients, respectively. The predominance of diabetes and hypertension indicates a substantial burden of metabolic disorders among TB patients.

Table 3: Comparison of Treatment Outcomes

Outcome	TB with NCDs	TB without NCDs	P-value
Successful treatment	66 (68.7%)	105 (84.6%)	<0.05
Delayed sputum conversion	31 (32.3%)	17 (13.7%)	<0.01
Treatment failure	12 (12.5%)	6 (4.8%)	<0.05
Mortality	10 (10.4%)	4 (3.2%)	<0.05

Treatment outcome analysis demonstrated significantly poorer outcomes among TB patients with NCDs compared to those without NCDs. Successful treatment was achieved in 68.7% of patients with NCDs, whereas the success rate was significantly higher among patients without NCDs (84.6%; $p<0.05$). Delayed sputum conversion was observed in nearly one-third (32.3%) of TB patients with NCDs, compared with only 13.7% among those without NCDs, indicating slower microbiological response to therapy ($p<0.01$).

Furthermore, treatment failure was significantly more frequent among patients with NCDs (12.5%) than among those without NCDs (4.8%; $p<0.05$). Mortality was also substantially higher in the TB-NCD group, affecting 10.4% of patients compared with 3.2% in the TB-only group ($p<0.05$). These findings indicate that the presence of NCDs adversely affects TB treatment outcomes, leading to delayed recovery, increased treatment failure, and higher mortality rates.

Overall, the study demonstrates that TB patients with coexisting NCDs are generally older and have a higher prevalence of smoking and alcohol consumption. Diabetes mellitus and hypertension emerged as the most common comorbid conditions. Importantly, the presence of NCDs was associated with significantly poorer TB treatment outcomes, including

lower treatment success rates, delayed sputum conversion, higher treatment failure, and increased mortality. These findings highlight the need for integrated management of TB and NCDs to improve patient outcomes and reduce disease burden.

DISCUSSION

The present study demonstrated that non-communicable diseases significantly affect tuberculosis outcomes. Among the identified NCDs, diabetes mellitus was the most common comorbidity, consistent with previous Indian and international studies.

Patients with diabetes had delayed sputum conversion and poorer treatment response. Hyperglycemia impairs macrophage and lymphocyte function, increasing susceptibility to severe TB infection. Similar findings were reported by Baker et al. and Jeon & Murray.

Hypertension and cardiovascular diseases were also associated with poor treatment adherence and prolonged hospitalization. COPD patients experienced increased pulmonary complications due to reduced lung function. The mortality rate was significantly higher among TB patients with NCDs. This may be due to impaired immunity, systemic inflammation, and increased adverse drug reactions.

Integrated screening for NCDs among TB patients is necessary to improve clinical outcomes. Collaborative management strategies involving pulmonologists, physicians, and public health professionals are essential.

CONCLUSION

Non-communicable diseases substantially worsen tuberculosis treatment outcomes by increasing complications, treatment failure, delayed recovery, and mortality. Diabetes mellitus emerged as the most significant comorbidity associated with poor prognosis. Routine screening and integrated management of NCDs in TB patients should be incorporated into national tuberculosis control programs for better healthcare delivery and patient outcomes.

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Limitations

- Single-center study.
- Limited sample size.
- Exclusion of HIV-positive patients.
- Short follow-up duration.

Recommendations

- Routine NCD screening among TB patients.
- Integrated TB-NCD healthcare programs.
- Lifestyle modification counseling.
- Larger multicentric studies for broader validation.

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