Original Article

Prevalence of Comorbidities among Pulmonary Tuberculosis Cases Reporting to a Respiratory Clinic in Western Maharashtra

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Abstract

Background: Tuberculosis is a highly infectious disease responsible for millions of deaths each year, with a disproportionately high incidence in developing countries like India. Comorbidities associated with tuberculosis can complicate treatment and increase mortality risk. This study aims to assess the prevalence of comorbidities among pulmonary tuberculosis patients, which could provide insights for improving patient management and reducing mortality.

Materials and Methods: A cross-sectional study was conducted among 400 diagnosed pulmonary tuberculosis patients at a respiratory clinic in Western Maharashtra, following approval from the Institutional Ethics Committee (IEC) of SKNMCGH (Approval No.2024/274). Demographic information and comorbidity status were collected for each participant and entered into Excel spreadsheets. The Chi-square test was applied to the recorded data using OpenEpi software to study associations between comorbidities and sociodemographic factors. Sample size was determined using a comorbidity prevalence of 39% as reported by Sathish Rajaa, Yuvaraj Krishnamoorthy, et al. in a cross-sectional study of tuberculosis patients in South India, with an allowable error of 5%. This resulted in a minimum required sample size of 367, and our study includes 400 pulmonary tuberculosis patients.[1]

Results: Out of the 400 pulmonary tuberculosis patients studied, 158 (39.5%) were found to have one or more comorbidities. The incidence of comorbidities increased with age. The most common comorbidity was found to be diabetes affecting 84 (21%) of patients, followed by hypertension, asthma and malnutrition, affecting 17.25%, 14.50% and 11% of patients respectively. There were also various other comorbidities, but none of them affected more than 2% of the patients.

Conclusion: A large proportion of tuberculosis patients have comorbidities, which can lead to unsuccessful

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treatment and an increase in their mortality. Therefore, it is very important to detect and diagnose these comorbidities and control their progression.

Key Words: Pulmonary Tuberculosis, comorbidities, risk factors, prevalence, cross sectional analysis

Introduction

Tuberculosis affects 10 million people annually, with 1.5 million deaths, making it the deadliest infectious disease worldwide. Almost half of the tuberculosis cases are found in developing countries.[2] India accounts for 28% of the world's tuberculosis load, resulting in approximately 3 million new patients each year.[3]

Tuberculosis is associated with a wide range of comorbidities which act as risk factors and also lead to poor treatment results in the patients. According to WHO, the most common comorbidities are HIV (human immunodeficiency virus), diabetes and malnutrition.[4] Other comorbidities include hypertension, asthma, chronic obstructive pulmonary disease, lung carcinoma, chronic kidney disease, rheumatoid arthritis, systemic lupus erythematosus, and many more.[5,6,7]

In general, people living with HIV are 18 times more likely to develop tuberculosis, with a range of 15 to 21 times higher risk compared to those without HIV.[8] Individuals with diabetes mellitus have a threefold higher risk of developing tuberculosis. Diabetes in tuberculosis patients makes the duration of treatment required longer, causes poor prognosis and even increases mortality.[9]

Comorbidities can lead to a poor prognosis and may even prevent the use of some efficacious anti-tubercular drugs.[10] Therefore, it is very important to diagnose these conditions early and to treat them alongside tuberculosis to improve the patient's prognosis.

Aims and Objectives

1. To estimate the prevalence of various types of co-morbidities among patients of pulmonary tuberculosis
2. To study the association between co - morbidities and various sociodemographic factors, if any

Materials and Methods Study design: Cross-sectional study

Study setting: an outpatient department at a respiratory clinic in Western Maharashtra

Sample size: By taking prevalence of comorbidities obtained from other research papers as 39.28% with 5% allowable error, estimated sample size was to 367 (minimum sample size). The study has taken a sample size of 400 pulmonary tuberculosis patients.

Sampling method: All patients who fit the inclusion criteria were included till the sample size is attained

Inclusion criteria: Those already suffering from pulmonary tuberculosis and consented

Exclusion criteria: Patients who do not give consent

Data analysis: The data collected was analyzed using open-Epi software

Results

400 pulmonary tuberculosis patients were studied and they were divided according to their sociodemographic factors as depicted in table 1.

Note: The Modified BG Prasad scale includes five socio-economic classes ranging from upper to lower class based on per capita monthly income. However, in this study, the five classes were combined into two broader categories, "Lower class" and "Upper class," due to small sample sizes within some individual classes. This approach was necessary to ensure sufficient statistical power for meaningful analysis while maintaining clarity in reporting socio-economic associations with pulmonary tuberculosis and comorbidities.

Table 1: Demographic and Socio-Economic Characteristics of P.TB Patients

GENDER	FREQUENCY (n)	PERCENTAGE (%)
MALE	176	44
FEMALE	224	56
AGE GROUP (in years)	**FREQUENCY (n)**	**PERCENTAGE (%)**
9-19	52	13
20-29	87	21.75
30-39	67	16.75
40-49	58	14.5
50-59	56	14
60 and above	80	20
SOCIO-ECONOMIC STATUS	**FREQUENCY (n)**	**PERCENTAGE (%)**
Lower class	49	12.25
Upper class	351	87.75

400 pulmonary tuberculosis patients were studied, and the prevalence of various comorbidities found are listed in Table 2.

TABLE 2: The prevalence of various comorbidities among pulmonary tuberculosis patients.

Note: Frequencies are for individual comorbidities. Patients may have more than one comorbidity; therefore, sums of frequencies do not equate to total number of patients.

COMORBIDITIES	FREQUENCY (n)	PERCENTAGE (%)
1. Diabetes	84	21
2. HIV	4	1
3. Malnutrition	44	11
4. Hypertension	69	17.25
5. Asthma	58	14.50
6. COPD	44	11
7. Lung cancer	1	0.25
8. Pneumothorax	1	0.25
9. RHD	0	0
10. Chronic bronchitis	1	0.25
11. Bronchiectasis	0	0
12. RA	3	0.75
13. SLE	0	0
14. CRF	3	0.75
15. Hypothyroidism	7	1.75
16. Psychiatric disorders	5	1.25

After estimating the prevalence of the comorbidities, we divided the patients having comorbidities according to their age, gender and socioeconomic status. We then applied the chi-square test to determine if there was any correlation (association) between the prevalence of a specific comorbidity and the age, gender or socioeconomic class of the study participant.

Among the 176 males, 43.18% had comorbidities compared to 36.6% in 224 females (Table 3). This difference was not statistically significant. ($\chi^2 = 1.695$, p-value =0.193)

TABLE 3: Gender Distribution of Pulmonary Tuberculosis Patients with Comorbidities.

GENDER	NO. OF PATIENTS WITH COMORBIDITIES	NUMBER OF P.TB PATIENTS	PERCENTAGE (%)	CHI-SQUARE STATISTIC	P-VALUE
Male	76	176	43.18	1.695	0.193
Female	82	224	36.6		

The study group was also divided according to their age group as depicted in table 4. On applying the chi-square test, the calculated chi-square statistic (47.831) was much greater than the critical value (11.070). Thus, it proves that age is an important factor influencing the presence of co-morbidities in P.TB patients. Comorbidities varied significantly across age groups (Table 4), with the highest prevalence in the 50-59 group (69.64%) and the lowest in the 20-29 group (11.49%).

TABLE 4: Age Group Distribution of Pulmonary Tuberculosis Patients with Comorbidities

AGE GROUP (in years)	NO. OF P.TB PATIENTS WITH COMORBIDITIES	NUMBER OF P.TB PATIENTS	PERCENTAGE (%)	CHI-SQUARE STATISTIC	P-VALUE
9-19	10	52	19.23	47.831	<0.00001
20-29	10	87	11.49		
30-39	19	67	28.36		
40-49	28	58	48.28		
50-59	39	56	69.64		
60 and above	52	80	65		

The socioeconomic status of the study group was determined using the modified BG Prasad scale. Upon applying the chi-square test to Table 5, we found that the p-value (2.34×10^{-9}) was significantly lower than the standard significance level (0.05), indicating a significant association between socioeconomic status and the presence of comorbidities in P.TB patients. As shown in Table 5, comorbidities were more prevalent in the lower socioeconomic class compared to the upper class.

TABLE 5: Socio-Economic Status of Pulmonary Tuberculosis Patients with Comorbidities

SOCIO-ECONOMIC STATUS	NO. OF P.TB PATIENTS WITH COMORBIDITIES	NUMBER OF P.TB PATIENTS	PERCENTAGE (%)	CHI-SQUARE STATISTIC	P-VALUE
Lower class	39 (79.59%)	49	79.59	82.63	2.34×10^{-9}
Upper Class	119 (33.9%)	351	33.9		

Table 2 shows that the most common comorbidities among pulmonary tuberculosis patients were diabetes, hypertension, asthma, malnutrition, and COPD. Other comorbidities affected less than 2% of patients.

Table 6 presents the distribution of diabetes among pulmonary tuberculosis patients, revealing significant associations with age group and gender but no significant association with socioeconomic status.

TABLE 6: Distribution of Pulmonary Tuberculosis Patients with and without Diabetes by Gender, Age Group, and Socio-Economic Status

GENDER	P.TB AND DIABETES	ONLY P.TB	CHI-SQUARE STATISTIC	P-VALUE
Male	48 (27.3%)	128 (72.7%)	7.43	0.0064
Female	36 (16.1%)	188 (83.9%)		
AGE GROUP	**P.TB AND DIABETES**	**ONLY P.TB**	**CHI-SQUARE STATISTIC**	**P-VALUE**
Less than 50 years	14 (4.7%)	250 (95.3%)	20.75	< 0.00001
Above 50 years	70 (51.1%)	66 (48.9%)		
SOCIO-ECONOMIC STATUS	**P.TB AND DIABETES**	**ONLY P.TB**	**CHI-SQUARE STATISTIC**	**P-VALUE**
Lower class	15 (30.6%)	34 (69.4%)	2.48	0.115
Upper class	69 (19.7%)	282 (80.3%)		

The second most common comorbidity among the P.TB cases found was hypertension. In table 7 given below, we applied the chi-square test and we studied the relationship of hypertension as a comorbidity of P.TB with various socio-demographic variables.

Since the p-value is less than 0.05, we can confidently reject the null hypothesis and conclude that gender,age and socio-economic status are significantly associated with the presence of P.TB and Hypertension vs. Only P.TB.

TABLE 7: Distribution of Pulmonary Tuberculosis Patients with and without Hypertension by Gender, Age Group, and Socio-Economic Status

GENDER	P.TB AND HYPERTENSION	ONLY P.TB	CHI-SQUARE STATISTIC	P-VALUE
Male	39 (22.16%)	137 (77.84%)	5.13	0.023
Female	30 (13.39%)	194 (86.61%)		
AGE GROUP	**P.TB AND HYPERTENSION**	**ONLY P.TB**	**CHI-SQUARE STATISTIC**	**P-VALUE**
Less than 50 years	27 (10.91%)	237 (89.09%)	21.49	< 0.00001
above 50 years	42 (31.82%)	94 (68.18%)		
SOCIO-ECONOMIC STATUS	**P.TB AND HYPERTENSION**	**ONLY P.TB**	**CHI-SQUARE STATISTIC**	**P-VALUE**
Lower class	14 (28.57%)	35 (71.43%)	4.15	0.0416
Upper class	55 (15.67%)	296 (84.33%)		

Table 8 compares pulmonary tuberculosis patients with asthma to those without. There was no significant association with gender or socio-economic status, but age showed a significant association with the presence of asthma.

TABLE 8: Distribution of Pulmonary Tuberculosis Patients with and without Asthma by Gender, Age Group, and Socio-Economic Status.

GENDER	P.TB AND ASTHMA	ONLY P.TB	CHI-SQUARE STATISTIC	P-VALUE
Male	25 (14.2%)	151 (85.8%)	0.02	0.89
Female	33 (14.73%)	191 (85.27%)		

AGE GROUP	P.TB AND ASTHMA	ONLY P.TB	CHI-SQUARE STATISTIC	P-VALUE
Less than 50 years	30 (10.71%)	234 (89.29%)	5.40	0.02
Above 50 years	28 (16.67%)	108 (83.33%)		
SOCIO-ECONOMIC STATUS	**P.TB AND ASTHMA**	**ONLY P.TB**	**CHI-SQUARE STATISTIC**	**P-VALUE**
Lower class	6 (12.24%)	43 (87.76%)	0.07	0.79
Upper class	52 (14.81%)	299 (85.19%)		

Table 9 shows no significant association between gender and COPD among pulmonary tuberculosis patients. However, significant associations were observed with age group and socio-economic status, indicating these are important factors related to COPD in this population.

TABLE 9: Distribution of Pulmonary Tuberculosis Patients with and without COPD by Gender, Age Group, and Socio-Economic Status

GENDER	P.TB AND COPD	ONLY P.TB	CHI-SQUARE STATISTIC	P-VALUE
Male	20 (11.36%)	156 (88.64%)	0.04	0.8374
Female	24 (10.71%)	200 (89.29%)		
AGE GROUP	**P.TB AND COPD**	**ONLY P.TB**	**CHI-SQUARE STATISTIC**	**P-VALUE**
Less than 50 years	22 (7.85%)	242 (92.15%)	4.88	0.027
Above 50 years	22 (13.64%)	114 (86.36%)		
SOCIO-ECONOMIC STATUS	**P.TB AND COPD**	**ONLY P.TB**	**CHI-SQUARE STATISTIC**	**P-VALUE**
Lower class	16 (32.65%)	33 (67.35%)	22.23	< 0.00001
Upper class	28 (7.98%)	323 (92.02%)		

As shown in Table 10, socio-economic status was significantly associated with malnutrition among pulmonary tuberculosis patients, while gender and age group were not.

TABLE 10: Distribution of Pulmonary Tuberculosis Patients with and without Malnutrition by Gender, Age Group, and Socio-Economic Status.

GENDER	P.TB AND MALNUTRITION	ONLY P.TB	CHI-SQUARE STATISTIC	P-VALUE
Male	23 (13.07%)	153 (86.93%)	1.38	0.241
Female	21 (9.38%)	203 (90.62%)		
AGE GROUP	**P.TB AND MALNUTRITION**	**ONLY P.TB**	**CHI-SQUARE STATISTIC**	**P-VALUE**
Less than 50 years	27 (9.64%)	237 (90.36%)	0.27	0.603
Above 50 years	17 (10.53%)	119 (89.47%)		
SOCIO-ECONOMIC STATUS	**P.TB AND MALNUTRITION**	**ONLY P.TB**	**CHI-SQUARE STATISTIC**	**P-VALUE**
Lower class	16 (32.65%)	33 (67.35%)	18.12	<0.00001
Upper class	28 (7.98%)	323 (92.02%)		

Discussion

The study revealed that 39.5% (158) of the 400 pulmonary tuberculosis (P.TB) cases examined had comorbidities, representing a significant proportion. These comorbidities were associated to both age group and socio-economic status, with no significant association observed with gender. The most common comorbidities identified were diabetes, hypertension, asthma, malnutrition, and COPD.

Upon examining the relationship between specific comorbidities and factors such as age, gender, and socio-economic status, we found that both diabetes and hypertension were significantly associated with all three factors. In contrast, asthma and COPD showed associations only with age and socio-economic status, but not with gender. Malnutrition, on the other hand, was significantly linked only to socio-economic status, with no association found with gender or age.

Another paper based in Maharashtra found a higher incidence of P.TB to be significantly higher in males.[11] The same results of males having a higher prevalence of P.TB was also found in a study in Dehradun, India.[12] A meta- analysis of 28 countries on sex differences in tuberculosis also states the same, that TB rates are higher in men.[13] Even though our paper has a higher percentage of men (43.18%) diagnosed with TB as compared to women (36.6%), the chi-square test states that there is no association of gender with the prevalence of TB. This could be due to the reason that men face more difficulties than women in accessing and seeking healthcare and are less likely to participate in prevalence surveys, which leads to less men getting diagnosed.[13] Even in our study, more women compared to men have participated.

A number of studies, both in India and internationally, have shown that tuberculosis is more common in older age groups, which is consistent with the findings of this paper.[14,15] Older adults are at an increased risk of tuberculosis due to age-related decline in immune function, co-existing health conditions, malnutrition, chronic alcohol use and greater likelihood of living in institutional settings.[14,15] The findings of our study align with several research papers, which show that tuberculosis was notably more prevalent among the impoverished in India.[16,17] This can be attributed to overcrowding, poor ventilation in homes, lack of sanitation, poor nutrition and limited access to healthcare services in lower-income households.[17] Regular screening for active TB detection, enhanced awareness of the importance of early diagnosis, and the use of mobile clinics could aid in the timely identification of cases.[15] Since it has been identified that older individuals and those from lower socio-economic backgrounds have a higher prevalence of pulmonary TB, screening strategies should be enhanced for these groups.

The most common comorbidity associated with pulmonary TB in the study population was diabetes, affecting 21%. A study conducted in South India, along with a global meta-analysis of 2.3 million patients, reported a diabetes incidence in TB patients ranging from 15% to 30%, which is consistent with our findings.[18,19] Similar to our study, the meta-analysis also indicates that diabetes as a comorbidity of TB is more prevalent in men and increases with age.[19] A study also found a significant association between lower-income countries and the dual burden of TB and diabetes, suggesting that those in poverty are more vulnerable to developing both conditions as comorbidities.[20] However, out study does not find a statistically significant association between the prevalence of diabetes and the socioeconomic status of an individual. Diabetes with TB results in atypical symptoms, complicating detection, and increases treatment failures, relapses, and mortality.[21]

Our study found that 17.25% of pulmonary TB patients also had hypertension, highlighting it as an important comorbidity. While some studies fail to establish a significant link between hypertension and TB, many others suggest a relationship between the two conditions.[22,23,24] This study found a higher incidence of TB and hypertension as comorbid conditions in males, older age groups, and individuals with lower socio-economic status. According to the findings of a study in Taiwan, hypertension is linked to higher mortality within the first 9 months after starting tuberculosis treatment.[23] Therefore, it is crucial to screen TB patients for hypertension and initiate appropriate treatment for both conditions simultaneously.

A study conducted in Patiala, Punjab, examining patients with both tuberculosis and asthma, revealed

that 69.6% of the patients developed tuberculosis after being diagnosed with asthma. This suggests that tuberculosis may elevate the risk of developing bronchial asthma.[25] Individuals with tuberculosis may experience bronchial asthma as a result of allergic reactions to medications or damage to the lungs and airways. This damage can facilitate the entry of allergens, triggering inflammation and allergic symptoms. [26] Tuberculosis also plays a significant role in causing airflow obstruction (COPD), linking two of the most prevalent diseases globally. For most TB patients, achieving microbiological cure is just the first step in their treatment, not the end. Effective prevention and treatment of tuberculosis would help alleviate the burden of airflow obstruction, particularly in developing countries.[27] According to this study, 14.50% of tuberculosis patients have asthma, while 11% suffer from COPD. The chi-square test results indicate that both asthma and COPD are associated with age. Socio-economic status was linked to COPD but not to asthma, and no association was found with gender.

Malnutrition significantly contributes to the burden of tuberculosis and can be both a result of and a factor that worsens the condition. It may negatively impact treatment outcomes in cases of TB and play a role in the growing issue of drug resistance in tuberculosis.[28] This study reports that the prevalence of malnutrition among tuberculosis patients is 11%. It was found that malnutrition in TB patients is associated solely with their socio-economic status, with no association observed with age or gender. It was found to be significantly higher in the lower socio-economic groups.

As shown in this paper, P.TB is associated with a wide range of comorbidities that affect almost 40% of the patients. Comorbid conditions along with TB may limit the use of some anti-tubercular drugs, may cause treatment failures, and also increase mortality. Thus, it is essential to develop and implement comprehensive screening strategies promptly to mitigate the impact of comorbid conditions on tuberculosis patients and support their treatment.[29]

Conflicts of Interest: The authors declare that they have no conflict of interest regarding the publication of this paper.

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Strengths and Limitations: This study's strengths include a sizable sample of pulmonary tuberculosis patients and detailed assessment of various comorbidities and their associations with socio-demographic factors. The use of the Modified BG Prasad scale provides a standardized measure of socio-economic status.

However, limitations should also be noted. The combination of socio-economic classes due to small sample sizes may have masked some associations. Additionally, reliance on self-reported data for some comorbidities and socio-demographic factors could introduce reporting bias. Lastly, certain rarer comorbidities with very low prevalence could not be robustly analyzed.

These limitations warrant consideration when interpreting the findings and suggest directions for future prospective and larger-scale studies.

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