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ANALYSIS OF FACTORS AFFECTING SUCCESSFUL PULMONARY TUBERCULOSIS TREATMENT AT STABAT HEALTH CENTER

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ABSTRACT

Background: Pulmonary Tuberculosis (TB) is a significant global public health problem, mainly affecting the lungs. Many factors are associated with the successful treatment of pulmonary TB patients. This study aims to analyze factors affecting the successful treatment of pulmonary TB at Stabat Health Center, Langkat District.
Method: This observational analytic study used a cross-sectional design and was conducted from October 2024 to January 2025 at Stabat Health Center. All pulmonary TB patients diagnosed between 2022 and 2023 who met the inclusion and exclusion criteria were included using a total sampling approach. Data were collected from the Tuberculosis Information System and analyzed using univariate, bivariate, and multivariate analyses.
Results: The treatment success was significantly associated with comorbid diabetes mellitus (DM) and distance to health facility (p=0.003; OR=7.01 and p=0.022; OR=4.44, consecutively). In contrast, age, sex, occupation, comorbid HIV infection, and treatment status did not show a statistically significant association with treatment outcomes.
Conclusion: Comorbid DM had the greatest effect on the success of pulmonary TB treatment at Stabat Health Center. TB patients with these comorbidities need special attention. Further research is needed to analyze other potential factors.

Keywords: Pulmonary TB, successful treatment, Stabat Health Center

ABSTRAK

Latar Belakang: Tuberkulosis paru (TB) adalah masalah yang signifikan kesehatan masyarakat secara global, terutama mempengaruhi paru-paru. Banyak faktor yang terkait dengan keberhasilan pengobatan pasien TB paru. Penelitian ini bertujuan untuk menganalisis faktor-faktor yang mempengaruhi keberhasilan pengobatan TB paru di Puskesmas Stabat, Kecamatan Langkat.
Metode: Studi analitik observasional ini menggunakan desain *cross-sectional* dan dilakukan dari Oktober 2024 hingga Januari 2025 di Puskesmas Stabat. Semua pasien TB paru yang didiagnosis antara tahun 2022 dan 2023 yang memenuhi kriteria inklusi dan eksklusi dimasukkan menggunakan pendekatan pengambilan sampel. Data dikumpulkan dari Sistem Informasi Tuberkulosis dan dianalisis menggunakan analisis univariat, bivariat, dan multivariat.
Hasil: Keberhasilan pengobatan secara signifikan dikaitkan dengan diabetes mellitus komorbid (DM) dan jarak ke fasilitas kesehatan (p=0,003; OR = 7,01 dan p = 0,022; OR = 4,44, berturut-turut). Sebaliknya, usia, jenis kelamin, pekerjaan,

infeksi HIV komorbid, dan status pengobatan tidak menunjukkan hubungan yang signifikan secara statistik dengan hasil pengobatan.
Kesimpulan: DM komorbid memiliki efek terbesar terhadap keberhasilan pengobatan TB paru di Puskesmas Stabat. Pasien TB dengan komorbiditas ini membutuhkan perhatian khusus. Penelitian lebih lanjut diperlukan untuk menganalisis faktor potensial lainnya.

Kata kunci: TB paru, pengobatan berhasil, Puskesmas Stabat

1. Introduction

Pulmonary tuberculosis (TB) is a global public health problem that usually affects the lungs [1]. TB is an infectious disease that spreads through the air, and its main symptoms include prolonged cough, fever, weight loss, and fatigue [2]. TB can be fatal if not treated properly because it is one of the ten biggest causes of death in the world [3]. Globally, there were 7.5 million newly diagnosed and reported cases in 2019 [4]. In 2023, Indonesia recorded 1,060,000 TB cases, the highest number ever reported. This marks a significant increase compared to 824,000 cases in 2020 and 969,000 cases in 2021. In North Sumatra Province, TB cases also rose, from 19,147 in 2021 to 34,714 in 2022. The number of TB cases in Langkat District is a serious concern for local health authorities because it occupies the third-highest position in the number of TB cases in North Sumatra, which is 2.147 cases in 2023. This case increased from the previous year, which was 1.899 cases in 2022. The Tuberculosis Information System serves as the primary source of data from health facilities in the implementation of tuberculosis control programs, encompassing activities ranging from health promotion and case detection to treatment and preventive therapy. These data play a crucial role in monitoring disease trends, evaluating program performance, and informing evidence-based tuberculosis control policies; therefore, data completeness and accuracy are essential prerequisites for effective decision-making [5]. Systematic evaluation of tuberculosis programs at the primary healthcare level is necessary to assess the effectiveness of disease control efforts within the community.

The success of pulmonary tuberculosis treatment is influenced by multiple factors related to both individual patients and healthcare services. Evidence from the literature indicates that individual factors include sociodemographic characteristics, nutritional status, comorbid conditions such as HIV and diabetes mellitus, patient knowledge, and treatment adherence. Healthcare service–related factors include family support, the role of treatment supervisors, continuity and availability of anti-tuberculosis drugs, quality of treatment monitoring, and the accuracy of recording and reporting systems [4,5]. Based on this background, this study aims to analyze the factors affecting successful pulmonary tuberculosis treatment at Stabat Health Center in Langkat District, to support improvements in tuberculosis control program performance.

2. Methods

This study employed an observational analytic approach with a cross-sectional design. The research was conducted from October 2024 to January 2025 at the Stabat Health Center, located in Langkat District, North Sumatra. The study population consisted of patients diagnosed with pulmonary TB between 2022 and 2023. A total sampling method was applied, including all patients aged 18 years or older with either bacteriologically confirmed or clinically diagnosed pulmonary tuberculosis. Exclusion criteria included incomplete medical records and cases of extrapulmonary TB. After applying these criteria, 148 subjects were included in the final analysis. Secondary data were obtained from the Tuberculosis Information System of the Stabat Health Center for the period 2022–2023. Multivariate logistic regression analysis was performed to identify the dominant factors associated with successful pulmonary TB treatment outcomes at the study site. The Health Research Ethics Committee of the Universitas Sumatera Utara approved this study, as documented in approval number 1312/KEPK/USU/2024, dated November 12, 2024.

3. Results

The Stabat Health Center is a primary healthcare facility located in Langkat District. Its working area covers 4 sub-districts and 2 villages, including Stabat Baru Village, Kwala Bingai Village, Paya Mabar Village, Sidomulyo Village, Banyumas Village, and Pantai Gemi Village.

A total of 148 patients diagnosed with pulmonary TB who met the inclusion criteria were included in the study. Table 1 presents the sociodemographic characteristics of the study population, including age, sex, and occupational status. Most TB patients were male (58.1%). The largest number of patients were in the 36–45 year age group. Based on the type of occupation characteristic, housewives were the most common (23.6%).

Table 1. Sociodemographic Data of Pulmonary TB Patients

Characteristics	n	%
Age (years)		
18 – 25	33	22.3
26 – 35	21	14.2
36 – 45	37	25
46 – 55	27	18.2
56 – 65	24	16.2
>65	6	4.1
Sex		
Male	86	58.1
Female	62	41.9
Occupation		
Self-employed	34	23
Military/police	2	1.4
Civil servant	4	2.7
Housewife	35	23.6
Student	15	10.1
Driver	4	2.7
SOEs/Private employees	3	2
Farmer/Breeder/Fisherman	5	3.4
Teacher/Lecturer	5	3.4
Health worker	1	0.7
Laborer	7	4.7
Not Working	33	22.3
Total	148	100

Most TB patients did not have comorbid DM (88.5%), and none of the patients had comorbid HIV. The majority of patients (60.1%) lived more than 3 km away from the health facility where they received treatment, and most were new treatment cases (73.6%). Based on treatment outcomes, patients were cured (42.6%), completed treatment (43.9%), experienced treatment failure (0.7%), died (2%), and lost to follow-up (10.8%), as presented in Table 2.

Table 2. Clinical Characteristics of Pulmonary TB Patients

Characteristics	N=148	%
Comorbid DM		
No	131	88.5
Yes	17	11.5
Comorbid HIV		
No	148	100
Yes	0	0
Treatment status		
No	109	73.6
Yes	39	26.4
Distance to health facility (KM)		
≤ 3	59	39.9
> 3	89	60.1
Treatment outcomes		
Cured	63	42.6
Treatment completed	65	43.9
Treatment failure	1	0.7
Died	3	2
Lost to follow-up	16	10.8

Bivariate analysis showed a statistically significant association between comorbid DM and treatment success ($p = 0.016$). In contrast, other variables—age ($p = 0.375$), sex ($p = 0.360$), occupation ($p = 0.258$), treatment

status (p = 1.000), and distance to health facility (p = 0.088) were not significantly associated with treatment outcomes. No patients in the study had HIV comorbidity, so the association with treatment success could not be assessed. The detailed results of the bivariate analysis are shown in Table 3.

Table 3. Respondent Characteristics Based on Measured Variables

Characteristic	Successful Treatment of Pulmonary TB				p-value*
	Successful		Unsuccessful		
	n	%	n	%	
Age (years)					
≤ 45	81	89	10	11	0.375
> 45	47	82.5	10	17.5	
Sex					
Male	72	83.7	14	16.3	0.360
Female	56	90.3	6	9.7	
Occupation					
Working	97	84.3	18	15.7	0.258
Not working	31	93.9	2	6.1	
Comorbid DM					
No	117	89.3	14	10.7	0.016
Yes	11	64.7	6	35.3	
Comorbid HIV					
No	128	86.5	20	13.5	-
Yes	0	0	0	0	
Distance to health facility (km)					
≤ 3	55	93.2	4	6.8	0.088
> 3	73	82	16	18	
Treatment status					
No	94	86.2	15	13.8	1.000
Yes	34	87.2	5	12.8	
Total	128	86.5	20	13.5	

*Chi-square test

Furthermore, multivariate analysis was conducted on variables that had a significance value of p <0.25, namely the comorbid DM variable (p = 0.016) and distance to health facilities (p = 0.088). Multivariate analysis showed that comorbid DM was significantly associated with pulmonary TB treatment outcomes (OR = 7.01, 95% CI: 1.95–25.17), with patients without DM having a 7.01 times greater chance of achieving successful treatment. Comorbid DM was identified as the most common factor associated with successful treatment outcomes (Table 4).

Table 4. Factor Associated with Successful Treatment Outcomes

Variable	B	p-value	Exp(B)	95% CI
Comorbid DM	1.947	0.003	7.01	1.95 – 25.17
Distance to health facility	1.492	0.022	4.44	1.25 – 15.87

4. Discussions

This study found that comorbid DM was the most significant factor affecting pulmonary TB treatment outcomes. Immune system changes among DM patients can reduce anti-TB drug levels, leading to extended treatment durations and adjustment of drug dosage, which could hinder pulmonary TB recovery or cause treatment failure [6]. According to a previous study by Adane et al (2023), TB patients with DM are 14.8 times more likely to experience treatment failure compared to those without DM [7]. DM worsens the condition of the pulmonary cavity in TB patients, and patients with DM often face challenges in the recovery process due to weakened immune responses and poor glycemic control, ultimately increasing the risk of treatment failure [8]. Therefore, health workers should provide intensive monitoring and appropriate management for TB patients with DM to improve treatment outcomes. Although most TB patients at Stabat Health Center did not

have comorbid DM, this did not diminish the importance of giving special attention to those who did. Patients with DM remain at a higher risk of treatment failure, so comprehensive management, including blood glucose monitoring, diabetes control, and integrated TB care, is essential to improve treatment outcomes [9].

The distance between patients' homes and the health facility plays a crucial role in the success of pulmonary TB treatment. Treatment success largely depends on patients consistently taking their anti-TB drugs on time [10]. At Stabat Health Center, most TB patients lived >3 km away and faced these challenges. Similarly, a study by Marahata (2021) in Nepal found that patients living far from health facilities often struggled to adhere to treatment due to factors such as high transportation costs and limited time availability [11].

Individuals of all age groups have an equal chance of recovery as long as they follow the prescribed treatment regimen [12]. Although increasing age is often associated with reduced medication adherence [13], this study, consistent with previous research, found that age is not the sole factor influencing treatment success. The important thing was that, regardless of age, patients had an opportunity for recovery if they remained committed to taking their medications and completing their treatment regimen [14]. Interestingly, a study conducted in South India revealed that older adults are at a higher risk of treatment failure. However, even patients between the ages of 56 and 65 years still had a chance of successful treatment [15]. In addition to age, treatment success is influenced by several other factors, including education level, occupation, the type and involvement of treatment supervisors, smoking habits, access to healthcare services, and other related variables [16]. The majority of patients in this study were aged ≤45 years. This age group had relatively stable physical conditions [17]. This observation may partly explain the association between age and the success of pulmonary TB treatment. As long as patients strictly adhered to the established treatment protocols, including compliance with prescribed medication schedules and participation in regular clinical evaluations, the probability of recovery remained high, irrespective of the specific age group [14].

Despite differences in social, environmental, lifestyle, and biological factors, males and females had equal access to information and treatment. Treatment success depended on individual adherence and determination, with equal recovery chances for both when treatment was followed consistently [18]. The higher incidence of this disease in males was linked to habits such as tobacco smoking and alcohol consumption, which weakened the immune system and increased susceptibility to pulmonary TB infection [19]. Females often delayed seeking healthcare due to embarrassment and fear of stigma, but with strong family and community support, they showed determination to complete treatment and succeed [16]. This study found no significant association between sex and the success of pulmonary TB treatment, likely because males and females had equal access to healthcare and information. Treatment outcomes depended more on patient adherence and health-seeking behavior than on gender itself [20].

Every occupation carries responsibilities or burdens for the person performing it [13]. The majority of respondents were working individuals whose occupations involve various risks in daily life. Occupation could have affected health through the risk of TB exposure and the ability to achieve successful treatment. Nevertheless, pulmonary TB patients, regardless of their occupation type or income level, would have received the same access to effective treatment. This is mainly because pulmonary TB treatment is supported by a nationwide disease control program that provides comprehensive care at minimal or no cost to patients. Furthermore, the availability of transportation and easy access to healthcare facilities also contributed to the successful treatment outcomes for these patients [16].

Patients with pulmonary TB who had a relapse faced worse outcomes and a higher risk of treatment failure and even had the potential to progress to multidrug-resistant tuberculosis (MDR-TB), which required longer treatment [21,22]. Longer treatment caused patients to feel stressed, which made them less likely to follow their medication and decreased their chances of recovery [23]. At the Stabat Health Center, no significant association was found between anti-TB drug treatment history and successful treatment of pulmonary TB. This was likely because of strict supervision and strong adherence among both new and previously treated patients. Patients with no previous treatment tended to have slightly better results, but the difference wasn't statistically significant. Still, treatment history remains an important factor to consider in planning TB programs [24].

Although this study did not analyze the effect of comorbid HIV on the successful treatment of pulmonary TB, Limenh (2024) stated that patients with comorbid HIV also had worse treatment outcomes, and individuals without HIV were three times more likely to achieve successful treatment outcomes [25].

This study benefits from the use of standardized data from the national Tuberculosis Information System and the inclusion of all eligible pulmonary tuberculosis patients through total sampling, which enhances data completeness and program relevance. The use of multivariate analysis strengthens the identification of independent factors associated with treatment success. However, the cross-sectional design limits causal inference, and the reliance on secondary data restricts the assessment of behavioral and socioeconomic variables. In addition, findings from a single health center may limit generalizability to other settings.

5. Conclusion

This study identified comorbid DM as the most significant factor affecting the success of pulmonary TB treatment at the Stabat Health Center. Therefore, healthcare professionals must provide continuous support to TB patients with comorbid DM. Strengthening education on the importance of completing TB treatment is also vital, particularly for high-risk populations. Effective collaboration between healthcare providers and local authorities is essential to enhance public awareness initiatives. Future research is recommended to analyze other potential influencing factors such as income, smoking habits, access to healthcare services, alcohol consumption, and education level.

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Conflict of Interest Statement

The author declares that there is no conflict of interest related to this study.

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