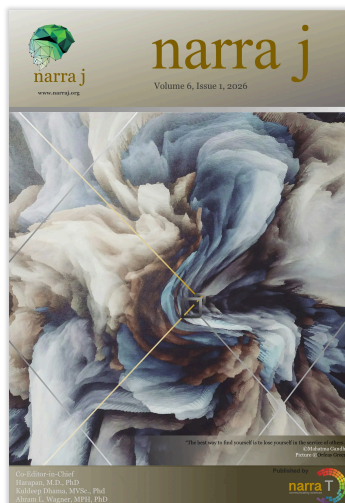


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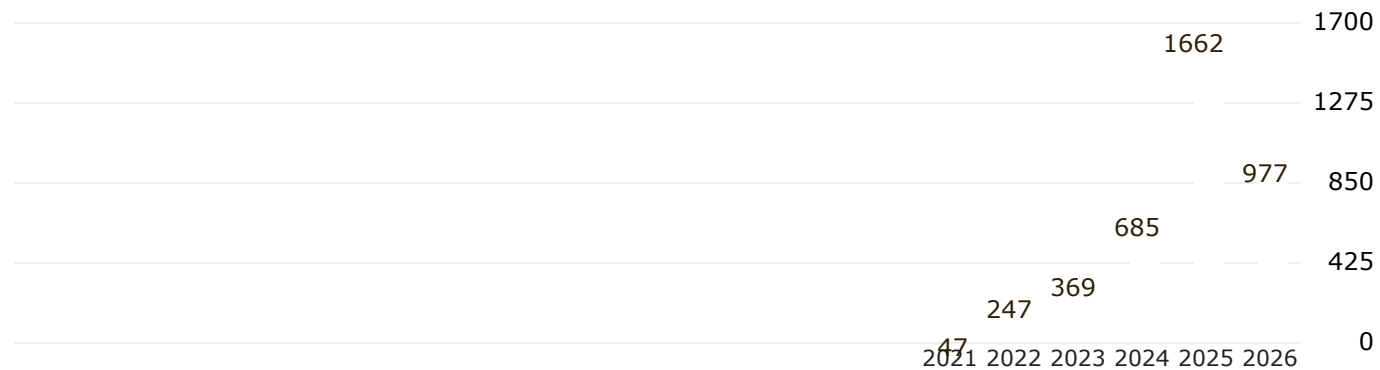
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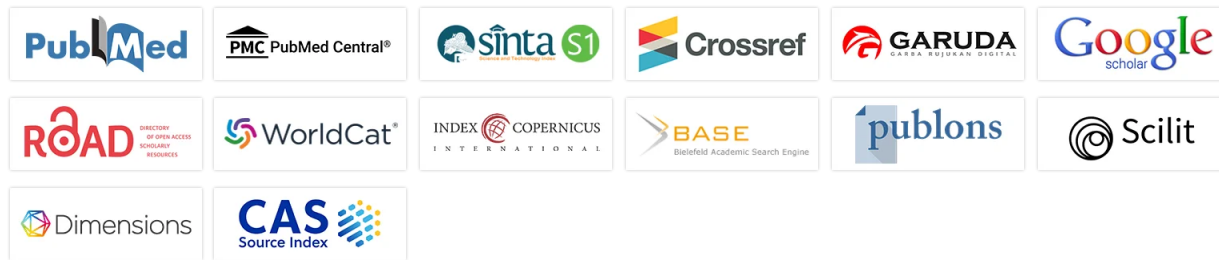
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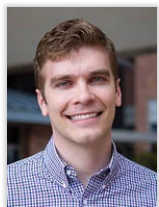
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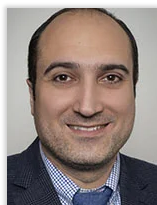
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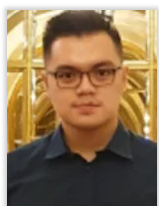
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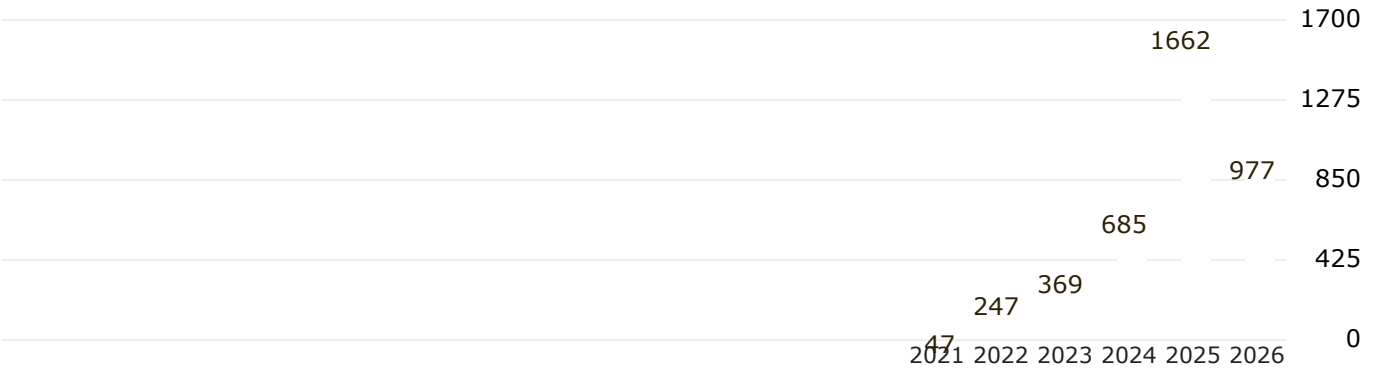
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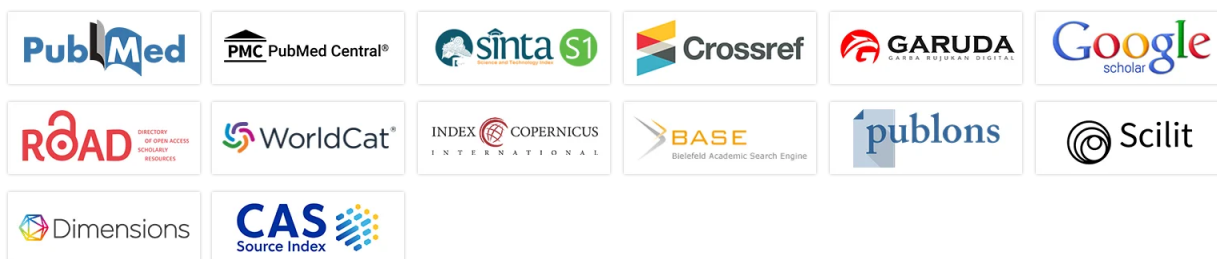
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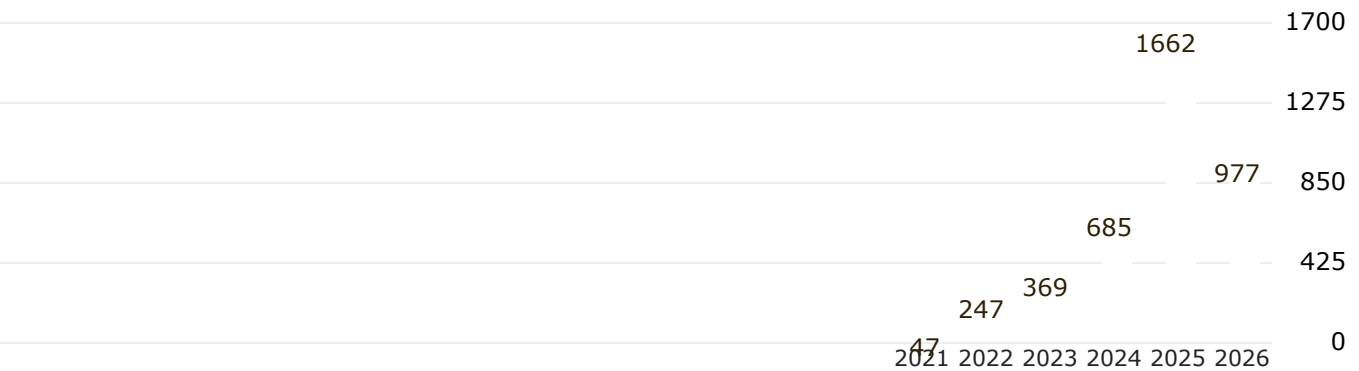
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Original Article

Tuberculosis treatment outcomes and associated factors: A retrospective study in West Nusa Tenggara, Indonesia

Meiyanti Meiyanti^{1,2*}, Adang Bachtiar³, Rina K. Kusumaratna⁴, Arifah Alfiah³, Machrumnizar Machrumnizar⁵ and Pusparini Pusparini⁶

¹Philosophy Doctor in Public Health Program, Faculty of Public Health, Universitas Indonesia, Depok, Indonesia; ²Department of Pharmacology and Pharmacy, Faculty of Medicine, Universitas Trisakti, Jakarta, Indonesia; ³Department of Health Policy and Administration, Faculty of Public Health, Universitas Indonesia, Depok, Indonesia; ⁴Department of Public Health, Faculty of Medicine, Universitas Trisakti, Jakarta, Indonesia; ⁵Department of Parasitology, Faculty of Medicine, Universitas Trisakti, Jakarta, Indonesia; ⁶Department of Clinical Pathology, Faculty of Medicine, Universitas Trisakti, Jakarta, Indonesia

*Corresponding author: meiyanti@trisakti.ac.id

Abstract

Successfully treating tuberculosis (TB) could significantly help reduce its spread. The aim of this study was to identify factors associated with successful TB treatment. A retrospective study was conducted in West Nusa Tenggara, Indonesia, using data from the National TB Information System (SITB) covering patients from January 1 to December 31, 2022. Patients were classified into two groups: those with successful treatment outcomes (cured or completed treatment) and those with unsuccessful outcomes (including treatment failure, loss to follow-up, or death). Univariate and multivariate logistic regression analyses were performed to identify factors associated with treatment outcomes, providing odds ratios (OR) and adjusted odds ratios (aOR) with 95% confidence intervals (CIs). A total of 2,225 TB patients (1,382 males and 843 females) were included in the study. Of these, 2,048 (92.1%) achieved successful treatment outcomes. Univariate analysis indicated that older age (OR: 0.47; 95%CI: 0.28–0.78) and a high number of AFB in sputum smears (OR: 0.23; 95%CI: 0.09–0.66) were associated with a higher likelihood of unsuccessful TB treatment. In contrast, having no HIV infection (OR: 13.44; 95%CI: 6.22–29.08), clinical TB cases (diagnosed clinically rather than bacteriologically) (OR: 1.50; 95%CI: 1.04–2.20) and longer duration of TB treatments were associated with successful treatment outcomes. Multivariate analysis suggested that the TB treatment durations of 4–6 months (aOR: 1256.95; 95%CI: 431.89–3658.19) and 7–12 months (aOR: 575.5; 95%CI: 99.1–3342.06) were associated with a significantly higher likelihood of success compared to durations of 0–3 months. In conclusion, this study highlights that a minimum treatment duration of three months was crucial for increasing the likelihood of successful TB treatment. These findings emphasize the importance of comprehensive support programs to ensure adherence to treatment guidelines and improve outcomes.

Keywords: Tuberculosis, treatment success, patient, risk factors, Indonesia

Introduction

Since 1991, the World Health Assembly has identified tuberculosis (TB), a preventable and curable infectious disease, as a major global health concern, leading to intensified international efforts for its effective management [1]. TB is classified into pulmonary TB, involving the lungs or



tracheobronchial tree, and extrapulmonary TB, affecting organs outside the lungs, such as the pleura, lymph nodes, or abdominal area [2-4]. According to the World Health Organization (WHO), 87% of global TB cases in 2022 were concentrated in high-burden countries, including India (27%) and Indonesia (10%), where coronavirus disease 2019 (COVID-19) disruptions contributed to a >60% reduction in diagnosed TB cases from 2020 to 2021 [5]. The COVID-19 pandemic-related challenges threaten the global TB elimination goal, highlighting the need for robust TB control efforts. One of the United Nations Sustainable Development Goals (SDGs) aims to end the TB epidemic by 2030 [1,6]. WHO has set a TB treatment success rate target of 90% by 2025, emphasizing effective, prompt treatment initiation and adherence [7-9].

In West Nusa Tenggara, Indonesia, a lower-middle-income region with a population of 5 million, achieved a 91.4% TB treatment success rate in 2022 despite challenging socio-demographic conditions [10]. Treatment adherence and post-treatment factors, such as completion rate, mortality risk, and cure rate, are critical for evaluating TB program success and improving clinical outcomes [11-12]. Factors such as age, sex, alcohol use, smoking, sputum conversion results, and human immunodeficiency virus (HIV) status influence TB treatment success globally, with current rates still below the 85% target [13]. In many regions around the globe, treatment protocols fail to meet the standards necessary for curing TB patients and preventing the spread of drug-resistant *Mycobacterium tuberculosis* strains, an issue driven by various contributing factors [14]. The aim of this study was to assess TB treatment outcomes and the factors associated with treatment success among TB patients in West Nusa Tenggara, Indonesia. The findings of this study would be valuable for both local and national governments in reducing TB infection rates and improving knowledge to enhance successful treatment outcomes.

Methods

Study design and setting

A retrospective study was conducted in West Nusa Tenggara, Indonesia, utilizing data from the National TB Information System or *Sistem Informasi Tuberkulosis* (SITB) covering TB patients from January 1 to December 31, 2022. SITB, an application-based platform that records and reports TB cases across the country, is serving as a mandatory reporting tool for all healthcare stakeholders, including primary healthcare facilities, hospitals, independent practitioners, clinics, laboratories, and pharmacies. The data analyzed in this study pertained to TB treatment registrations, encompassing information on participants who sought treatment for TB and the outcomes of their treatments. This retrospective approach facilitated a thorough evaluation of treatment patterns and effectiveness, providing valuable insights into TB management in the region.

Patients and criteria

This study included data from patients aged 19 years and older in West Nusa Tenggara diagnosed with TB. All patients were actively receiving anti-TB treatment during the study period, with comprehensive data securely stored in the SITB database. Patients were excluded from the analysis if their records contained incomplete information, defined as any missing values in the following variables: age, sex, the year of treatment initiation, or treatment outcomes (cured, completion, treatment failure, and death).

Data collection processes

Data for this study were sourced from the SITB encompassing multiple datasets. The first dataset included the sociodemographic variables of patients. The second, the healthcare utilization database, contained data from TB screenings, TB type, sputum smear results, chest X-ray findings, and relevant comorbidities, specifically HIV infection and diabetes.

To have a better understanding of the TB treatment outcomes among the patients, the outcomes were classified into five categories (cured, treatment completed, failed, lost to follow-up, and died) based on the modified 2021 WHO definitions and the National TB Control Program [15]. Patients were classified as 'cured' if they began treatment with a bacteriologically confirmed

strain and completed the regimen without evidence of treatment failure. 'Treatment completed' referred to patients who adhered to the prescribed TB regimen until the end but did not meet the criteria for cure or experienced treatment failure. 'Treatment failure' was defined as a regimen that was permanently halted or changed due to lack of clinical improvement or due to the presence of adverse reactions. Patients classified as 'died' for any reason when the patient has been registered in SITB included those who passed away for any reason, either during treatment or before initiating treatment. Individuals were classified as 'lost to follow-up' if they missed eight consecutive weeks of TB treatment after starting the regimen [10]. Patients who were registered in the SITB database but had not yet begun treatment were not included in this category. Additionally, when a definitive treatment outcome could not be determined, typically due to patient transfer to another facility, the outcome was recorded as 'not evaluated'. These two categories were excluded from the study.

Study variables

The dependent variable in this study was the treatment outcomes that were classified as successful or unsuccessful based on WHO criteria [15]. A successful treatment outcome was defined when a patient was either cured of TB or has resolved all TB-related symptoms, demonstrated by a negative smear microscopy result at the end of treatment and during follow-up evaluations (i.e., cured and treatment completed groups). An unsuccessful treatment outcome included patients who continued to show TB-related symptoms after treatment, as evidenced by a positive smear result after five months, along with those who were lost to follow-up or who died due to TB-related complications (i.e., failed, lost to follow-up, and died groups).

To have a better understanding of factors associated with treatment outcomes; plausible associated variables (independent variables) were collected and analyzed. The independent variables included were sex, age, type of healthcare facility, TB anatomical location, chest X-ray, sputum smear, type of diagnosis confirmation, rifampicin resistance, HIV status, diabetes status, and duration of treatment. Age was grouped into four groups: 19–34, 35–50, 51–65, and over 65 years. Healthcare facility type referred to whether the patient was treated at a primary healthcare center (first level of health facilities in Indonesia including community health centers (*Puskesmas*) and private clinics) or a secondary healthcare center (advanced referral health facilities such as hospitals). TB anatomical location was classified as either pulmonary TB or extrapulmonary TB (TB infection outside the lungs, such as in lymph nodes or bones). Chest X-ray results were classified as positive (indicating signs of TB), negative (no signs of TB), or not conducted (no X-ray performed). Sputum smear results were categorized as negative (no TB bacteria found), not conducted (test not performed), or graded based on bacterial load: 1–9 acid-fast bacilli (AFB), 1+, 2+, and 3+ based on the levels of bacterial presence [15–16]. Diagnosis confirmation was categorized as bacteriologically confirmed (confirmed through lab tests detecting TB bacteria) or clinical diagnosis (based on symptoms and clinical assessment without bacteriological test confirmation). Rifampicin resistance was assessed using molecular tests like GeneXpert or line probe assay, which detect genetic markers associated with resistance to rifampicin. HIV and diabetes status were recorded as either positive or present (yes) and negative or absent (no). Treatment duration was categorized into 0–3 months, 4–6 months, 7–12 months, and over 12 months.

Statistical analysis

In this study, univariate logistic regression was used initially to assess the association of each independent variable with TB treatment outcomes individually, identifying those with significant relationships based on unadjusted odds ratios (OR) with 95% confidence intervals (95%CI) to be considered in the multivariate analysis. Variables with $p < 0.05$ in univariate logistic regressions were then included in a multivariate logistic regression model, where the adjusted odds ratio (aOR) with their 95%CI was calculated. Statistical significance was considered with a $p < 0.05$. All data analyses were conducted using STATA 16 (StataCorp LLC, College Station, USA).

Results

Characteristics of the patients

In total, 2,483 patients diagnosed with various forms of TB from SITB were collected in this study. Among these, 258 patients remained in treatment progress and were excluded. A total of 2,225 patients had complete data on treatment outcomes and were included in the analysis. The characteristics of the patients included in this study are presented in **Table 1**. The majority of patients were male (62.1%), with a peak age incidence between 35 and 50 years, accounting for 702 patients (31.5%). Primary healthcare centers were the main sites for TB management, providing care to 1,845 patients (82.9%). Among the 2,225 TB patients, 2,166 cases (97.4%) had pulmonary TB and a notable proportion of patients, 1,176 (52.8%), did not undergo chest X-ray examinations. Out of the total, 1,604 (72.1%) had bacteriologically confirmed diagnoses and rifampicin-sensitive TB cases were confirmed in the vast majority of patients, with 2,216 patients (99.6%) showing no resistance. The prevalence of comorbidities was low, with 2,198 patients (98.8%) free of HIV and 2,004 patients (90.1%) without diabetes. The predominant treatment duration was 4 to 6 months, encompassing 92.1% of the total patients (**Table 1**).

Table 1. Characteristics and clinical characteristics of the TB patients included in this study (n=2,225)

Characteristic	Frequency	Percentage
Sex		
Male	1382	62.1
Female	843	37.9
Age (year)		
19–34	637	28.6
35–50	702	31.5
51–65	642	28.9
>65	244	11.0
Healthcare facility		
Secondary healthcare	380	17.1
Primary healthcare	1845	82.9
Anatomical location		
Pulmonary TB	2166	97.4
Extrapulmonary TB	59	2.6
Chest X-ray		
Positive	963	43.3
Negative	86	3.9
Not conducted	1176	52.8
Sputum smear		
Negative	143	6.4
Not conducted	1821	81.8
1–9	8	0.4
1+	121	5.4
2+	76	3.4
3+	56	2.5
Type of diagnosis confirmation		
Bacteriological	1604	72.1
Clinical	621	27.9
Rifampicin resistance		
Yes	9	0.4
No	2216	99.6
HIV status		
Positive	27	1.2
Negative	2198	98.8
Diabetes status		
Yes	221	9.9
No	2004	90.1
Duration of treatment		
0–3 months	128	5.7
4–6 months	2049	92.1
7–12 months	44	2.0
>12 months	4	0.2
Treatment outcome		
Unsuccessful	177	7.9
Successful	2048	92.1

Treatment outcomes

The treatment outcomes of TB patients included in this study are presented in **Figure 1**. The overall treatment success rate was 92.1% (2048/2,225) of which 1083 (48.7%) achieved a cure, and 965 (43.4%) completed their treatment. The unsuccessful treatment rate, therefore, was 7.96% (177/2,225) of which 3.7% (83 patients) were lost to follow-up, 0.1% (3 patients) experienced treatment failure, and 4.1% (91 patients) died (**Figure 1**). This study indicated that the successful treatment outcomes from 2,225 patients were more than 90%.

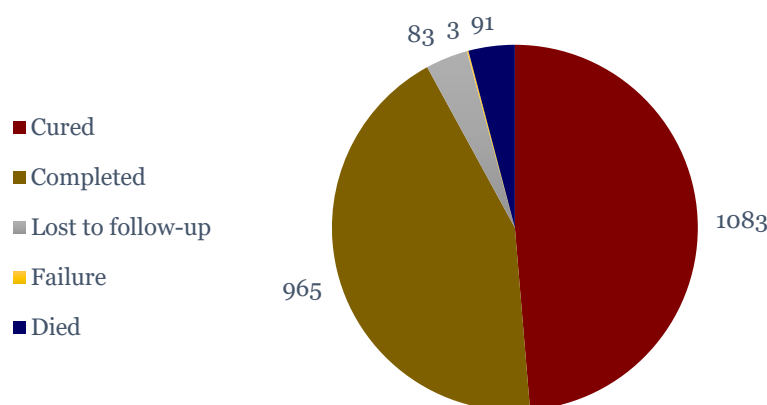


Figure 1. Treatment outcomes of the tuberculosis patients in West Nusa Tenggara, Indonesia, from National TB Information System (SITB), 2022 (n=2,225).

Factors associated with successful TB treatment outcomes: Univariate analyses

Based on the treatment outcomes, patients were then categorized as either successful or unsuccessful. Successful outcomes included patients who were cured, demonstrating recovery based on bacteriological evidence, or who completed the prescribed treatment regimen with clinical improvement, even without bacteriological confirmation. Unsuccessful outcomes encompassed patients who were lost to follow-up, experienced treatment failure, or died during treatment. Univariate logistic regression showing factors associated with treatment outcomes among tuberculosis patients included in the study is presented in **Table 2**.

Our data indicated that older age and a higher number of AFB in sputum smear were associated with the chance of unsuccessful TB treatment (**Table 2**). Being HIV positive was significantly associated with unsuccessful TB treatment compared to those without HIV infection (OR: 13.44; 95%CI: 6.22–29.08). In addition, patients who were diagnosed clinically and those who received a longer duration of TB treatment had a higher chance of having successful TB treatment compared to patients diagnosed bacteriologically and those treated with a shorter treatment duration (**Table 2**).

Table 2. Univariate logistic regression showing factors associated with treatment outcomes among tuberculosis patients included in the study (n=2,225)

Variable	Treatment outcomes		Univariate analysis	
	Successful (n=2048)	Unsuccessful (n=177)	OR (95%CI)	p-value
	Frequency (%)	Frequency (%)		
Sex				
Male (R)	1274 (62.2)	108 (61.0)	0.95 (0.69–1.30)	0.754
Female	774 (37.8)	69 (39.0)		
Age (year)				
19–34 (R)	599 (29.2)	38 (21.5)	0.86 (0.56–1.34)	0.516
35–50	654 (31.9)	48 (27.1)		
51–65	580 (28.3)	62 (35.0)		
>65	215 (10.5)	29 (16.4)		
Healthcare facility				
Secondary healthcare (R)	346 (16.9)	34 (19.2)	1.17 (0.79–1.73)	0.433
Primary healthcare	1702 (83.1)	143 (80.8)		
Anatomical location				

Variable	Treatment outcomes		Univariate analysis	
	Successful (n=2048)	Unsuccessful (n=177)	OR (95%CI)	p-value
	Frequency (%)	Frequency (%)		
Extrapulmonary TB (R)	54 (2.6)	5 (2.8)		
Pulmonary TB	1994 (97.4)	172 (97.2)	1.07 (0.42–2.72)	0.881
Chest X-ray				
Positive (R)	888 (43.4)	75 (42.4)		
Not conducted	1081 (52.8)	95 (53.7)	0.96 (0.70–1.32)	0.805
Negative	79 (3.9)	7 (4.0)	0.95 (0.42–2.14)	0.907
Sputum smear				
Negative (R)	136 (6.6)	7 (4.0)		
Not conducted	1675 (81.8)	146 (82.5)	0.59 (0.27–1.29)	0.185
1–9	7 (0.3)	1 (0.6)	0.36 (0.04–3.35)	0.369
1+	114 (5.6)	7 (4.0)	0.83 (0.29–2.46)	0.748
2+	70 (3.4)	6 (3.4)	0.60 (0.19–1.86)	0.376
3+	46 (2.2)	10 (5.6)	0.23 (0.09–0.66)	0.006**
Type of diagnosis confirmation				
Bacteriological (R)	1464 (71.5)	140 (79.1)		
Clinical	584 (28.5)	37 (20.9)	1.50 (1.04–2.20)	0.031*
Rifampicin resistance				
Yes (R)	8 (0.4)	1 (0.6)		
No	2040 (99.6)	176 (99.4)	1.44 (0.18–11.65)	0.727
HIV status				
Positive (R)	13 (0.6)	14 (7.9)		
Negative	2035 (99.4)	163 (92.1)	13.44 (6.22–29.08)	<0.001**
Diabetes status				
Yes (R)	202 (9.9)	19 (10.7)		
No	1846 (90.1)	158 (89.3)	1.09 (0.67–1.81)	0.710
Duration of treatment				
0–3 months (R)	4 (0.2)	124 (70.1)		
4–6 months	1998 (97.6)	51 (28.8)	1214.5 (431.9–3414.5)	<0.001**
7–12 months	42 (2.1)	2 (1.1)	651 (115.0–3683.3)	<0.001**
>12 months	4 (0.2)	0 (0.0)	1	

*Statistically significant at $p=0.05$ **Statistically significant at $p=0.01$

Factors associated with successful TB treatment outcomes: Multivariate analysis

All variables with $p<0.05$ in univariate analysis (age, sputum smear, type of diagnosis confirmation, HIV status, and duration of TB treatment) were included in multivariate analysis, and the results are presented in **Table 3**. Our data indicated that older patients (aged more than 65 years old) had a lower chance of having TB treatment success compared to those aged between 19 and 34 years (OR: 0.39; 95%CI: 0.16–0.97; $p=0.043$). In addition, there was a significant association between treatment duration and success of TB treatment of which patients receiving treatment for 4–6 months (aOR: 1256.95; 95%CI: 431.89–3658.19) and 7–12 months (aOR: 575.5; 95%CI: 99.1–3342.06) had a substantially higher likelihood of achieving treatment success compared to those treated for 0–3 months (**Table 3**).

Table 3. Multivariate logistic regression showing factors associated with treatment outcomes among tuberculosis patients included in the study (n=2,225)

Variable	Treatment outcomes		Multivariate analysis	
	Successful (n=2048)	Unsuccessful (n=177)	Adjusted odds ratio (95%CI)	p-value
	Frequency (%)	Frequency (%)		
Age (year)				
19–34 (R)	599 (29.2)	38 (21.5)		
35–50	654 (31.9)	48 (27.1)	0.56 (0.27–1.19)	0.135
51–65	580 (28.3)	62 (35.0)	0.63 (0.30–1.37)	0.250
>65	215 (10.5)	29 (16.4)	0.39 (0.16–0.97)	0.043*
Sputum smear				
Negative (R)	136 (6.6)	7 (4.0)		
Not done	1675 (81.8)	146 (82.5)	0.56 (0.12–2.63)	0.469
1–9	7 (0.3)	1 (0.6)	4.01 (0.00–12131.9)	0.734
1+	114 (5.6)	7 (4.0)	1.35 (0.16–11.30)	0.782

Variable	Treatment outcomes		Multivariate analysis	
	Successful (n=2048)	Unsuccessful (n=177)	Adjusted odds ratio (95%CI)	p-value
	Frequency (%)	Frequency (%)		
2+	70 (3.4)	6 (3.4)	0.59 (0.076–4.61)	0.618
3+	46 (2.2)	10 (5.6)	0.25 (0.04–1.76)	0.166
Type of diagnosis confirmation				
Bacteriological (R)	1464 (71.5)	140 (79.1)		
Clinical	584 (28.5)	37 (20.9)	1.79 (0.87–3.70)	1.794
HIV status				
Positive (R)	13 (0.6)	14 (7.9)		
Negative	2035 (99.4)	163 (92.1)	5.08 (0.80–32.47)	0.085
Duration of treatment				
0–3 months (R)	4 (0.2)	124 (70.1)		
4–6 months	1998 (97.6)	51 (28.8)	1256.95 (431.8–3658.1)	<0.001**
7–12 months	42 (2.1)	2 (1.1)	575.5 (99.1–3342.1)	<0.001**
>12 months	4 (0.2)	0 (0.0)	1	

R: reference group

*Statistically significant at $p=0.05$

**Statistically significant at $p=0.01$

Discussion

This study identified a high treatment success rate (92.1%) among TB patients treated in West Nusa Tenggara, Indonesia. However, TB case findings remain below the national target, which requires efforts for early detection and more effective and optimal interventions to achieve TB elimination [10]. This gap reflects a persistent challenge in high TB-burden countries, suggesting that targeted public health interventions could further bolster case detection and improve overall treatment success [5].

Our univariate analysis identified age, diagnostic type, comorbid conditions, and treatment duration as factors influencing treatment outcomes. However, multivariate logistic regression underscored treatment duration as the only statistically significant predictor, emphasizing the critical role of prolonged therapy adherence for optimal TB management. Effective treatment outcomes are indicative of not only disease progression but also healthcare system efficiency, particularly in managing patient adherence, preventing default, and reducing transfer-out rates. These findings reinforce the importance of consistent patient follow-up and support mechanisms to sustain prolonged treatment adherence.

Sex disparities in TB treatment outcomes have been variably reported. While studies in Indonesia suggested higher success rates among male patients, studies from Finland, Ethiopia, Malaysia, India, China, and South Korea reported that male sex was associated with higher risks of unfavorable outcomes, including mortality [17–22]. In contrast, this study found minimal sex-based differences, likely attributable to the single-year data collection period, which may not fully capture the outcomes for all patients throughout an entire treatment cycle [23]. Additionally, age emerged as a significant factor in TB treatment outcomes, of which older patients had a higher failure rate of treatment. Other studies indicated that older age may increase susceptibility to TB recurrence [24–26]. However, some studies from urban settings reported a higher risk of unsuccessful treatment among middle-old adults (45–54 years) [21,27–31]. These differing findings suggest that age may act as a confounding variable in TB outcomes, warranting further investigation to determine age-related risks in treatment efficacy and long-term recovery [32–34].

Access to and affordability of TB services are essential for promoting adherence and achieving successful treatment outcomes [31]. Although the present study did not establish a direct correlation between healthcare facility access and TB outcomes, other studies have highlighted that the quality of care and facility accessibility can significantly impact treatment success rates [21,35–40]. Future studies evaluating TB service quality in relation to patient outcomes could provide a more comprehensive perspective on these determinants within the Indonesian healthcare system [32–33].

Diagnostic tools, particularly chest X-ray, play an increasingly critical role in active TB case finding and ensuring equitable access to care [38]. Abnormal chest X-ray findings, which are suggestive of TB, show a strong correlation with positive sputum smears and diagnostic confirmation [39]. Although chest X-ray findings were not directly associated with treatment

outcomes in our study, chest X-rays remain valuable for initial TB detection. When used in conjunction with molecular diagnostics, such as the Xpert test, chest X-rays enhance early detection capabilities and diagnostic accuracy, reinforcing their role in comprehensive TB management strategies [40]. Furthermore, sputum smear testing, valued for its high sensitivity and specificity, plays a critical role in monitoring bacteriologically confirmed pulmonary TB cases [41-45]. Routine smear assessments at two, five, and six months into treatment serve as important benchmarks for evaluating treatment progress and outcomes [43]. However, in this present study, the limited availability of comprehensive sputum smear data restricted our ability to fully assess the correlation between smear results and treatment success.

Comorbid conditions, particularly diabetes and HIV, significantly impact TB treatment outcomes. For instance, several studies have reported that TB patients with DM frequently experience higher rates of mortality and unsuccessful treatment outcomes, underscoring the complex challenges posed by diabetes in TB management [46-51]. Conversely, while HIV is typically associated with poorer TB outcomes, some studies indicate that patients with HIV can achieve favorable results when provided with consistent monitoring and support, as regular follow-up enhances treatment adherence [48-49,52-55]. These findings highlight the importance of integrated comorbidity management and ongoing healthcare provider support throughout the TB treatment process [53].

A minimum treatment duration of three months with consistent medication adherence was found to significantly improve the likelihood of treatment success, in line with standard TB treatment guidelines that emphasize prolonged adherence to fully eradicate infection and prevent recurrence or drug resistance. Rifampicin-resistant TB presents considerable challenges to successful treatment due to an elevated risk of treatment failure and relapse [56-58]. Recent studies suggest that shorter, optimized treatment regimens for rifampicin-resistant TB can improve outcomes [58-59]. Nevertheless, our study did not find any association between rifampicin resistance and TB treatment outcomes.

This study utilized the data from national surveillance, which may have limitations, such as reporting delays or biases, including underreporting of treatment outcomes in certain regions or among specific populations. These could affect the accuracy and generalizability of the findings. Although important factors were included in our analysis, other variables, such as socio-economic status and underlying health conditions, were not thoroughly explored. Future studies should incorporate a broader range of factors that could influence treatment success. Additionally, the data might reflect regional or local healthcare differences, which could limit the applicability of the findings to other regions with differing healthcare infrastructures.

Conclusion

This study demonstrated that older age, a high number of AFB in sputum smears, and HIV infection were associated with a higher likelihood of unsuccessful TB treatment. In contrast, clinical TB cases (diagnosed clinically rather than bacteriologically) and a longer duration of TB treatment (more than three months) were associated with a higher likelihood of successful treatment outcomes. These findings highlight the need for tailored interventions to improve TB treatment outcomes, particularly for high-risk groups such as older patients, those with high AFB counts, and individuals with HIV infection. Enhanced monitoring, early detection of treatment challenges, and integrated care for co-infections like HIV could help mitigate these risks. Additionally, the positive association between extended treatment duration and successful outcomes underscores the importance of maintaining adherence to longer treatment regimens when clinically appropriate.

Ethics approval

This study was approved by the Directorate General of Communicable Disease Prevention and Control, Ministry of Health Indonesia (PM.01.01/C.III/4651/2024). The ethics and review committee approved that informed consent was not applicable due to the retrospective nature of the study. All data were kept confidential and used only for the intended purpose.

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Competing interests

All the authors declare that there are no conflicts of interest.

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Underlying data

Derived data supporting the findings of this study are available from the corresponding author on request.

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References

1. World Health Organization. A situational analysis of programmatic management of TB preventive treatment in the WHO South-East Asia Region. Available from: <https://www.who.int/publications/i/item/9789290228059>. Accessed: 2 May 2024.
2. Pottage T, Bennett A. Mycobacterium tuberculosis. In: European Centre for Disease Prevention and Control. Handbook on tuberculosis laboratory diagnostic methods in the European Union – Updated 2022. Stockholm: ECDC; 2023.
3. Centers for Disease Control and Prevention (CDC). Tuberculosis. Available from: https://archive.cdc.gov/www_cdc_gov/globalhealth/newsroom/topics/tb/index.html. Accessed: 2 May 2024.
4. David S, Katalinić-Janković V, Fattorini L, *et al.* Culture tests for *Mycobacterium tuberculosis* complex. In: European Centre for Disease Prevention and Control. Handbook on tuberculosis laboratory diagnostic methods in the European Union – Updated 2022. Stockholm: ECDC; 2023.
5. World Health Organization. Global tuberculosis report 2023. Available from: <https://www.who.int/news-room/fact-sheets/detail/tuberculosis>. Accessed: 8 September 2024.
6. Linh NN, Viney K, Gegia M, *et al.* World Health Organization treatment outcome definitions for tuberculosis: 2021 update. Eur Resp J 2021;58(2):2100804.
7. Tok PSK, Liew SM, Wong LP, *et al.* Determinants of unsuccessful treatment outcomes and mortality among tuberculosis patients in Malaysia: A registry-based cohort study. PLoS One 2020;15(4):e0231986.
8. Pradipta IS, Idrus LR, Probandari A, *et al.* Barriers and strategies to successful tuberculosis treatment in a high-burden tuberculosis setting: A qualitative study from the patient's perspective. BMC Public Health 2021;21(1):1903.
9. Nyarko RO, Prakash A, Kumar N, *et al.* Tuberculosis a globalized disease. Asian J Pharm Res Dev 2021;9(1):198201.
10. Ministry of Health Indonesia. Program penanggulangan tuberkulosis kementerian kesehatan RI. Jakarta: Direktorat Jendral Pencegahan dan Pengendalian Penyakit; 2023.
11. Putra, Oki Nugraha, Hidayatullah AYN. Factors associated with treatment outcomes in drug-resistant tuberculosis. Int J Mycobacteriol 2022;11(2):226-227.
12. Kassim SA, Cote A, Kassim SM, *et al.* Factors influencing treatment outcomes of tuberculosis patients attending health facilities in Galkayo Puntland, Somalia. J Public Health 2021;43(4):887-895.
13. Chaves Torres NM, Quijano Rodríguez JJ, Porras Andrade PS, *et al.* Factors predictive of the success of tuberculosis treatment: A systematic review with meta-analysis. PLoS One 2019;14(12):e0226507.
14. Liebenberg D, Gordhan BG, Kana BD. Drug resistant tuberculosis: Implications for transmission, diagnosis, and disease management. Front Cell Infect Microbiol 2022;12:943545.
15. World Health Organization. Definitions and reporting framework for tuberculosis–2013 revision: Updated December 2014 and January 2020. Available from: <https://www.who.int/publications/i/item/9789241505345>. Accessed: 5 May 2024.

16. Stinson K, Eisenach K, Kayes S, *et al.* Mycobacteriology laboratory manual, global laboratory initiative advancing TB diagnosis. Geneva: Global Laboratory Initiative of Stop TB Partnership; 2014.
17. Korhonen V, Lyytikäinen O, Ollgren J, *et al.* Risk factors affecting treatment outcomes for pulmonary tuberculosis in Finland 2007–2014: A national cohort study. BMC Public Health 2020;20(1):1250.
18. Assefa A, Girma A, Kloos H. Predictors of unsuccessful treatment of tuberculosis in Arsi-Robe Hospital, Arsi Zone, Oromia Regional State, Central Ethiopia: A retrospective study. Alex J Med 2023;59(1):75–85.
19. Liew SM, Khoo EM, Ho BK, *et al.* Tuberculosis in Malaysia: Predictors of treatment outcomes in a national registry. Int J Tuberc Lung Dis 2015;19(7):764–771.
20. Bhargava A, Bhargava M, Juneja A. Social determinants of tuberculosis: Context, framework, and the way forward to ending TB in India. Expert Rev Respir Med 2021;15(7):867–883.
21. Zhou Z, Yi H, Zhou Q, *et al.* Evolution and epidemic success of Mycobacterium tuberculosis in eastern China: Evidence from a prospective study. BMC Genomics 2023;24(1):241.
22. Youn HM, Shin MK, Jeong D, *et al.* Risk factors associated with tuberculosis recurrence in South Korea determined using a nationwide cohort study. PLoS One 2022;17(6):e0268290.
23. Soeroto AY, Nurhayati RD, Purwiga A, *et al.* Factors associated with treatment outcome of MDR/RR-TB patients treated with shorter injectable based regimen in West Java Indonesia. PLoS One 2022;17(1):e0263304.
24. Chilyabanyama R, Kamanga N, Mwandia JN. Factors associated with tuberculosis treatment outcomes among TB patients aged 15 years and older at Chawama level one hospital in Lusaka, Zambia. Glob Public Health 2024;19(1):2307979.
25. Kumar A, Harakuni S, Paranjape R, *et al.* Factors determining successful treatment outcome among notified tuberculosis patients in Belagavi district of North Karnataka, India. Clin Epidemiol Glob Health 2024;25:101505.
26. Mengesha MM, Gebremichael MA, Watumo D, *et al.* Poor adult tuberculosis treatment outcome and associated factors in Gibe Woreda, Southern Ethiopia: An institution-based cross-sectional study. PLOS Glob Public Health 2022;2(3):e0000161.
27. Adamu AL, Gadanya MA, Abubakar IS, *et al.* High mortality among tuberculosis patients on treatment in Nigeria: A retrospective cohort study. BMC Infect Dis 2017;17:1–11.
28. Prajapati AC, Shah T, Panchal S, *et al.* Treatment outcomes and associated factors among patients with drug-sensitive tuberculosis on daily fixed-dose combination drugs: A cohort study from Ahmedabad, India. J Family Med Prim Care 2023;12(3):452–459.
29. Alipanah N, Jarlsberg L, Miller C, *et al.* Adherence interventions and outcomes of tuberculosis treatment: A systematic review and meta-analysis of trials and observational studies. PLoS Med 2018;15(7):e1002595.
30. Peetluk LS, Ridolfi FM, Rebeiro PF, *et al.* Systematic review of prediction models for pulmonary tuberculosis treatment outcomes in adults. BMJ Open 2021;11(3):e044687.
31. Grigoryan Z, McPherson R, Harutyunyan T, *et al.* Factors influencing treatment adherence among drug-sensitive tuberculosis (DS-TB) patients in Armenia: A qualitative study. Patient Prefer Adherence 2022:2399–2408.
32. Silva-Sobrinho RA, Wysocki AD, Scatena LM, *et al.* Assessment of primary health care in the treatment of tuberculosis in a Brazilian locality of the International Triple Frontier. Open Nurs J 2017;11:124.
33. Lolong DB, Aryastami NK, Kusriani I, *et al.* Nonadherence to anti-tuberculosis treatment, reasons and associated factors among pulmonary tuberculosis patients in the communities in Indonesia. PLoS One 2023;18(8):e0287628.
34. Ruru Y, Matasik M, Oktavian A, *et al.* Factors associated with non-adherence during tuberculosis treatment among patients treated with DOTS strategy in Jayapura, Papua Province, Indonesia. Glob Health Action 2018;11(1):1510592.
35. Reviono R, Ramadhiana Y, Probandari AN, *et al.* Factors associated with success rate for tuberculosis treatment in hospital: A directly observed treatment short tuberculosis prevention strategy in central java. J Epidemiol Public Health 2019;4(4):283–295.
36. Hamidi S, Raharjo SS, Wijaya M. Path analysis on the determinants of adherence to anti tuberculosis drug treatment in Kaur District, Bengkulu, Indonesia. J Epidemiol Public Health 2019;4(3):205–214.
37. Ulfah U, Windiyansih C, Abidin Z, *et al.* Faktor-Faktor yang berhubungan dengan kepatuhan berobat pada penderita tuberkulosis paru. Indones J Infect Dis 2018;4(1):413292.
38. Vo LNQ, Codlin A, Ngo TD, *et al.* Early evaluation of an ultra-portable x-ray system for tuberculosis active case finding. Trop Med Infect Dis 2021;6(3):163.
39. Datta B, Prakash A, Ford D, *et al.* Implementing upfront mobile digital chest x-ray for tuberculosis diagnosis in India—feasibility and benefits. Trans R Soc Trop Med Hyg 2020;114(7):499–505.

40. Ananthakrishnan R, Thiagesan R, Auguesteen S, *et al.* The impact of chest radiography and Xpert MTB/RIF testing among household contacts in Chennai, India. *PLoS One* 2020;15(11):e0241203.
41. Yang J, Shen Y, Wang L, *et al.* Efficacy of the Xpert *Mycobacterium tuberculosis*/rifampicin assay for diagnosing sputum-smear negative or sputum-scarce pulmonary tuberculosis in bronchoalveolar lavage fluid. *Int J Infect Dis* 2021;107:121-126.
42. Nsubuga R, Adrawa N, Okoboi S, *et al.* Complete sputum smear monitoring among adults with pulmonary tuberculosis in central Uganda: Evidence from a retrospective cohort study. *BMC Infect Dis* 2022;22(1):191.
43. Migliori GB, Wu SJ, Matteelli A, *et al.* Clinical standards for the diagnosis, treatment and prevention of TB infection. *Int J Tuberc Lung Dis* 2022;26(3):190-205.
44. Mave V, Gaikwad S, Barthwal M, *et al.* Diabetes mellitus and tuberculosis treatment outcomes in Pune, India. *Open Forum Infect Dis* 2021;8(4):ofab097.
45. Eze TO, Nwadinigwe FC, Ameh GM. Treatment outcome of tuberculosis cases and HIV co-infected patients. A retrospective study at a Federal Medical Centre of North Central Nigeria. *J Epidemiol Kesehat Komun* 2023;8(1):6-13.
46. Nowiński A, Wesołowski S, Korzeniewska-Koseła M. The impact of comorbidities on tuberculosis treatment outcomes in Poland: A national cohort study. *Front Public Health* 2023;11:1253615.
47. Jiang W, Trimawartinah, Rahman FM, *et al.* The co-management of tuberculosis-diabetes co-morbidities in Indonesia under the National Tuberculosis Control Program: Results from a cross-sectional study from 2017 to 2019. *BMC Public Health* 2022;22(1):689.
48. Iswahyuni S, Fauziah AN, Indarto, *et al.* The effects of diabetes mellitus comorbidities on the risk of treatment failure in tuberculosis patients: A meta-analysis. *Indones J Med* 2022;7(4):417-427.
49. Bigna JJR, Noubiap JJN, Agbor AA, *et al.* Early mortality during initial treatment of tuberculosis in patients co-infected with HIV at the Yaoundé Central Hospital, Cameroon: An 8-year retrospective cohort study (2006-2013). *PLoS One* 2015;10(7):e0132394.
50. Akila D, Kweku M, Aninagyei E, *et al.* Effectiveness and challenges associated with the symptoms-based screening tool for active tuberculosis case finding in outpatient departments in healthcare facilities in Ghana. *Authorea Preprints* 2020.
51. Boadu AA, Yeboah-Manu M, Osei-Wusu S, *et al.* Tuberculosis and diabetes mellitus: The complexity of the comorbid interactions. *Int J Infect Dis* 2024:107140.
52. Faye LM, Hosu MC, Iruedo J, *et al.* Treatment outcomes and associated factors among tuberculosis patients from selected rural eastern cape hospitals: An ambidirectional study. *Trop Med Infect Dis* 2023;8(6):315.
53. Selimin DS, Ismail A, Ahmad N, *et al.* Tuberculosis treatment outcome in patients with TB-HIV coinfection in Kuala Lumpur, Malaysia. *J Trop Med* 2021;2021:1-10.
54. Chaves-Torres NM, Fadul S, Patiño J, *et al.* Factors associated with unfavorable treatment outcomes in patients with rifampicin-resistant tuberculosis in Colombia 2013–2015: A retrospective cohort study. *PLoS One* 2021;16(4):e0249565.
55. Schwöebel V, Trébucq A, Kashongwe Z, *et al.* Outcomes of a nine-month regimen for rifampicin-resistant tuberculosis up to 24 months after treatment completion in nine African countries. *EClinicalMedicine* 2020;20:100268.
56. Cox V, McKenna L, Acquah R, *et al.* Clinical perspectives on treatment of rifampicin-resistant/multidrug-resistant TB. *Int J Tuberc Lung Dis* 2020;24(11):1134-1144.
57. Abidi S, Achar J, Neino MMA, *et al.* Standardised shorter regimens versus individualised longer regimens for rifampin- or multidrug-resistant tuberculosis. *Eur Respir J* 2020;55(3):1901467.
58. Abraham Y, Assefa DG, Hailemariam T, *et al.* Efficacy and safety of shorter multidrug-resistant or rifampicin-resistant tuberculosis regimens: A network meta-analysis. *BMC Infect Dis* 2024;24(1):1087.
59. Souleymane MB, Decroo T, Soumana A, *et al.* Safety, effectiveness, and adherence of a short and all-oral treatment regimen for the treatment of rifampicin-resistant tuberculosis in Niger: A study protocol of a pragmatic randomised clinical trial with stratified block randomisation. *Trials* 2022;23(1):1011.

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Original Article

Tuberculosis treatment outcomes and associated factors: A retrospective study in West Nusa Tenggara, Indonesia

Meiyanti Meiyanti^{1,2*}, Adang Bachtiar³, Rina K. Kusumaratna⁴, Arifah Alfiyyah³, Machrumnizar Machrumnizar⁵ and Pusparini Pusparini⁶

¹Philosophy Doctor in Public Health Program, Faculty of Public Health, Universitas Indonesia, Depok, Indonesia; ²Department of Pharmacology and Pharmacy, Faculty of Medicine, Universitas Trisakti, Jakarta, Indonesia; ³Department of Health Policy and Administration, Faculty of Public Health, Universitas Indonesia, Depok, Indonesia; ⁴Department of Public Health, Faculty of Medicine, Universitas Trisakti, Jakarta, Indonesia; ⁵Department of Parasitology, Faculty of Medicine, Universitas Trisakti, Jakarta, Indonesia; ⁶Department of Clinical Pathology, Faculty of Medicine, Universitas Trisakti, Jakarta, Indonesia

*Corresponding author: meiyanti@trisakti.ac.id

Abstract

Successfully treating tuberculosis (TB) could significantly help reduce its spread. The aim of this study was to identify factors associated with successful TB treatment. A retrospective study was conducted in West Nusa Tenggara, Indonesia, using data from the National TB Information System (SITB) covering patients from January 1 to December 31, 2022. Patients were classified into two groups: those with successful treatment outcomes (cured or completed treatment) and those with unsuccessful outcomes (including treatment failure, loss to follow-up, or death). Univariate and multivariate logistic regression analyses were performed to identify factors associated with treatment outcomes, providing odds ratios (OR) and adjusted odds ratios (aOR) with 95% confidence intervals (CIs). A total of 2,225 TB patients (1,382 males and 843 females) were included in the study. Of these, 2,048 (92.1%) achieved successful treatment outcomes. Univariate analysis indicated that older age (OR: 0.47; 95%CI: 0.28–0.78) and a high number of AFB in sputum smears (OR: 0.23; 95%CI: 0.09–0.66) were associated with a higher likelihood of unsuccessful TB treatment. In contrast, having no HIV infection (OR: 13.44; 95%CI: 6.22–29.08), clinical TB cases (diagnosed clinically rather than bacteriologically) (OR: 1.50; 95%CI: 1.04–2.20) and longer duration of TB treatments were associated with successful treatment outcomes. Multivariate analysis suggested that the TB treatment durations of 4–6 months (aOR: 1256.95; 95%CI: 431.89–3658.19) and 7–12 months (aOR: 575.5; 95%CI: 99.1–3342.06) were associated with a significantly higher likelihood of success compared to durations of 0–3 months. In conclusion, this study highlights that a minimum treatment duration of three months was crucial for increasing the likelihood of successful TB treatment. These findings emphasize the importance of comprehensive support programs to ensure adherence to treatment guidelines and improve outcomes.

Keywords: Tuberculosis, treatment success, patient, risk factors, Indonesia

Introduction

Since 1991, the World Health Assembly has identified tuberculosis (TB), a preventable and curable infectious disease, as a major global health concern, leading to intensified international efforts for its effective management [1]. TB is classified into pulmonary TB, involving the lungs or



tracheobronchial tree, and extrapulmonary TB, affecting organs outside the lungs, such as the pleura, lymph nodes, or abdominal area [2-4]. According to the World Health Organization (WHO), 87% of global TB cases in 2022 were concentrated in high-burden countries, including India (27%) and Indonesia (10%), where coronavirus disease 2019 (COVID-19) disruptions contributed to a >60% reduction in diagnosed TB cases from 2020 to 2021 [5]. The COVID-19 pandemic-related challenges threaten the global TB elimination goal, highlighting the need for robust TB control efforts. One of the United Nations Sustainable Development Goals (SDGs) aims to end the TB epidemic by 2030 [1,6]. WHO has set a TB treatment success rate target of 90% by 2025, emphasizing effective, prompt treatment initiation and adherence [7-9].

In West Nusa Tenggara, Indonesia, a lower-middle-income region with a population of 5 million, achieved a 91.4% TB treatment success rate in 2022 despite challenging socio-demographic conditions [10]. Treatment adherence and post-treatment factors, such as completion rate, mortality risk, and cure rate, are critical for evaluating TB program success and improving clinical outcomes [11-12]. Factors such as age, sex, alcohol use, smoking, sputum conversion results, and human immunodeficiency virus (HIV) status influence TB treatment success globally, with current rates still below the 85% target [13]. In many regions around the globe, treatment protocols fail to meet the standards necessary for curing TB patients and preventing the spread of drug-resistant *Mycobacterium tuberculosis* strains, an issue driven by various contributing factors [14]. The aim of this study was to assess TB treatment outcomes and the factors associated with treatment success among TB patients in West Nusa Tenggara, Indonesia. The findings of this study would be valuable for both local and national governments in reducing TB infection rates and improving knowledge to enhance successful treatment outcomes.

Methods

Study design and setting

A retrospective study was conducted in West Nusa Tenggara, Indonesia, utilizing data from the National TB Information System or *Sistem Informasi Tuberkulosis* (SITB) covering TB patients from January 1 to December 31, 2022. SITB, an application-based platform that records and reports TB cases across the country, is serving as a mandatory reporting tool for all healthcare stakeholders, including primary healthcare facilities, hospitals, independent practitioners, clinics, laboratories, and pharmacies. The data analyzed in this study pertained to TB treatment registrations, encompassing information on participants who sought treatment for TB and the outcomes of their treatments. This retrospective approach facilitated a thorough evaluation of treatment patterns and effectiveness, providing valuable insights into TB management in the region.

Patients and criteria

This study included data from patients aged 19 years and older in West Nusa Tenggara diagnosed with TB. All patients were actively receiving anti-TB treatment during the study period, with comprehensive data securely stored in the SITB database. Patients were excluded from the analysis if their records contained incomplete information, defined as any missing values in the following variables: age, sex, the year of treatment initiation, or treatment outcomes (cured, completion, treatment failure, and death).

Data collection processes

Data for this study were sourced from the SITB encompassing multiple datasets. The first dataset included the sociodemographic variables of patients. The second, the healthcare utilization database, contained data from TB screenings, TB type, sputum smear results, chest X-ray findings, and relevant comorbidities, specifically HIV infection and diabetes.

To have a better understanding of the TB treatment outcomes among the patients, the outcomes were classified into five categories (cured, treatment completed, failed, lost to follow-up, and died) based on the modified 2021 WHO definitions and the National TB Control Program [15]. Patients were classified as 'cured' if they began treatment with a bacteriologically confirmed

strain and completed the regimen without evidence of treatment failure. 'Treatment completed' referred to patients who adhered to the prescribed TB regimen until the end but did not meet the criteria for cure or experienced treatment failure. 'Treatment failure' was defined as a regimen that was permanently halted or changed due to lack of clinical improvement or due to the presence of adverse reactions. Patients classified as 'died' for any reason when the patient has been registered in SITB included those who passed away for any reason, either during treatment or before initiating treatment. Individuals were classified as 'lost to follow-up' if they missed eight consecutive weeks of TB treatment after starting the regimen [10]. Patients who were registered in the SITB database but had not yet begun treatment were not included in this category. Additionally, when a definitive treatment outcome could not be determined, typically due to patient transfer to another facility, the outcome was recorded as 'not evaluated'. These two categories were excluded from the study.

Study variables

The dependent variable in this study was the treatment outcomes that were classified as successful or unsuccessful based on WHO criteria [15]. A successful treatment outcome was defined when a patient was either cured of TB or has resolved all TB-related symptoms, demonstrated by a negative smear microscopy result at the end of treatment and during follow-up evaluations (i.e., cured and treatment completed groups). An unsuccessful treatment outcome included patients who continued to show TB-related symptoms after treatment, as evidenced by a positive smear result after five months, along with those who were lost to follow-up or who died due to TB-related complications (i.e., failed, lost to follow-up, and died groups).

To have a better understanding of factors associated with treatment outcomes, plausible associated variables (independent variables) were collected and analyzed. The independent variables included were sex, age, type of healthcare facility, TB anatomical location, chest X-ray, sputum smear, type of diagnosis confirmation, rifampicin resistance, HIV status, diabetes status, and duration of treatment. Age was grouped into four groups: 19–34, 35–50, 51–65, and over 65 years. Healthcare facility type referred to whether the patient was treated at a primary healthcare center (first level of health facilities in Indonesia including community health centers (*Puskesmas*) and private clinics) or a secondary healthcare center (advanced referral health facilities such as hospitals). TB anatomical location was classified as either pulmonary TB or extrapulmonary TB (TB infection outside the lungs, such as in lymph nodes or bones). Chest X-ray results were classified as positive (indicating signs of TB), negative (no signs of TB), or not conducted (no X-ray performed). Sputum smear results were categorized as negative (no TB bacteria found), not conducted (test not performed), or graded based on bacterial load: 1–9 acid-fast bacilli (AFB), 1+, 2+, and 3+ based on the levels of bacterial presence [15–16]. Diagnosis confirmation was categorized as bacteriologically confirmed (confirmed through lab tests detecting TB bacteria) or clinical diagnosis (based on symptoms and clinical assessment without bacteriological test confirmation). Rifampicin resistance was assessed using molecular tests like GeneXpert or line probe assay, which detect genetic markers associated with resistance to rifampicin. HIV and diabetes status were recorded as either positive or present (yes) and negative or absent (no). Treatment duration was categorized into 0–3 months, 4–6 months, 7–12 months, and over 12 months.

Statistical analysis

In this study, univariate logistic regression was used initially to assess the association of each independent variable with TB treatment outcomes individually, identifying those with significant relationships based on unadjusted odds ratios (OR) with 95% confidence intervals (95%CI) to be considered in the multivariate analysis. Variables with $p < 0.05$ in univariate logistic regressions were then included in a multivariate logistic regression model, where the adjusted odds ratio (aOR) with their 95%CI was calculated. Statistical significance was considered with a $p < 0.05$. All data analyses were conducted using STATA 16 (StataCorp LLC, College Station, USA).

Results

Characteristics of the patients

In total, 2,483 patients diagnosed with various forms of TB from SITB were collected in this study. Among these, 258 patients remained in treatment progress and were excluded. A total of 2,225 patients had complete data on treatment outcomes and were included in the analysis. The characteristics of the patients included in this study are presented in Table 1. The majority of patients were male (62.1%), with a peak age incidence between 35 and 50 years, accounting for 702 patients (31.5%). Primary healthcare centers were the main sites for TB management, providing care to 1,845 patients (82.9%). Among the 2,225 TB patients, 2,166 cases (97.4%) had pulmonary TB and a notable proportion of patients, 1,176 (52.8%), did not undergo chest X-ray examinations. Out of the total, 1,604 (72.1%) had bacteriologically confirmed diagnoses and rifampicin-sensitive TB cases were confirmed in the vast majority of patients, with 2,216 patients (99.6%) showing no resistance. The prevalence of comorbidities was low, with 2,198 patients (98.8%) free of HIV and 2,004 patients (90.1%) without diabetes. The predominant treatment duration was 4 to 6 months, encompassing 92.1% of the total patients (Table 1).

Table 1. Characteristics and clinical characteristics of the TB patients included in this study (n=2,225)

Characteristic	Frequency	Percentage
Sex		
Male	1382	62.1
Female	843	37.9
Age (year)		
19–34	637	28.6
35–50	702	31.5
51–65	642	28.9
>65	244	11.0
Healthcare facility		
Secondary healthcare	380	17.1
Primary healthcare	1845	82.9
Anatomical location		
Pulmonary TB	2166	97.4
Extrapulmonary TB	59	2.6
Chest X-ray		
Positive	963	43.3
Negative	86	3.9
Not conducted	1176	52.8
Sputum smear		
Negative	143	6.4
Not conducted	1821	81.8
1–9	8	0.4
1+	121	5.4
2+	76	3.4
3+	56	2.5
Type of diagnosis confirmation		
Bacteriological	1604	72.1
Clinical	621	27.9
Rifampicin resistance		
Yes	9	0.4
No	2216	99.6
HIV status		
Positive	27	1.2
Negative	2198	98.8
Diabetes status		
Yes	221	9.9
No	2004	90.1
Duration of treatment		
0–3 months	128	5.7
4–6 months	2049	92.1
7–12 months	44	2.0
>12 months	4	0.2
Treatment outcome		
Unsuccessful	177	7.9
Successful	2048	92.1

Treatment outcomes

The treatment outcomes of TB patients included in this study are presented in **Figure 1**. The overall treatment success rate was 92.1% (2048/2,225) of which 1083 (48.7%) achieved a cure, and 965 (43.4%) completed their treatment. The unsuccessful treatment rate, therefore, was 7.96% (177/2,225) of which 3.7% (83 patients) were lost to follow-up, 0.1% (3 patients) experienced treatment failure, and 4.1% (91 patients) died (**Figure 1**). This study indicated that the successful treatment outcomes from 2,225 patients were more than 90%.

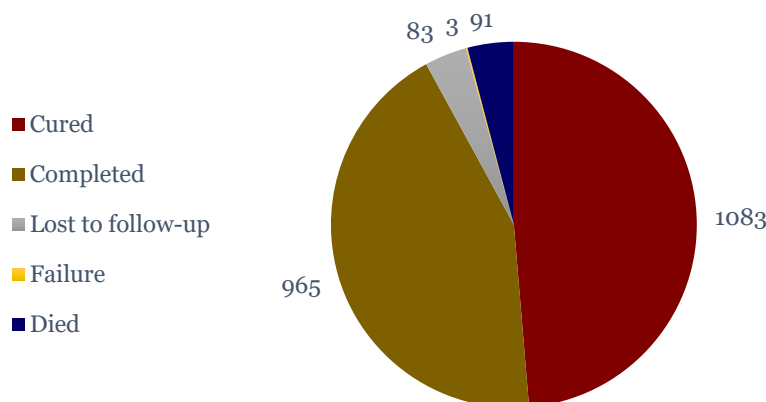


Figure 1. Treatment outcomes of the tuberculosis patients in West Nusa Tenggara, Indonesia, from National TB Information System (SITB), 2022 (n=2,225).

Factors associated with successful TB treatment outcomes: Univariate analyses

Based on the treatment outcomes, patients were then categorized as either successful or unsuccessful. Successful outcomes included patients who were cured, demonstrating recovery based on bacteriological evidence, or who completed the prescribed treatment regimen with clinical improvement, even without bacteriological confirmation. Unsuccessful outcomes encompassed patients who were lost to follow-up, experienced treatment failure, or died during treatment. Univariate logistic regression showing factors associated with treatment outcomes among tuberculosis patients included in the study is presented in **Table 2**.

Our data indicated that older age and a higher number of AFB in sputum smear were associated with the chance of unsuccessful TB treatment (**Table 2**). Being HIV positive was significantly associated with unsuccessful TB treatment compared to those without HIV infection (OR: 13.44; 95%CI: 6.22–29.08). In addition, patients who were diagnosed clinically and those who received a longer duration of TB treatment had a higher chance of having successful TB treatment compared to patients diagnosed bacteriologically and those treated with a shorter treatment duration (**Table 2**).

Table 2. Univariate logistic regression showing factors associated with treatment outcomes among tuberculosis patients included in the study (n=2,225)

Variable	Treatment outcomes		Univariate analysis	
	Successful (n=2048)	Unsuccessful (n=177)	OR (95%CI)	p-value
	Frequency (%)	Frequency (%)		
Sex				
Male (R)	1274 (62.2)	108 (61.0)	0.95 (0.69–1.30)	0.754
Female	774 (37.8)	69 (39.0)		
Age (year)				
19–34 (R)	599 (29.2)	38 (21.5)	0.86 (0.56–1.34)	0.516
35–50	654 (31.9)	48 (27.1)		
51–65	580 (28.3)	62 (35.0)		
>65	215 (10.5)	29 (16.4)		
Healthcare facility				
Secondary healthcare (R)	346 (16.9)	34 (19.2)	1.17 (0.79–1.73)	0.433
Primary healthcare	1702 (83.1)	143 (80.8)		
Anatomical location				

Variable	Treatment outcomes		Univariate analysis	
	Successful (n=2048)	Unsuccessful (n=177)	OR (95%CI)	p-value
	Frequency (%)	Frequency (%)		
Extrapulmonary TB (R)	54 (2.6)	5 (2.8)		
Pulmonary TB	1994 (97.4)	172 (97.2)	1.07 (0.42–2.72)	0.881
Chest X-ray				
Positive (R)	888 (43.4)	75 (42.4)		
Not conducted	1081 (52.8)	95 (53.7)	0.96 (0.70–1.32)	0.805
Negative	79 (3.9)	7 (4.0)	0.95 (0.42–2.14)	0.907
Sputum smear				
Negative (R)	136 (6.6)	7 (4.0)		
Not conducted	1675 (81.8)	146 (82.5)	0.59 (0.27–1.29)	0.185
1–9	7 (0.3)	1 (0.6)	0.36 (0.04–3.35)	0.369
1+	114 (5.6)	7 (4.0)	0.83 (0.29–2.46)	0.748
2+	70 (3.4)	6 (3.4)	0.60 (0.19–1.86)	0.376
3+	46 (2.2)	10 (5.6)	0.23 (0.09–0.66)	0.006**
Type of diagnosis confirmation				
Bacteriological (R)	1464 (71.5)	140 (79.1)		
Clinical	584 (28.5)	37 (20.9)	1.50 (1.04–2.20)	0.031*
Rifampicin resistance				
Yes (R)	8 (0.4)	1 (0.6)		
No	2040 (99.6)	176 (99.4)	1.44 (0.18–11.65)	0.727
HIV status				
Positive (R)	13 (0.6)	14 (7.9)		
Negative	2035 (99.4)	163 (92.1)	13.44 (6.22–29.08)	<0.001**
Diabetes status				
Yes (R)	202 (9.9)	19 (10.7)		
No	1846 (90.1)	158 (89.3)	1.09 (0.67–1.81)	0.710
Duration of treatment				
0–3 months (R)	4 (0.2)	124 (70.1)		
4–6 months	1998 (97.6)	51 (28.8)	1214.5 (431.9–3414.5)	<0.001**
7–12 months	42 (2.1)	2 (1.1)	651 (115.0–3683.3)	<0.001**
>12 months	4 (0.2)	0 (0.0)	1	

*Statistically significant at $p=0.05$

**Statistically significant at $p=0.01$

Factors associated with successful TB treatment outcomes: Multivariate analysis

All variables with $p<0.05$ in univariate analysis (age, sputum smear, type of diagnosis confirmation, HIV status, and duration of TB treatment) were included in multivariate analysis, and the results are presented in Table 3. Our data indicated that older patients (aged more than 65 years old) had a lower chance of having TB treatment success compared to those aged between 19 and 34 years (OR: 0.39; 95%CI: 0.16–0.97; $p=0.043$). In addition, there was a significant association between treatment duration and success of TB treatment of which patients receiving treatment for 4–6 months (aOR: 1256.95; 95%CI: 431.89–3658.19) and 7–12 months (aOR: 575.5; 95%CI: 99.1–3342.06) had a substantially higher likelihood of achieving treatment success compared to those treated for 0–3 months (Table 3).

Table 3. Multivariate logistic regression showing factors associated with treatment outcomes among tuberculosis patients included in the study (n=2,225)

Variable	Treatment outcomes		Multivariate analysis	
	Successful (n=2048)	Unsuccessful (n=177)	Adjusted odds ratio (95%CI)	p-value
	Frequency (%)	Frequency (%)		
Age (year)				
19–34 (R)	599 (29.2)	38 (21.5)		
35–50	654 (31.9)	48 (27.1)	0.56 (0.27–1.19)	0.135
51–65	580 (28.3)	62 (35.0)	0.63 (0.30–1.37)	0.250
>65	215 (10.5)	29 (16.4)	0.39 (0.16–0.97)	0.043*
Sputum smear				
Negative (R)	136 (6.6)	7 (4.0)		
Not done	1675 (81.8)	146 (82.5)	0.56 (0.12–2.63)	0.469
1–9	7 (0.3)	1 (0.6)	4.01 (0.00–12131.9)	0.734
1+	114 (5.6)	7 (4.0)	1.35 (0.16–11.30)	0.782

Variable	Treatment outcomes		Multivariate analysis	
	Successful (n=2048)	Unsuccessful (n=177)	Adjusted odds ratio (95%CI)	p-value
	Frequency (%)	Frequency (%)		
2+	70 (3.4)	6 (3.4)	0.59 (0.076–4.61)	0.618
3+	46 (2.2)	10 (5.6)	0.25 (0.04–1.76)	0.166
Type of diagnosis confirmation				
Bacteriological (R)	1464 (71.5)	140 (79.1)		
Clinical	584 (28.5)	37 (20.9)	1.79 (0.87–3.70)	1.794
HIV status				
Positive (R)	13 (0.6)	14 (7.9)		
Negative	2035 (99.4)	163 (92.1)	5.08 (0.80–32.47)	0.085
Duration of treatment				
0–3 months (R)	4 (0.2)	124 (70.1)		
4–6 months	1998 (97.6)	51 (28.8)	1256.95 (431.8–3658.1)	<0.001**
7–12 months	42 (2.1)	2 (1.1)	575.5 (99.1–3342.1)	<0.001**
>12 months	4 (0.2)	0 (0.0)	1	

R: reference group

*Statistically significant at $p=0.05$

**Statistically significant at $p=0.01$

Discussion

This study identified a high treatment success rate (92.1%) among TB patients treated in West Nusa Tenggara, Indonesia. However, TB case findings remain below the national target, which requires efforts for early detection and more effective and optimal interventions to achieve TB elimination [10]. This gap reflects a persistent challenge in high TB-burden countries, suggesting that targeted public health interventions could further bolster case detection and improve overall treatment success [5].

Our univariate analysis identified age, diagnostic type, comorbid conditions, and treatment duration as factors influencing treatment outcomes. However, multivariate logistic regression underscored treatment duration as the only statistically significant predictor, emphasizing the critical role of prolonged therapy adherence for optimal TB management. Effective treatment outcomes are indicative of not only disease progression but also healthcare system efficiency, particularly in managing patient adherence, preventing default, and reducing transfer-out rates. These findings reinforce the importance of consistent patient follow-up and support mechanisms to sustain prolonged treatment adherence.

Sex disparities in TB treatment outcomes have been variably reported. While studies in Indonesia suggested higher success rates among male patients, studies from Finland, Ethiopia, Malaysia, India, China, and South Korea reported that male sex was associated with higher risks of unfavorable outcomes, including mortality [17–22]. In contrast, this study found minimal sex-based differences, likely attributable to the single-year data collection period, which may not fully capture the outcomes for all patients throughout an entire treatment cycle [23]. Additionally, age emerged as a significant factor in TB treatment outcomes, of which older patients had a higher failure rate of treatment. Other studies indicated that older age may increase susceptibility to TB recurrence [24–26]. However, some studies from urban settings reported a higher risk of unsuccessful treatment among middle-old adults (45–54 years) [21,27–31]. These differing findings suggest that age may act as a confounding variable in TB outcomes, warranting further investigation to determine age-related risks in treatment efficacy and long-term recovery [32–34].

Access to and affordability of TB services are essential for promoting adherence and achieving successful treatment outcomes [31]. Although the present study did not establish a direct correlation between healthcare facility access and TB outcomes, other studies have highlighted that the quality of care and facility accessibility can significantly impact treatment success rates [21,35–40]. Future studies evaluating TB service quality in relation to patient outcomes could provide a more comprehensive perspective on these determinants within the Indonesian healthcare system [32–33].

Diagnostic tools, particularly chest X-ray, play an increasingly critical role in active TB case finding and ensuring equitable access to care [38]. Abnormal chest X-ray findings, which are suggestive of TB, show a strong correlation with positive sputum smears and diagnostic confirmation [39]. Although chest X-ray findings were not directly associated with treatment

outcomes in our study, chest X-rays remain valuable for initial TB detection. When used in conjunction with molecular diagnostics, such as the Xpert test, chest X-rays enhance early detection capabilities and diagnostic accuracy, reinforcing their role in comprehensive TB management strategies [40]. Furthermore, sputum smear testing, valued for its high sensitivity and specificity, plays a critical role in monitoring bacteriologically confirmed pulmonary TB cases [41-45]. Routine smear assessments at two, five, and six months into treatment serve as important benchmarks for evaluating treatment progress and outcomes [43]. However, in this present study, the limited availability of comprehensive sputum smear data restricted our ability to fully assess the correlation between smear results and treatment success.

Comorbid conditions, particularly diabetes and HIV, significantly impact TB treatment outcomes. For instance, several studies have reported that TB patients with DM frequently experience higher rates of mortality and unsuccessful treatment outcomes, underscoring the complex challenges posed by diabetes in TB management [46-51]. Conversely, while HIV is typically associated with poorer TB outcomes, some studies indicate that patients with HIV can achieve favorable results when provided with consistent monitoring and support, as regular follow-up enhances treatment adherence [48-49,52-55]. These findings highlight the importance of integrated comorbidity management and ongoing healthcare provider support throughout the TB treatment process [53].

A minimum treatment duration of three months with consistent medication adherence was found to significantly improve the likelihood of treatment success, in line with standard TB treatment guidelines that emphasize prolonged adherence to fully eradicate infection and prevent recurrence or drug resistance. Rifampicin-resistant TB presents considerable challenges to successful treatment due to an elevated risk of treatment failure and relapse [56-58]. Recent studies suggest that shorter, optimized treatment regimens for rifampicin-resistant TB can improve outcomes [58-59]. Nevertheless, our study did not find any association between rifampicin resistance and TB treatment outcomes.

This study utilized the data from national surveillance, which may have limitations, such as reporting delays or biases, including underreporting of treatment outcomes in certain regions or among specific populations. These could affect the accuracy and generalizability of the findings. Although important factors were included in our analysis, other variables, such as socio-economic status and underlying health conditions, were not thoroughly explored. Future studies should incorporate a broader range of factors that could influence treatment success. Additionally, the data might reflect regional or local healthcare differences, which could limit the applicability of the findings to other regions with differing healthcare infrastructures.

Conclusion

This study demonstrated that older age, a high number of AFB in sputum smears, and HIV infection were associated with a higher likelihood of unsuccessful TB treatment. In contrast, clinical TB cases (diagnosed clinically rather than bacteriologically) and a longer duration of TB treatment (more than three months) were associated with a higher likelihood of successful treatment outcomes. These findings highlight the need for tailored interventions to improve TB treatment outcomes, particularly for high-risk groups such as older patients, those with high AFB counts, and individuals with HIV infection. Enhanced monitoring, early detection of treatment challenges, and integrated care for co-infections like HIV could help mitigate these risks. Additionally, the positive association between extended treatment duration and successful outcomes underscores the importance of maintaining adherence to longer treatment regimens when clinically appropriate.

Ethics approval

This study was approved by the Directorate General of Communicable Disease Prevention and Control, Ministry of Health Indonesia (PM.01.01/C.III/4651/2024). The ethics and review committee approved that informed consent was not applicable due to the retrospective nature of the study. All data were kept confidential and used only for the intended purpose.

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Competing interests

All the authors declare that there are no conflicts of interest.

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Underlying data

Derived data supporting the findings of this study are available from the corresponding author on request.

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References

1. World Health Organization. A situational analysis of programmatic management of TB preventive treatment in the WHO South-East Asia Region. Available from: <https://www.who.int/publications/i/item/9789290228059>. Accessed: 2 May 2024.
2. Pottage T, Bennett A. Mycobacterium tuberculosis. In: European Centre for Disease Prevention and Control. Handbook on tuberculosis laboratory diagnostic methods in the European Union – Updated 2022. Stockholm: ECDC; 2023.
3. Centers for Disease Control and Prevention (CDC). Tuberculosis. Available from: https://archive.cdc.gov/www_cdc_gov/globalhealth/newsroom/topics/tb/index.html. Accessed: 2 May 2024.
4. David S, Katalinić-Janković V, Fattorini L, *et al.* Culture tests for *Mycobacterium tuberculosis* complex. In: European Centre for Disease Prevention and Control. Handbook on tuberculosis laboratory diagnostic methods in the European Union – Updated 2022. Stockholm: ECDC; 2023.
5. World Health Organization. Global tuberculosis report 2023. Available from: <https://www.who.int/news-room/fact-sheets/detail/tuberculosis>. Accessed: 8 September 2024.
6. Linh NN, Viney K, Gegia M, *et al.* World Health Organization treatment outcome definitions for tuberculosis: 2021 update. Eur Resp J 2021;58(2):2100804.
7. Tok PSK, Liew SM, Wong LP, *et al.* Determinants of unsuccessful treatment outcomes and mortality among tuberculosis patients in Malaysia: A registry-based cohort study. PLoS One 2020;15(4):e0231986.
8. Pradipta IS, Idrus LR, Probandari A, *et al.* Barriers and strategies to successful tuberculosis treatment in a high-burden tuberculosis setting: A qualitative study from the patient's perspective. BMC Public Health 2021;21(1):1903.
9. Nyarko RO, Prakash A, Kumar N, *et al.* Tuberculosis a globalized disease. Asian J Pharm Res Dev 2021;9(1):198201.
10. Ministry of Health Indonesia. Program penanggulangan tuberkulosis kementerian kesehatan RI. Jakarta: Direktorat Jendral Pencegahan dan Pengendalian Penyakit; 2023.
11. Putra, Oki Nugraha, Hidayatullah AYN. Factors associated with treatment outcomes in drug-resistant tuberculosis. Int J Mycobacteriol 2022;11(2):226-227.
12. Kassim SA, Cote A, Kassim SM, *et al.* Factors influencing treatment outcomes of tuberculosis patients attending health facilities in Galkayo Puntland, Somalia. J Public Health 2021;43(4):887-895.
13. Chaves Torres NM, Quijano Rodríguez JJ, Porras Andrade PS, *et al.* Factors predictive of the success of tuberculosis treatment: A systematic review with meta-analysis. PLoS One 2019;14(12):e0226507.
14. Liebenberg D, Gordhan BG, Kana BD. Drug resistant tuberculosis: Implications for transmission, diagnosis, and disease management. Front Cell Infect Microbiol 2022;12:943545.
15. World Health Organization. Definitions and reporting framework for tuberculosis–2013 revision: Updated December 2014 and January 2020. Available from: <https://www.who.int/publications/i/item/9789241505345>. Accessed: 5 May 2024.

16. Stinson K, Eisenach K, Kayes S, *et al.* Mycobacteriology laboratory manual, global laboratory initiative advancing TB diagnosis. Geneva: Global Laboratory Initiative of Stop TB Partnership; 2014.
17. Korhonen V, Lyytikäinen O, Ollgren J, *et al.* Risk factors affecting treatment outcomes for pulmonary tuberculosis in Finland 2007–2014: A national cohort study. BMC Public Health 2020;20(1):1250.
18. Assefa A, Girma A, Kloos H. Predictors of unsuccessful treatment of tuberculosis in Arsi-Robe Hospital, Arsi Zone, Oromia Regional State, Central Ethiopia: A retrospective study. Alex J Med 2023;59(1):75–85.
19. Liew SM, Khoo EM, Ho BK, *et al.* Tuberculosis in Malaysia: Predictors of treatment outcomes in a national registry. Int J Tuberc Lung Dis 2015;19(7):764–771.
20. Bhargava A, Bhargava M, Juneja A. Social determinants of tuberculosis: Context, framework, and the way forward to ending TB in India. Expert Rev Respir Med 2021;15(7):867–883.
21. Zhou Z, Yi H, Zhou Q, *et al.* Evolution and epidemic success of Mycobacterium tuberculosis in eastern China: Evidence from a prospective study. BMC Genomics 2023;24(1):241.
22. Youn HM, Shin MK, Jeong D, *et al.* Risk factors associated with tuberculosis recurrence in South Korea determined using a nationwide cohort study. PLoS One 2022;17(6):e0268290.
23. Soeroto AY, Nurhayati RD, Purwiga A, *et al.* Factors associated with treatment outcome of MDR/RR-TB patients treated with shorter injectable based regimen in West Java Indonesia. PLoS One 2022;17(1):e0263304.
24. Chilyabanyama R, Kamanga N, Mwandia JN. Factors associated with tuberculosis treatment outcomes among TB patients aged 15 years and older at Chawama level one hospital in Lusaka, Zambia. Glob Public Health 2024;19(1):2307979.
25. Kumar A, Harakuni S, Paranjape R, *et al.* Factors determining successful treatment outcome among notified tuberculosis patients in Belagavi district of North Karnataka, India. Clin Epidemiol Glob Health 2024;25:101505.
26. Mengesha MM, Gebremichael MA, Watumo D, *et al.* Poor adult tuberculosis treatment outcome and associated factors in Gibe Woreda, Southern Ethiopia: An institution-based cross-sectional study. PLOS Glob Public Health 2022;2(3):e0000161.
27. Adamu AL, Gadanya MA, Abubakar IS, *et al.* High mortality among tuberculosis patients on treatment in Nigeria: A retrospective cohort study. BMC Infect Dis 2017;17:1–11.
28. Prajapati AC, Shah T, Panchal S, *et al.* Treatment outcomes and associated factors among patients with drug-sensitive tuberculosis on daily fixed-dose combination drugs: A cohort study from Ahmedabad, India. J Family Med Prim Care 2023;12(3):452–459.
29. Alipanah N, Jarlsberg L, Miller C, *et al.* Adherence interventions and outcomes of tuberculosis treatment: A systematic review and meta-analysis of trials and observational studies. PLoS Med 2018;15(7):e1002595.
30. Peetluk LS, Ridolfi FM, Rebeiro PF, *et al.* Systematic review of prediction models for pulmonary tuberculosis treatment outcomes in adults. BMJ Open 2021;11(3):e044687.
31. Grigoryan Z, McPherson R, Harutyunyan T, *et al.* Factors influencing treatment adherence among drug-sensitive tuberculosis (DS-TB) patients in Armenia: A qualitative study. Patient Prefer Adherence 2022:2399–2408.
32. Silva-Sobrinho RA, Wysocki AD, Scatena LM, *et al.* Assessment of primary health care in the treatment of tuberculosis in a Brazilian locality of the International Triple Frontier. Open Nurs J 2017;11:124.
33. Lolong DB, Aryastami NK, Kusriani I, *et al.* Nonadherence to anti-tuberculosis treatment, reasons and associated factors among pulmonary tuberculosis patients in the communities in Indonesia. PLoS One 2023;18(8):e0287628.
34. Ruru Y, Matasik M, Oktavian A, *et al.* Factors associated with non-adherence during tuberculosis treatment among patients treated with DOTS strategy in Jayapura, Papua Province, Indonesia. Glob Health Action 2018;11(1):1510592.
35. Reviono R, Ramadhiana Y, Probandari AN, *et al.* Factors associated with success rate for tuberculosis treatment in hospital: A directly observed treatment short tuberculosis prevention strategy in central java. J Epidemiol Public Health 2019;4(4):283–295.
36. Hamidi S, Raharjo SS, Wijaya M. Path analysis on the determinants of adherence to anti tuberculosis drug treatment in Kaur District, Bengkulu, Indonesia. J Epidemiol Public Health 2019;4(3):205–214.
37. Ulfah U, Windyaningsih C, Abidin Z, *et al.* Faktor-Faktor yang berhubungan dengan kepatuhan berobat pada penderita tuberkulosis paru. Indones J Infect Dis 2018;4(1):413292.
38. Vo LNQ, Codlin A, Ngo TD, *et al.* Early evaluation of an ultra-portable x-ray system for tuberculosis active case finding. Trop Med Infect Dis 2021;6(3):163.
39. Datta B, Prakash A, Ford D, *et al.* Implementing upfront mobile digital chest x-ray for tuberculosis diagnosis in India—feasibility and benefits. Trans R Soc Trop Med Hyg 2020;114(7):499–505.

40. Ananthakrishnan R, Thiagesan R, Auguesteen S, *et al.* The impact of chest radiography and Xpert MTB/RIF testing among household contacts in Chennai, India. *PLoS One* 2020;15(11):e0241203.
41. Yang J, Shen Y, Wang L, *et al.* Efficacy of the Xpert *Mycobacterium tuberculosis*/rifampicin assay for diagnosing sputum-smear negative or sputum-scarce pulmonary tuberculosis in bronchoalveolar lavage fluid. *Int J Infect Dis* 2021;107:121-126.
42. Nsubuga R, Adrawa N, Okoboi S, *et al.* Complete sputum smear monitoring among adults with pulmonary tuberculosis in central Uganda: Evidence from a retrospective cohort study. *BMC Infect Dis* 2022;22(1):191.
43. Migliori GB, Wu SJ, Matteelli A, *et al.* Clinical standards for the diagnosis, treatment and prevention of TB infection. *Int J Tuberc Lung Dis* 2022;26(3):190-205.
44. Mave V, Gaikwad S, Barthwal M, *et al.* Diabetes mellitus and tuberculosis treatment outcomes in Pune, India. *Open Forum Infect Dis* 2021;8(4):ofab097.
45. Eze TO, Nwadinigwe FC, Ameh GM. Treatment outcome of tuberculosis cases and HIV co-infected patients. A retrospective study at a Federal Medical Centre of North Central Nigeria. *J Epidemiol Kesehat Komun* 2023;8(1):6-13.
46. Nowiński A, Wesołowski S, Korzeniewska-Koseła M. The impact of comorbidities on tuberculosis treatment outcomes in Poland: A national cohort study. *Front Public Health* 2023;11:1253615.
47. Jiang W, Trimawartinah, Rahman FM, *et al.* The co-management of tuberculosis-diabetes co-morbidities in Indonesia under the National Tuberculosis Control Program: Results from a cross-sectional study from 2017 to 2019. *BMC Public Health* 2022;22(1):689.
48. Iswahyuni S, Fauziah AN, Indarto, *et al.* The effects of diabetes mellitus comorbidities on the risk of treatment failure in tuberculosis patients: A meta-analysis. *Indones J Med* 2022;7(4):417-427.
49. Bigna JJR, Noubiap JJN, Agbor AA, *et al.* Early mortality during initial treatment of tuberculosis in patients co-infected with HIV at the Yaoundé Central Hospital, Cameroon: An 8-year retrospective cohort study (2006-2013). *PLoS One* 2015;10(7):e0132394.
50. Akila D, Kweku M, Aninagyei E, *et al.* Effectiveness and challenges associated with the symptoms-based screening tool for active tuberculosis case finding in outpatient departments in healthcare facilities in Ghana. *Authorea Preprints* 2020.
51. Boadu AA, Yeboah-Manu M, Osei-Wusu S, *et al.* Tuberculosis and diabetes mellitus: The complexity of the comorbid interactions. *Int J Infect Dis* 2024:107140.
52. Faye LM, Hosu MC, Iruedo J, *et al.* Treatment outcomes and associated factors among tuberculosis patients from selected rural eastern cape hospitals: An ambidirectional study. *Trop Med Infect Dis* 2023;8(6):315.
53. Selimin DS, Ismail A, Ahmad N, *et al.* Tuberculosis treatment outcome in patients with TB-HIV coinfection in Kuala Lumpur, Malaysia. *J Trop Med* 2021;2021:1-10.
54. Chaves-Torres NM, Fadul S, Patiño J, *et al.* Factors associated with unfavorable treatment outcomes in patients with rifampicin-resistant tuberculosis in Colombia 2013–2015: A retrospective cohort study. *PLoS One* 2021;16(4):e0249565.
55. Schwöebel V, Trébucq A, Kashongwe Z, *et al.* Outcomes of a nine-month regimen for rifampicin-resistant tuberculosis up to 24 months after treatment completion in nine African countries. *EClinicalMedicine* 2020;20:100268.
56. Cox V, McKenna L, Acquah R, *et al.* Clinical perspectives on treatment of rifampicin-resistant/multidrug-resistant TB. *Int J Tuberc Lung Dis* 2020;24(11):1134-1144.
57. Abidi S, Achar J, Neino MMA, *et al.* Standardised shorter regimens versus individualised longer regimens for rifampin- or multidrug-resistant tuberculosis. *Eur Respir J* 2020;55(3):1901467.
58. Abraham Y, Assefa DG, Hailemariam T, *et al.* Efficacy and safety of shorter multidrug-resistant or rifampicin-resistant tuberculosis regimens: A network meta-analysis. *BMC Infect Dis* 2024;24(1):1087.
59. Souleymane MB, Decroo T, Soumana A, *et al.* Safety, effectiveness, and adherence of a short and all-oral treatment regimen for the treatment of rifampicin-resistant tuberculosis in Niger: A study protocol of a pragmatic randomised clinical trial with stratified block randomisation. *Trials* 2022;23(1):1011.