SCRIPTA SCORE Scientific Medical Journal
Journal homepage: https://talenta.usu.ac.id/scripta

Pulmonary Tuberculosis Case Before and During Pandemic COVID-19: Prevalence and Frequency Distribution Differences at Arifin Achmad General Hospital, Riau Province

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ARTICLE INFO

Article history:
Received 20 April 2026
Revised 21 July 2026
Accepted 4 August 2026
Available online 28 August 2026

E-ISSN: 2686-0864
P-ISSN: 2088-8686

How to cite:
Simanjuntak AM, Yovi I, Suyanto, Fauzy ZA. Pulmonary tuberculosis case before and during pandemic COVID-19: prevalence and frequency distribution differences at Arifin Achmad General Hospital, Riau Province. SCRIPTA SCORE Sci Med J. 2026 Aug 28;8(1):019–025

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https://doi.org/10.32734/scripta.v8i1.25280

ABSTRACT

Background: The COVID-19 pandemic severely disrupted tuberculosis (TB) control efforts, leading to a global "diagnostic deficit." **Objectives:** This study aimed to compare the incidence and frequency distribution of new pulmonary TB cases before and during the pandemic at Arifin Achmad General Hospital, Riau Province. **Methods:** Adhering to STROBE guidelines, this observational cross-sectional study analyzed 343 medical records from March 2018 to March 2022. Comparison was made between the pre-pandemic (2018–2020) and pandemic (2020–2022) periods using Chi-square analysis and Odds Ratios. **Results:** New pulmonary TB case notifications significantly declined by 33.5%, falling from 206 cases (60.1%) pre-pandemic to 137 cases (39.9%) during the pandemic. Of the total cases, 291 (84.8%) were drug-sensitive (DS-TB) and 52 (15.2%) were drug-resistant (DR-TB). Bivariate analysis revealed highly significant associations ($p < 0.001$) between the pandemic period and both smoking history and a history of COVID-19 infection. Significant associations were also found with comorbidities, including Diabetes Mellitus and HIV ($p = 0.01$). **Conclusion:** The observed decline reflects a diagnostic deficit driven by healthcare disruptions and reduced health-seeking behavior rather than a true reduction in incidence. The biological synergy between SARS-CoV-2 and *Mycobacterium tuberculosis* likely catalyzed active disease in vulnerable groups. Healthcare systems must prepare for a "time lag" phenomenon, where undiagnosed community transmission leads to a future surge in advanced TB presentations. Intensified active case-finding is essential to mitigate the pandemic's long-term epidemiological impact.
Keyword: COVID-19 Pandemic, Incidence, Time Lag, Tuberculosis

ABSTRAK

Latar Belakang: Pandemi COVID-19 telah sangat mengganggu upaya pengendalian tuberkulosis (TB), yang mengakibatkan terjadinya "defisit diagnosis" secara global. **Tujuan:** Penelitian ini bertujuan untuk membandingkan insidensi dan distribusi frekuensi kasus TB paru baru sebelum dan selama pandemi di Rumah Sakit Umum Arifin Achmad, Provinsi Riau. **Metode:** Sesuai dengan pedoman STROBE, studi observasional *cross-sectional* ini menganalisis 343 rekam medis dari Maret 2018 hingga Maret 2022. Perbandingan dilakukan antara periode pra-pandemi (2018–2020) dan pandemi (2020–2022) menggunakan analisis *Chi-square* dan *Odds Ratios*. **Hasil:** Laporan kasus TB paru baru menurun secara signifikan sebesar 33,5%, dari 206 kasus (60,1%) pada periode pra-pandemi menjadi 137 kasus (39,9%) selama pandemi. **Kesimpulan:** Penurunan yang diamati mencerminkan kekurangan dalam diagnosis yang disebabkan oleh gangguan layanan kesehatan dan berkurangnya perilaku mencari perawatan kesehatan, bukan penurunan insiden yang sesungguhnya. Sinergi biologis antara SARS-CoV-2 dan *Mycobacterium tuberculosis* kemungkinan

besar memicu penyakit aktif pada kelompok rentan. Sistem layanan kesehatan harus bersiap menghadapi fenomena "*time lag*", di mana penularan di masyarakat yang tidak terdiagnosis akan menyebabkan lonjakan kasus TB stadium lanjut di masa depan. Peningkatan upaya pencarian kasus secara aktif sangat penting untuk memitigasi dampak epidemiologis jangka panjang dari pandemi ini.
Kata kunci: Insidensi, Pandemi COVID-19, *Time Lag*, Tuberkulosis

1. Introduction

Tuberculosis (TB) remains a preeminent global health threat, consistently ranking as one of the leading causes of death from a single infectious agent, surpassed only recently by COVID-19. In 2022, an estimated 10.6 million people developed TB worldwide, with Indonesia bearing a significant portion of this burden as the second-highest contributor to global TB incidence.[1] Despite decades of progress under the World Health Organization (WHO) End TB Strategy, the emergence of the SARS-CoV-2 pandemic in late 2019 created an unprecedented disruption in essential health services, reversing years of gains in TB control.[2]

The collateral damage of the COVID-19 pandemic on TB programs is most visible in the dramatic decline of new case notifications. Globally, the number of people newly diagnosed with TB and reported to national authorities fell from 7.1 million in 2019 to 5.8 million in 2020, representing an 18% reduction.[1,3] In Indonesia, this drop was even more pronounced, with notifications decreasing by approximately 14–20% during the peak of the pandemic.[1] This decline does not reflect a true reduction in disease prevalence but rather a "missing millions" phenomenon, where cases remained undiagnosed and untreated within the community, thereby fueling ongoing transmission.[4]

Several multifaceted factors contributed to this diagnostic gap. Structural barriers, including large-scale social restrictions in Indonesia and the repurposing of TB diagnostic tools—specifically the GeneXpert (Rapid Molecular Test) platforms—for COVID-19 testing, severely limited healthcare accessibility.[5] Furthermore, the clinical overlap between TB and COVID-19 symptoms, such as cough and fever, fostered significant social stigma and fear, deterring symptomatic individuals from seeking care at health facilities.[6] Economic instability during the pandemic also exacerbated the "catastrophic costs" associated with TB, further hindering patient adherence and health-seeking behavior.[7]

The long-term consequence of these disruptions is a projected "time lag" in TB epidemiology, characterized by an eventual rebound in incidence and mortality. Recent data suggests that the reduction in case detection has led to increased household transmission and a rise in patients presenting with more advanced disease and complications.[3] As healthcare systems transition into the post-pandemic recovery phase, understanding the precise shifts in TB prevalence and patient characteristics is critical for tailoring intensified case-finding strategies.

In Riau Province, Arifin Achmad General Hospital serves as a primary referral center, managing complex TB cases, including drug-resistant (DR-TB) and HIV-coinfected patients. While national trends indicate a significant impact, localized data regarding the frequency distribution of TB characteristics before and during the pandemic in this region remains limited. This study aims to determine the incidence and frequency distribution differences of new pulmonary TB cases at Arifin Achmad General Hospital, comparing the two-year periods immediately preceding and during the COVID-19 pandemic to provide evidence-based insights for regional TB programmatic adjustments.

2. Method

2.1 Study Design and Setting

This study employed an observational, analytical cross-sectional design to compare the incidence and frequency distribution of new pulmonary tuberculosis (TB) cases across two distinct periods: the pre-pandemic period (March 2018 – February 2020) and the COVID-19 pandemic period (March 2020 – March 2022). The study was conducted at Arifin Achmad General Hospital, Riau Province—a tertiary referral center. Data collection was performed between December 2022 and January 2023.

2.2 Operational Definitions

New pulmonary TB cases: Patients with no prior history of TB treatment who received objective bacteriological confirmation (sputum acid-fast bacilli or GeneXpert MTB/RIF positive results) or conclusive radiological evidence. *Productive age*: Individuals aged between 18 and 60 years. *High-risk profession*: Occupations with increased potential for exposure, such as healthcare workers or those in congregate

settings. *Comorbidities*: Co-existing medical conditions documented in medical records, specifically focusing on Diabetes Mellitus, HIV, and COVID-19.

2.3 Participants and Eligibility Criteria

The study population encompassed all patients diagnosed with new pulmonary TB at Arifin Achmad General Hospital throughout the designated four-year study period. Utilizing a total sampling method, 343 medical records were identified for analysis based on specific eligibility criteria. Patients were included if they were newly diagnosed with pulmonary TB between March 2018 and March 2022, possessed complete medical records, and were included regardless of the presence or absence of comorbidities. Additionally, the inclusion criteria covered patients referred back to primary health facilities following diagnosis or those undergoing treatment control during the study period.

Conversely, records were excluded if there was a documented history of TB treatment prior to the study interval, representing retreatment cases, or if the diagnosis lacked objective bacteriological confirmation—such as sputum acid-fast bacilli or GeneXpert MTB/RIF results—or radiological evidence. Furthermore, individuals whose data existed solely within the GeneXpert database without a corresponding physical or electronic medical record were excluded from the final analysis to ensure data integrity.

2.4 Variables and Data Sources

The primary outcome of interest was the shift in TB prevalence and frequency distribution between the pre-pandemic and pandemic periods. Independent variables were categorized into three main clusters: demographic data, socio-behavioral factors, and clinical characteristics. Demographic data included gender and age, with the latter categorized into children (under 18 years), productive (18–60 years), and unproductive (above 60 years) groups. Socio-behavioral factors comprised the patient's smoking history and professional background, which was classified into low-risk or high-risk categories. Clinical characteristics involved documented comorbidities such as Diabetes Mellitus, HIV, and COVID-19, as well as the classification of TB into Drug-Sensitive (DS-TB) or Drug-Resistant (DR-TB) types and the primary clinical complaint reported upon admission. All relevant data were extracted from hospital medical records and subsequently cross-verified with the database of the Clinical Pathology Installation to ensure diagnostic precision, particularly concerning GeneXpert MTB/RIF results.

2.5 Statistical Analysis

Data were analyzed using SPSS software (v.26). Univariate analysis described the frequency and percentage of each variable. Bivariate analysis was conducted using the Chi-square test to determine associations between the pandemic period and patient characteristics; Fisher’s Exact test was utilized when expected cell frequencies were less than five. The strength of association was expressed via Odds Ratios (OR) with 95% Confidence Intervals (CI). Missing data were managed by excluding records with incomplete clinical or diagnostic information from the final analysis to ensure data integrity. A p-value <0.05 was considered statistically significant.

2.6 Ethical Considerations

This study was approved by the Ethical Review Board for Medicine and Health Research, Faculty of Medicine, Universitas Riau (Number: B/166/UN19.5.1.1.8/UEPKK/2022). Administrative permission was obtained from the Arifin Achmad General Hospital management. Patient confidentiality was maintained by anonymizing all extracted data.

3. Result

A total of 343 patient records were included. Patient characteristics are detailed in Table 1. New pulmonary TB case notifications were dominated by productive age (76.1%), male gender (65%), low-risk professions (95.3%), and shortness of breath (49.9%). Notifications significantly declined from 206 cases pre-pandemic to 137 cases during the pandemic. Across both periods, DS-TB accounted for 291 cases (84.8%) and DR-TB for 52 cases (15.2%). Pre-pandemic, there were 172 (83.5%) DS-TB and 34 (16.5%) DR-TB cases. During the pandemic, there were 119 (86.9%) DS-TB and 18 (13.1%) DR-TB cases.

Table 1. Patient Characteristics and Bivariate Analysis of Pre-Pandemic vs. Pandemic Periods (n=343)

Variable	Total (n=343) n (%)	Before Pandemic COVID-19 (n = 206) n (%)	During Pandemic COVID-19 (n = 137) n (%)	OR (95%CI)	P value
Age					
Children (<18 years old)	24 (7%)	11 (45.8%)	13 (54.2%)		0.87
Productive (18 – 60 years old)	261 (76.1%)	154 (59%)	107(41%)		
Unproductive (≥60 years old)	58 (16.9%)	41 (70.7%)	17 (29.3%)		
Gender					
Male	223 (65%)	134 (60.1%)	89 (39.9%)	1 (0.63 – 1.57)	1
Female	120 (35%)	72 (60%)	48 (40%)		
Profession					
Low Risk	327 (95.3%)	197 (60.2%)	130 (39.8%)	1.1 (0.42 – 3.2)	0.954
High Risk	16 (4.7%)	9 (56.3%)	7 (43.8%)		
Smoking History					
No	243 (70.8%)	130 (53.5%)	113 (46.5%)	0.3 (0.2 – 0.6)	<0.001
Yes	100 (29.2%)	76 (76%)	24 (24%)		
Comorbid					
No	217 (63.3%)	128 (59%)	89 (41%)		
HIV	4 (1.2%)	1 (25%)	3 (75%)		0.01
COVID-19	6 (1.7%)	0 (0%)	6 (100%)		
Diabetes Mellitus	89 (25.9%)	60 (67.4%)	29 (32.9%)		
Others	27 (7.9%)	17 (63%)	10 (37%)		
Type of tuberculosis					
Drug Sensitive Tuberculosis (DS-TB)	291 (84.8%)	172 (59.1%)	119 (40.9%)	0.7 (0.41 – 1.41)	0.485
Drug Resistant Tuberculosis (DR-TB)	52 (15.2%)	34 (65.4%)	18 (34.6%)		
History of COVID-19					
No	330 (96.2%)	204 (61.8%)	126 (38.2)	0.382 (0.33 – 0.438)	<0.001
Yes	13 (3.8%)	0 (0%)	11 (100%)		
Main Complaint					
Cough with phlegm	87 (25.4%)	48 (55.2%)	39 (44.8%)		
Bloody Cough	66 (19.2%)	44 (66.7%)	22 (33.3%)		0.294
Shortness of breath	171 (49.9%)	100 (58.5%)	71 (41.5%)		

Others	19 (5.5)	14 (73.7%)	5 (26.3%)

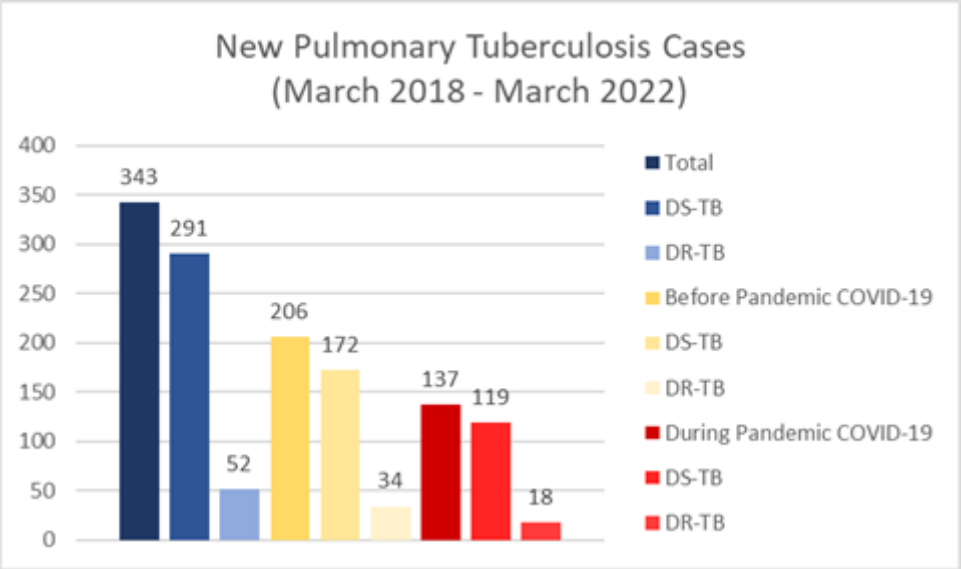

Figure 2. New Pulmonary Tuberculosis Cases During March 2018 – March 2022 in Arifin Achmad General Hospital, Riau Province.

Figure 2 presents the incidence of new pulmonary tuberculosis cases. Total notifications decreased from 206 cases pre-pandemic to 137 cases during the pandemic. Of the 343 total patients, 291 (84.8%) were drug-sensitive (DS-TB) and 52 (15.2%) were drug-resistant (DR-TB). Pre-pandemic counts were 172 DS-TB and 34 DR-TB; pandemic counts were 119 DS-TB and 18 DR-TB.

Table 2 presents the bivariate analysis on every variable with chi-square analysis. Few variables have no significant difference in statistics ($p>0.05$) were age, gender, profession, TB classification, and main complaint. There are variables has significant differences in statistics ($p<0.05$) such as smoking history ($p<0.001$), comorbid ($p=0.01$) and history of COVID-19 infection ($p<0.001$).

4. Discussion

4.1 Impact of COVID-19 on TB Prevalence: The Diagnostic Deficit

The current study identified a significant 33.5% reduction in the incidence of new pulmonary tuberculosis (TB) case notifications at Arifin Achmad General Hospital during the COVID-19 pandemic compared to the preceding two-year period. This localized decline mirrors the global and national trends reported by the World Health Organization, which highlighted Indonesia as one of the countries with the largest notification gaps during the pandemic.[1] The sharp decrease in identified cases likely represents a "diagnostic deficit" rather than a true decline in disease incidence.

4.2 The "Time Lag" Phenomenon and Biological Interactions

A critical concern arising from these results is the "time lag" effect in TB epidemiology, which suggests that the current decline in notifications is a precursor to a future surge in incidence. While hospital notifications decreased, the transmission of *Mycobacterium tuberculosis* likely intensified within households due to prolonged lockdowns and "stay-at-home" mandates.[3] Undiagnosed and untreated TB patients remained in close proximity to family members, facilitating a surge in subclinical transmission that will only manifest clinically as the pandemic's restrictive measures subside. This "time lag" is not merely administrative but is rooted in the natural history of TB, where the transition from latent infection to active disease can take months or years, often triggered by a breakdown in host immunity.

Recent evidence suggests that the biological interaction between TB and COVID-19 may lead to worse clinical outcomes through a synergistic suppression of the host immune system. SARS-CoV-2 infection is characterized by profound lymphopenia and a state of "immune exhaustion," where T-cell function critical for containing *M. tuberculosis* is impaired.[9] The observation that 100% of TB patients with a history of COVID-19 in this study were identified during the pandemic period ($p < 0.001$) highlights a significant

association that warrants further investigation into whether post-COVID lung damage and immunosuppression act as catalysts for active TB disease.

4.3 Shifts in Patient Characteristics and Vulnerabilities

The bivariate analysis revealed a significant association between smoking history and TB case identification ($p < 0.001$). The data shows a disproportionate drop in smokers presenting for TB care during the pandemic compared to non-smokers. This shift may be justified by the increased perceived risk among smokers; as smoking was early identified as a risk factor for severe COVID-19, this demographic may have practiced more stringent self-isolation or faced higher mortality before reaching TB diagnostic services.[2] Additionally, comorbidities such as Diabetes Mellitus and HIV remained significant factors ($p = 0.01$), reinforcing the established understanding that metabolic and immune-compromising conditions remain the primary drivers of TB vulnerability, even amidst a viral pandemic.[11] The lack of significant difference in age and gender distribution suggests that the "productive age" male population remains the demographic most affected by TB, regardless of the overarching public health crisis.[1,7]

4.4 Study Limitations and Confounding Factors

Despite the importance of these findings, several limitations must be addressed. The cross-sectional design prevents the establishment of a temporal or causal relationship between the pandemic's onset and the observed shifts in patient characteristics. As a single-center study in a tertiary referral hospital, these results are subject to "referral bias"; the decline in cases at Arifin Achmad could be partially confounded by the decentralization of GeneXpert services to primary health centers (Puskesmas), which may have handled uncomplicated cases. However, since Arifin Achmad specializes in complicated and drug-resistant TB, the reduction in its caseload remains a valid indicator of service disruption for the most vulnerable patients.

Furthermore, the reliance on medical records introduces the potential for information bias, particularly regarding missing data on socio-economic status and nutritional markers, which are known confounding variables in TB epidemiology. The "healthy-worker effect" or "survivor bias" may also be a confounder, as those with the most severe TB-COVID co-infections may have succumbed to the disease before a formal TB diagnosis could be recorded in the hospital system. Future longitudinal studies are required to monitor the predicted rebound in TB incidence—the "post-pandemic wave"—and to evaluate the long-term impact of COVID-19-induced lung injury on the regional TB burden in Riau Province.

Crucially, this study lacks a multivariable analysis, which limits the ability to control for potential confounders and establish independent risk factors for the observed changes in case notifications.

5. Conclusion

New pulmonary tuberculosis (TB) cases at Arifin Achmad General Hospital dropped by 33.4% during the COVID-19 pandemic. This decline resulted from service disruptions, diagnostic repurposing, mobility restrictions, and stigma-related changes in patient behavior. Significant associations were found between the pandemic and smoking history, HIV, Diabetes Mellitus, and prior COVID-19 infection. Notably, all TB patients with a COVID-19 history were identified during the pandemic, supporting the hypothesis that SARS-CoV-2 may trigger active TB in vulnerable individuals. Clinicians must address the "time lag" phenomenon, as the current notification gap likely hides undiagnosed cases. This pool could lead to a future surge in advanced disease and transmission. Healthcare services must intensify active case-finding and management protocols to counter the pandemic's long-term epidemiological impact.

6. Acknowledge

Authors would like to thank the Faculty of Medicine, Universitas Riau, Department of Medical Record, Clinical Pathology Installation, Ethical Review Board for Medicine and Health Research, Faculty of Medicine, Universitas Riau, and Arifin Achmad General Hospital.

7. Funding

This study did not receive any funding

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