Comparison of the Success of Pulmonary TB Treatment Before and After the COVID-19 Pandemic

Mochamad Zaky Alifyan M *, Heni Muflihah , Yuke Andriane

Study Program of Medical Education, Faculty of Medicine, Bandung Islamic University, Indonesia.

Zakyyam11@gmail.com, henimuflihah@unisba.ac.id, andrianeyuke@gmail.com

Abstract. Tuberculosis (TB) remains a major global public health challenge and continues to be one of the leading causes of illness and death from infectious diseases. Indonesia is the country with the second-highest TB burden worldwide after India, making TB control an essential national priority. The COVID-19 pandemic disrupted many essential health services, including TB programs, and may have affected treatment outcomes. This study aimed to compare the Treatment Success Rate (TSR) of pulmonary TB patients before and after the COVID-19 pandemic in primary health centers in Bandung City. This analytical observational research used a cross-sectional design with secondary data obtained from the Bandung Open Data Portal for the years 2018–2022. The period 2018–2019 was classified as pre-pandemic, while 2020–2022 represented the post-pandemic period. Data were analyzed using the Mann–Whitney test. Results showed that the average TSR increased from 80.1% before the pandemic to 88.55% after the pandemic; however, the difference was not statistically significant ($p > 0.05$). The TSR also remains below the WHO target of ≥90%. Strengthening TB services in the post-pandemic period—particularly in adherence monitoring, follow-up sputum examinations, and optimization of primary healthcare—will be essential to improving treatment outcomes.

Keywords: *Tuberculosis, COVID-19, Treatment Success Rate.*

*Zakyyam11@gmail.com

A. Introduction

Tuberculosis (TB) remains one of the most challenging infectious diseases globally, including in Indonesia. The Global Tuberculosis Report 2023 shows that the COVID-19 pandemic has had a major impact on TB control systems worldwide, particularly in terms of case detection, treatment continuity, and treatment success rates.[1] This situation continued in the following year's report, with the 2024 Global Tuberculosis Report reiterating that most low- and middle-income countries, including Indonesia, experienced a decline in TB service capacity and a slowdown in post-pandemic services recovery.[2] Indonesia is even listed as one of the three countries with the highest TB burden in the world, so any changes in TB services have significant implications for achieving national targets.

The impact of the COVID-19 pandemic on the success of TB treatment has been a concern for various researchers. A scoping review conducted by Maria et al. (2023) shows that the pandemic has disrupted all stages of TB services, from screening and diagnosis to monitoring the success of therapy.[3] These obstacles were related to social restrictions, a decline in patient visits to health facilities, and the diversion of health worker and logistical resources to COVID-19 response efforts. This situation was also experienced by many countries, such as Kenya, as reported by Mbithi et al. (2021), who found that TB and HIV services declined significantly during the pandemic and required rapid adjustments.[4] Other international studies confirm that the pandemic disrupted the diagnostic process and caused delays in bacteriological verification, which ultimately affected the classification of patient treatment outcomes.[5]

From a policy perspective, TB control efforts in Indonesia actually have a strong foundation through the 2020–2024 National Tuberculosis Control Strategy and a commitment to the WHO's End TB Strategy.[6], [7] This global strategy targets an 80% reduction in TB incidence and a 90% reduction in TB deaths by 2030.[8] However, various reports indicate that the pandemic has hindered the achievement of these targets. In fact, a number of derivative policies, such as TB management during the pandemic, had to be quickly adjusted to maintain the continuity of patient therapy.[6], [9]

This condition is also reflected in various regions in Indonesia, including the city of Bandung. Previous research shows that the characteristics of TB patients in the city of Bandung exhibit significant dynamics during the pandemic period, both in terms of the number of cases, treatment achievement, and gender distribution.[10] In addition, research on the quality of life of pulmonary TB patients in Bandung shows that social factors and health services also influence the success and continuity of treatment.[11] These findings indicate that any disruption to health services, such as those that occurred during the pandemic, has the potential to reduce the quality of treatment and hinder the success of therapy.

The implementation of close contact investigation in Bandung City also faced challenges during the pandemic. A study by Triyani et al. (2024) confirmed that the assistance of cadres plays a vital role in maintaining the continuity of TB programs, including the identification of close contacts and patient education.[12] However, the mentoring system and face-to-face communication were restricted during the pandemic, which could affect patient compliance and the treatment monitoring process.

In this context, it is important to analyze the success of TB treatment before and after the pandemic. The COVID-19 pandemic is known to have had a significant impact on various components of TB services, including the diagnosis process, laboratory follow-up, and the mechanism for determining the final treatment status. Studies report that during the pandemic, there were limitations on follow-up bacteriological examinations and a decline in service capacity, which affected how patients were classified into the “cured” or “treatment completed” categories.[3] This is parallel to the findings of other studies in various regions, which show modifications in TB management, such as the implementation of telemedicine, adjustments to visit schedules, and changes in the patient monitoring system, which have the potential to change the patterns of recording and reporting treatment success.[9]

In addition, the dynamics of patient distribution based on gender need to be considered. Data from Bandung City shows that before the pandemic, men dominated TB cases, which is in line with the national epidemiological pattern. However, after the pandemic, there was an increase in the proportion of women in the complete treatment category.[10] This change may be influenced by various factors, including differences in access to services during the pandemic and variations in treatment adherence between men and women.[10] Thus, analysis of gender distribution provides a more comprehensive context for understanding TB treatment outcomes during and after the pandemic.

Considering all these phenomena, there is an urgent need to conduct a local data-based study that can accurately describe how the COVID-19 pandemic has affected TB treatment success rates in Bandung City. Although various national and international studies have documented the impact of the pandemic on TB services, specific analyses in areas such as Bandung are still limited. In fact, each region has different health service characteristics, recording systems, and epidemiological dynamics.

Based on this background, this study was designed to answer the main question of how the success rate of treatment for BTA-positive pulmonary TB in Bandung City compared before and after the COVID-19 pandemic, while also analyzing changes in the treatment success rate and examining contextual factors that may have contributed, including the dynamics of patient distribution based on gender. Identifying these differences in outcomes is expected to contribute to improving TB service strategies at the regional level, strengthening case recording and reporting systems, and increasing access to further bacteriological examinations. In addition, the results of this study are also expected to support improvements in TB service policies, strengthen program monitoring systems, and contribute to enriching the local literature on the impact of the pandemic on tuberculosis services.

B. Method

This study employed an observational analytic design with a cross-sectional approach. The target population comprised all adult patients admitted to the Intensive Care Unit (ICU) at RSUD Al-Ihsan Bandung, while the accessible population included patients treated between January and December 2024.

The sampling was conducted using a total sampling technique. Inclusion criteria were patients aged ≥18 years, possessing complete medical records, and receiving ≥2 types of medications. Exclusion criteria included patients who passed away before their medication therapy was fully documented and those receiving only supportive therapy without pharmacological intervention. Based on the Slovin formula, the minimum required sample size was 94; however, this study successfully recruited 99 medical records that fulfilled the inclusion criteria and met none of the exclusion criteria.

This study employed a quantitative analytical observational design with a cross-sectional approach, using secondary data from the Bandung Open Data portal covering the period 2018–2022. The study subjects were all BTA-positive pulmonary tuberculosis patients recorded in the system, selected using total sampling. Data were grouped into the pre-COVID-19 period (2018–2019) and the post-COVID-19 period (2020–2022). Inclusion criteria comprised all patients recorded as cured or having completed treatment in each period, with no exclusion criteria applied. The data were obtained through documentation, then cleaned and categorized before analysis. All data were aggregated and anonymized, with no direct patient contact.

The tuberculosis treatment success rate (TSR) was calculated annually as the proportion of cured and treatment-completed patients among all treated BTA-positive cases. Data analysis included univariate analysis to describe patient outcomes and TSR values, followed by bivariate analysis to compare TSR before and after the COVID-19 pandemic. Because the data were not normally distributed and the sample size was limited, the Mann-Whitney U test was used with a 95% confidence level ($p < 0.05$). Statistical analysis was conducted using SPSS. Ethical approval in the form of an Ethical Exemption was obtained from the Al Islam Hospital Health Research Ethics Committee (Number : 051/KEPK-RSAI/08/2025).

C. Result and Discussion

The results of this study were obtained through the collection and analysis of data on BTA-positive pulmonary tuberculosis (TB) patients who received treatment at community health centers in the city of Bandung during the period 2018–2022. All data were then presented in tables and graphs to visualize trends in the number of patients treated, cured, and who completed treatment, thereby providing a clearer picture of the dynamics of pulmonary TB treatment success before and after the COVID-19 pandemic. The presentation of these graphs also allowed researchers to observe changes in patterns over time and identify potential factors that influenced the trends that emerged during the study period.

Table 1. Number of Patients Treated, Cured, and Completed Treatment for Pulmonary TB Before COVID-19

Treatment Status	2018	2019
Treated	1.020	7.491
Cured	652	1.297
Completed	162	4.727

Table 1 shows the number of pulmonary TB patients before the COVID-19 pandemic. The number of patients treated increased significantly, from 1,020 patients in 2018 to 7,491 patients in 2019. The number of patients cured in 2018 was higher than the number of patients who completed treatment, but in 2019 the opposite was true. The increase in the number of patients treated in the period before the pandemic illustrates the optimal TB service and surveillance system, as well as increased case finding efforts in primary health care facilities.

Table 2. Number of Patients Treated, Cured, and Completed Treatment for Pulmonary TB After COVID-19 Pandemic

Treatment Status	2020	2021	2022
Treated	3.850	6.156	6.317
Cured	725	653	785
Completed	2.980	4.614	4.524

Based on Table 2, the number of pulmonary TB patients treated after the pandemic decreased in 2020 to 3,850 patients. However, in 2021 and 2022, the number of patients increased again to 6,156 and 6,317 patients, respectively. Nevertheless, the number of patients treated in the post-pandemic period was still lower than the peak number of patients before the pandemic in 2019.

In all years after the pandemic, the number of patients with complete treatment status was much higher than the number of patients who recovered, with a difference of about 4–7 times. This shows that although many patients completed treatment, bacteriological verification as the basis for determining recovery status was not optimally carried out.

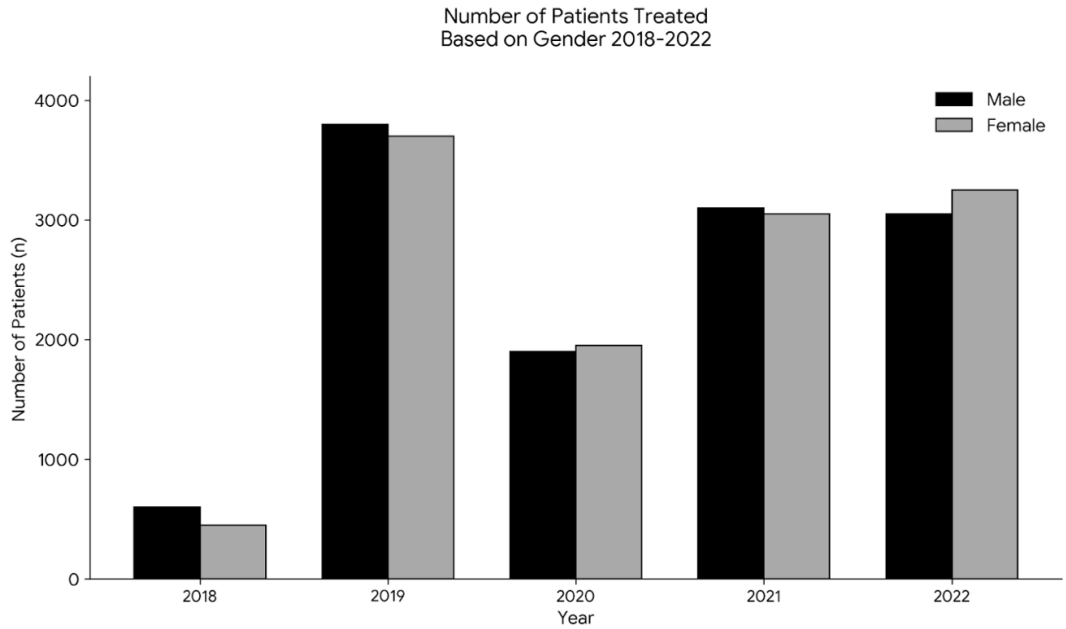

Figure 1. Number of Patients Treated by Gender, 2018-2022

Based on Figure 1, the number of sputum-positive pulmonary TB patients treated shows a fluctuating pattern, with the highest peak in 2019 and the lowest in 2018. Male patients tended to outnumber female patients in almost all observation periods, except in 2022.

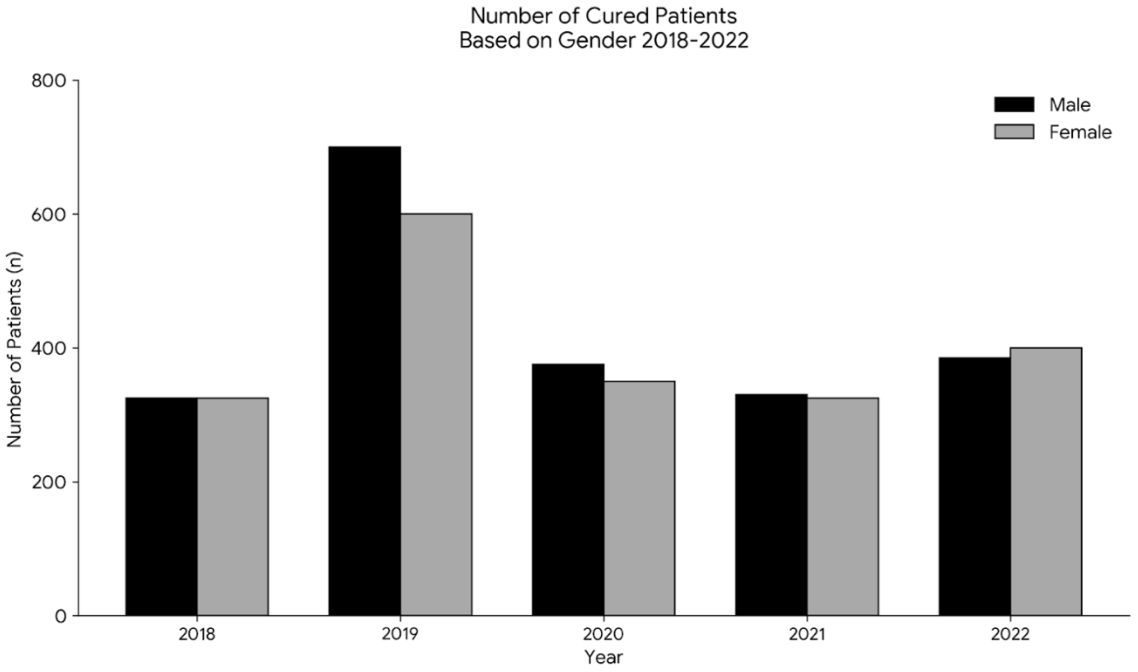

Figure 2. Number of Cured Patients by Gender, 2018-2022

Figure 2 shows the trend of recovered patients, which is also fluctuating, with a peak in 2019. The distribution of recovered patients between males and females is relatively balanced each year and shows no significant differences except in 2019.

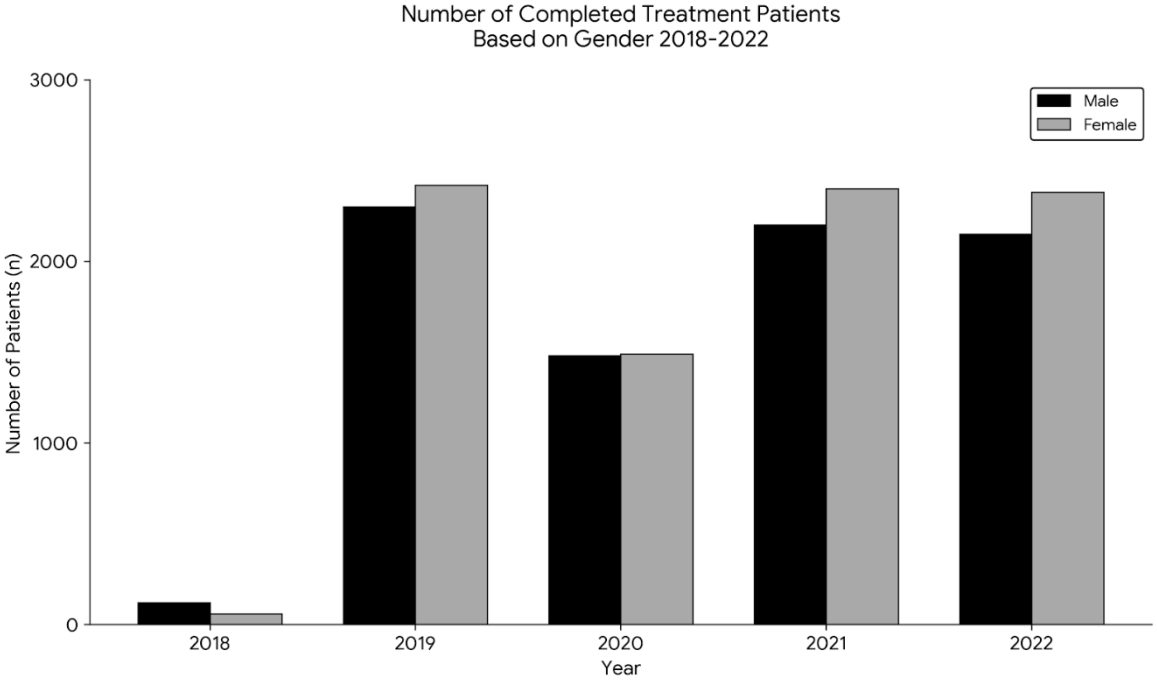

Figure 3. Number of Completed Treatment Patients by Gender, 2018-2022

Meanwhile, Figure 3 shows the number of BTA-positive pulmonary TB patients with high and nearly equal completion rates in 2019, 2021, and 2022. In those years, female patients tended to have higher completion rates than male patients.

Tabel 3. Comparison of Treatment Success Rates in BTA-Positive Pulmonary TB Patients in Bandung City

Period	Year	Treatment Success Rate (%)	Mean (%)	P-Value
Before COVID-19	2018	79,80	80,11	0,20
	2019	80,41		
After COVID-19	2020	96,23	88,55	
	2021	85,38		
	2022	84,04		

A comparison of overall treatment success rates is presented in Table 3, which shows that although the average success rate after the pandemic (88.55%) was higher than before the pandemic (80.11%), statistical tests showed no significant difference ($p = 0.20$). This finding is in line with the WHO (2021) report, which shows that the pandemic caused a global decline in TB treatment success, as well as the results of studies by Abdulkader et al. (2019) and Cardoso et al. (2017), which confirm that treatment success is highly sensitive to the stability of the service system. When service functions are disrupted, compliance decreases and the number of patients who discontinue treatment increases.[13], [14], [15]

Research results from the pre-COVID-19 period show that there are differences in patterns between cured patients and those who completed treatment, while the number of pulmonary TB patients treated increased sharply and peaked in 2019. This condition may illustrate two possibilities, namely an increase in TB cases found in the community or improvements in the case reporting and notification system at health facilities. This is in line with the literature which states that the increase in case notification rates before the pandemic was influenced by the expansion of testing coverage and the strengthening of contact tracing.[16]

In the post-COVID-19 period, the number of TB patients treated declined in 2020 as a result of the disruption of health services during the pandemic. This finding is in line with the 2023 global report, which states that the pandemic caused a decline in patient visits, limited access to health facilities, and the repurposing of diagnostic tools such as GeneXpert for SARS-CoV-2 testing. After 2020, the number of pulmonary TB patients treated increased again each year but remained lower than before the pandemic. The number of patients who completed treatment far outweighed those who were cured. The high number of patients who completed treatment, which was 4–7 times greater than those who were cured in the post-pandemic period, was most likely due to limited final bacteriological examinations, meaning that routine BTA negative verification could not be carried out. This condition does not necessarily reflect a clinical decline, but rather indicates that laboratory results documentation was not optimal during the recovery of health services. International literature, including reports from The Lancet Global Health, confirms that the pandemic caused a decline in follow-up examinations, so that many patients who should have met the criteria for "recovery" could only be classified as "completed treatment." National studies have also found similar patterns, especially in areas affected by mobility restrictions and laboratory staff shortages.[17]

The results showed that there was no statistically significant difference in the average treatment success rate of pulmonary TB patients between the periods before and after the COVID-19 pandemic at the Bandung City Regional Health Center ($p = 0.20$). However, the treatment success rate in both periods still did not reach the minimum target of 90%. This finding is in line with the results of a multinational study in 49 high-burden TB countries published in BMC Medicine in 2024, which reported that the pandemic did not significantly reduce the treatment success rate despite disruptions to health services.[18] Additionally, the dominance of complete treatment status compared to cured patients in almost all periods indicates limitations in bacteriological confirmation of cure. This condition is also reflected in national data from 2022–2023 and in Riau Province, where the treatment success rate increased but the cure rate decreased, indicating ongoing challenges in the monitoring and evaluation system.

D. Conlusion

This study concludes that variations in the Treatment Success Rate (TSR) for pulmonary tuberculosis in Bandung City were observed before and after the COVID-19 pandemic. The average TSR increased from 80.1% in the pre-pandemic period to 88.55% in the post-pandemic period; however, this difference was not statistically significant. The TSR value obtained was also still below the WHO target of ≥90%.

Although there was an overall increase in TSR, the low proportion of bacteriologically confirmed cured cases indicates that TB control programs need to be strengthened, particularly in follow-up sputum examinations, monitoring of treatment adherence, and optimization of TB services at primary health facilities.

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References

[1] World Health Organization, *Global Tuberculosis Report 2023*. World Health Organization, 2023.

[2] World Health Organization, "Global Tuberculosis Report 2024," Nov. 2024.

[3] N. Maria, H. Wilda Risni, and K. Citra Dewi Permata Sari, "Dampak Pandemi COVID-19 Terhadap Keberhasilan Pengobatan Tuberkulosis: Scoping Review," 2023, doi: 10.20956/mff.SpecialIssue.

[4] I. Mbithi *et al.*, "Assessing the real-time impact of covid-19 on tb and hiv services: The experience and response from selected health facilities in nairobi, kenya," *Trop. Med. Infect. Dis.*, vol. 6, Jun. 2021, doi: 10.3390/tropicalmed6020074.

[5] I. Rodrigues, A. Aguiar, G. B. Migliori, and R. Duarte, "Impact of the COVID-19 pandemic on tuberculosis services," *Pulmonology*, vol. 28, pp. 210–219, May 2022, doi: 10.1016/j.pulmoe.2022.01.015.

[6] Kementrian Kesehatan RI, "Strategi Nasional Penanggulangan Tuberkulosis di Indonesia 2020-2024," 2020.

[7] WHO, "End TB Strategy: Global Strategy and Targets for Tuberculosis Prevention, Care and Control after 2015," 2016. [Online]. Available: http://www.who.int/tb

[8] K. Lönnroth and M. Raviglione, "The WHO's new end tb strategy in the post-2015 era of the sustainable development goals," Oct. 2015, *Oxford University Press*. doi: 10.1093/trstmh/trv108.

[9] Hamdin, A. Hamid, and Cahyadin, "Adaptasi Tata Laksana Tuberkulosis Selama Pandemi Covid-19 di Kabupaten Bima," vol. 7, no. 1, 2023.

[10] N. R. A. Zulfa and N. A. Prihartono, "Karakteristik Pasien Tuberkulosis di Kota Bandung Tahun 2021," *Jurnal Integrasi Kesehatan & Sains*, vol. 5, no. 2, pp. 155–158, Jul. 2023, doi: 10.29313/jiks.v5i2.11804.

[11] T. N. Arifah, "Gambaran Kualitas Hidup Pada Pasien Tuberkulosis Paru Di Puskesmas Padasuka Kecamatan Cibeunying Kidul Kota Bandung," 2015.

[12] Y. Triyani, S. Achmad, R. Retno Ekowati, and B. Patologi Klinik Fakultas Kedokteran Universitas Islam Bandung, "Pendampingan Kader Posyandu pada Pelaksanaan Program Investigasi Kontak Erat Pasien Tuberkulosis Paru di Wilayah Kerja Puskesmas Margahayu Raya Kota Bandung 2 3 1*," 2024.

[13] WHO, *Global Tuberculosis Report 2021*. World Health Organization, 2021.

[14] M. Abdulkader, I. Van Aken, S. Niguse, H. Hailekiros, and M. Spigt, "Treatment outcomes and their trend among tuberculosis patients treated at peripheral health settings of Northern Ethiopia between 2009 and 2014: A registry-based retrospective analysis," *BMC Res. Notes*, vol. 12, no. 1, Dec. 2019, doi: 10.1186/s13104-019-4824-9.

[15] M. A. Cardoso, P. E. A. A. D. Brasil, C. A. S. Schmaltz, F. M. Sant'Anna, and V. C. Rolla, "Tuberculosis Treatment Outcomes and Factors Associated with Each of Them in a Cohort Followed Up between 2010 and 2014," *Biomed Res. Int.*, vol. 2017, 2017, doi: 10.1155/2017/3974651.

[16] B. Utomo *et al.*, "DOES COVID-19 PANDEMIC AFFECT THE ELIMINATION OF TUBERCULOSIS? LESSONS LEARNED FROM INDONESIA," *Afr. J. Infect. Dis.*, vol. 19, no. 2, pp. 1–7, Apr. 2025, doi: 10.21010/AJIDV19I2.1.

[17] H. Surendra *et al.*, "Impact of the COVID-19 pandemic on tuberculosis control in Indonesia: a nationwide longitudinal analysis of programme data," 2023. [Online]. Available: https://data.

[18] V. Gunsaru, M. Y. R. Henrion, and C. F. McQuaid, "The impact of the COVID-19 pandemic on tuberculosis treatment outcomes in 49 high burden countries," *BMC Medicine 2024 22:1*, vol. 22, no. 1, pp. 312-, Jul. 2024, doi: 10.1186/S12916-024-03532-7.

[19] Aini Agnia and Heni Muflihah, "Tingkat Kepatuhan Pengobatan Pasien Fase Intensif Berdasarkan Karakteristik Pasien TB di Puskesmas Rancasalak," *Jurnal Riset Kedokteran*, pp. 57–60, Jul. 2022, doi: 10.29313/jrk.vi.890.

[20] Clarisa Alfatihah Erman, Heni Muflihah, and Ismawati, "Studi Literatur: Peran Status Gizi pada Hasil Akhir Pengobatan Tuberkulosis Paru Anak," *Jurnal Riset Kedokteran*, vol. 4, no. 1, pp. 51–58, Jul. 2024, doi: 10.29313/jrk.v4i1.4398.