

# Analysis of determinants of adherence to anti-tuberculosis drugs in tb patients during covid-19 at the public health center of Aceh Besar Regency

Amiruddin<sup>1</sup>, Fahmi Ichwansyah<sup>2</sup>, Hermansyah<sup>3</sup>, Maidar<sup>4</sup>, Asnawi Abdullah<sup>5</sup>

<sup>1</sup>Student of Master's Program in Public Health, Postgraduate Universitas Muhammadiyah Aceh, Indonesia

<sup>2</sup>Health Research and Development Institute, Aceh, Ministry of Health, Indonesia

<sup>3</sup>Department of Nursing, Politeknik Kesehatan Kemenkes Aceh, Indonesia

<sup>4,5</sup>Lecturer in the Master's Program in Public Health, Postgraduate Universitas Muhammadiyah Aceh, Indonesia

## ARTICLE INFO

### Article history:

Received Feb 29, 2024

Revised Mar 8, 2024

Accepted Mar 25, 2024

### Keywords:

Compliance  
Covid19  
Taking Medicines  
Tuberculosis

## ABSTRACT

The Covid-19 pandemic has had a significant impact on TB patients, particularly in terms of treatment and drug monitoring. During the pandemic in 2020, there were 350 cases of TB in Aceh Besar District. This study aimed to assess the compliance of TB patients during the Covid-19 period at the Aceh Besar District Health Center. A cross-sectional study design was employed, and data were collected from 118 TB patients from April to October 2020. The research was conducted in April 2022. Questionnaires were used for data collection, and bivariate and multivariate analyses were performed using the STATA 12 application program. The results of the multivariate analysis revealed that several risk factors, including Covid-19, history of illness, sources of information, age, knowledge, and trips to the health center, were associated with non-compliance in taking OAT medications. Efforts to increase awareness and educate the public about the risk factors of TB should continue, even during the Covid-19 pandemic. Building partnerships with former TB patients who have completed treatment and recovered can also help in promoting adherence to OAT medications among current TB patients.

This is an open access article under the [CC BY-NC](https://creativecommons.org/licenses/by-nc/4.0/) license.



## Corresponding Author:

Amiruddin,

Student of Master's Program in Public Health,  
Postgraduate Universitas Muhammadiyah Aceh,

Jl. Muhammadiyah No.91, Batoh, Kec. Lueng Bata, Kota Banda Aceh, Aceh 23123, Indonesia

Email: [amirp2pme@gmail.com](mailto:amirp2pme@gmail.com)

## INTRODUCTION

Tuberculosis remains a major global public health issue, particularly in low- and middle-income countries (*Tuberculosis*, n.d.). According to the World Health Organization (*Global Tuberculosis Report 2022*, n.d.), the estimated number of people diagnosed with tuberculosis globally in 2021 was approximately 10.6 million cases, showing an increase of around 600,000 cases from the 2020 estimate of 10 million TB cases (Chakaya et al., 2021; Cilloni et al., 2020a). Out of the 10.6 million

cases, 6.4 million individuals (60.3%) have been reported and are undergoing treatment, while 4.2 million (39.7%) have not been reported or have not received adequate treatment. According to the Global TB Report 2022, Indonesia experienced a 17% increase in TB cases from 2020, with the total number of cases reaching 969,000 in 2022 (Agyeman & Ofori-Asenso, 2017; MacNeil et al., 2019). Several factors contributing to the increase in TB cases in Indonesia include low public awareness of the importance of TB prevention and treatment, limited access to healthcare services, and risk factors such as smoking, malnutrition, and HIV infection. Additionally, the COVID-19 pandemic has also impacted the rise in TB cases in Indonesia due to delays in TB diagnosis and treatment caused by the focus on addressing COVID-19 (Fukunaga et al., 2021; Glaziou, 2021). The Indonesian government has established four national strategies to control tuberculosis in the country: raising public awareness about TB, improving access to healthcare services, enhancing the quality of healthcare services, and developing a TB vaccine (Sanyaolu, 2019). The province of Aceh has experienced an increasing incidence of tuberculosis (TB) in Indonesia. Based on data collected from 2017 to 2019, the number of TB cases in the Aceh Province has risen each year. In 2021, there were 7,170 TB cases in Aceh, marking an increase from the previous year's 6,878 cases in 2020. This indicates a rise in TB-related deaths in 2021, reaching 276 cases or 5 per 100,000 population.

The government of Aceh has implemented various programs to address the TB issue in the province, including strengthening national TB eradication programs, improving access to TB services, optimizing efforts in TB promotion and prevention, TB treatment, infection control, and utilizing research and technology findings. According to data from the Aceh Besar District Health Office, in the last three years, there has been an increase in TB cases, with 260 pulmonary TB cases reported in 2017, 483 cases in 2018, 408 cases in 2019, and 350 cases in 2020. While several studies have assessed the relationship between biological factors and TB transmission, the understanding of the connection between TB transmission and social and economic factors remains incomplete (Fitria et al., 2017; Ima Afifa Himayati, 2023). The adherence to taking Anti-Tuberculosis Drugs (OAT) among TB patients during COVID-19 at community health center Aceh is influenced by various factors. Patient knowledge and attitudes toward TB treatment have been identified as factors affecting adherence to OAT (13)-(15). Additionally, the presence of a drug supervisor and treatment barriers also play a role in determining adherence (Cilloni et al., 2020b). In other studies, factors such as age, gender, and distance of residence have been found to be related to adherence to the use of Anti-Tuberculosis Drugs (OAT) in patients with pulmonary tuberculosis (Fitri, 2018; Rusman & K, 2019). In tuberculosis (TB) research, biological factors such as individual immune response and the characteristics of the TB-causing microbe have been the primary focus. However, understanding the relationship between TB transmission and social and economic factors has also become increasingly important.

Several previous studies have investigated the link between social and economic factors and TB transmission. Factors such as income level, educational attainment, population density, housing conditions, access to healthcare, migration, and social status have been examined in the context of TB transmission. However, the significance and findings of these studies may vary depending on the population under study, geographical context, and research methodology employed. Several relevant studies have shown that forgetfulness, undergoing advanced chemotherapy, experiencing TB symptoms during the interview, and HIV co-infection are significantly associated with non-adherence to anti-tuberculosis (TB) therapy (Adane et al., 2013). These findings have implications for improving TB management by designing more effective interventions, such as strong reminders and integrated approaches. Health policies supporting the integration of TB and HIV services are also necessary. Increasing public awareness of the importance of adherence to TB therapy can help reduce stigma and enhance social support for patients (Bagchi et al., 2010; Gebremariam et al., 2021).

Factors such as stigma, discrimination, and transportation disruptions due to COVID-19 prevention guidelines have contributed negatively to poor adherence (Amran et al., 2021;

Wulandari et al., 2018). The COVID-19 pandemic has had adverse effects on TB patients, increasing psychological stress and non-adherence to treatment. Efforts to prevent and control TB in Aceh Besar need to be strengthened, especially by identifying factors influencing adherence to taking Anti-Tuberculosis Drugs (OAT) among TB patients during the COVID-19 pandemic. Low adherence levels can pose the risk of wider TB spread, adversely affecting public health overall. Moreover, the presence of the COVID-19 pandemic adds uncertainty regarding the interaction between the two diseases, emphasizing the need for adherence to maintain the immune system of patients. In this context, analysis becomes essential to understand the Determinants of Adherence to OAT among TB Patients during COVID-19 at Community Health Center Aceh Besar regency.

## RESEARCH METHOD

The research design used in this study is a Cross-sectional study. A Cross-sectional study is an observational analytical epidemiological study that examines where the collection of data on independent and dependent variables is done at a single point in time with the entire population of respondents. The study was conducted at 28 Community health center (Puskesmas) in Aceh Besar Regency, Aceh Province, covering an area of 2,969 km<sup>2</sup>, consisting of 23 sub-districts, 604 villages, with a population of 409,000 people according to data (BPS, 2020). The study focused on the 28 Puskesmas locations, which are considered cases of Tuberculosis (TB), and was conducted in April 2021. The sample for this study consists of the entire population of positive Tuberculosis (TB) cases confirmed by Acid-Fast Bacilli (AFB) examination. Samples were taken from patients who had been evaluated during the 6-month treatment period, from April to October 2020, in the 28 Puskesmas in Aceh Besar Regency, totaling 118 patients. The sample selection criteria involved TB patients identified as AFB (+), receiving treatment services, within the scope of Community health center in Aceh Besar Regency, and officially registered at the Community health center. Data analysis in this study involved several important stages. The data collection preparation stage included obtaining research permits from the Master's Program of Muhammadiyah Aceh University and obtaining permission from the Health Office of Aceh Besar to conduct research at Community health center in the Aceh Besar Regency. Subsequently, the data collection stage was carried out with steps such as obtaining permission from the Community health center Head, obtaining approval and willingness of respondents to participate, filling out questionnaires, and conducting interviews according to structured questions.

As part of the data analysis stage, validity testing was conducted using the Pearson product-moment correlation technique. Logical validity of the instrument was measured based on reasoning and rationalization. Before the study began, validity and reliability tests were conducted in Banda Aceh City. The validity test involved 28 respondents and used the Pearson product-moment correlation technique by comparing the calculated *r*-value with the tabled *r*-value. The result showed that the product-moment correlation *r*-value at a significance level of 5% was 0.317. Furthermore, instrument reliability was measured using version 21. This stage confirmed the accuracy and reliability of the research instrument before further data analysis.

Data processing involved steps such as editing to ensure data completeness, coding to transform data into numerical values, data entry by inputting response results into a computer program, and cleaning to remove data with questionable information. Research ethics, including consent forms and anonymous policies, were applied to protect informant confidentiality and ensure the integrity of research results. Data analysis was divided into three stages: univariate analysis to detail the characteristics of variables, bivariate analysis to test the relationship between variables, and multivariate analysis with multiple logistic regression to investigate complex relationships. Through univariate analysis, an in-depth understanding of the distribution and patterns of variables related to medication adherence (OAT) in Tuberculosis (TB) patients during the COVID-19 pandemic at Community health center in Aceh Besar Regency was obtained. Bivariate analysis contributed to understanding the factors influencing adherence, while

multivariate analysis investigated complex relationships between variables, in line with the research objective to enhance understanding and management of TB in the region.

## RESULTS AND DISCUSSIONS

### Overview of the Research Location

Geographically, Aceh Besar Regency is located between 5° 2' - 5° 8' North Latitude and 95° 80' - 95° 88' East Longitude. With a land area of 2,969.00 km<sup>2</sup>, it encompasses 23 sub-districts and 604 villages, with a population of 409,000 people based on data from the Central Bureau of Statistics (BPS, 2020). The land area of Aceh Besar borders Banda Aceh City to the north, Aceh Jaya Regency to the southwest, and Pidie Regency to the south and southeast. Aceh Besar also includes island territories, namely in the Pulo Aceh sub-district. The island territories of Aceh Besar in the west, east, and north are bounded by the Indonesian Ocean, the Malacca Strait, and the Bengal Bay, which separates it from Weh Island, where the city of Sabang is located. The main islands include Breueh Island and Nasi Island.

### Univariate Analysis

**Table 1.** Frequency distribution of respondent characteristics

	Category	n	%
Family Income	> Regional Minimum Wage (UMR)	52	44,1
	< Regional Minimum Wage (UMR)	66	55,9
Number of Family Members	1-4	77	65,2
	> 4	41	34,7
Education	Higher Education	7	5,9
	High School (SMA)	47	39,8
	Junior High School (SMP)	43	36,4
	Elementary School (SD)	21	17,8
Occupation	Formal Employment	12	10,2
	Non-Formal Employment	70	59,2
	Unemployed	36	30,5

Based on the table above, it shows that respondents with income below the Regional Minimum Wage (UMR) are 55.9%, respondents with more than 4 family members are 34.7%, respondents with only elementary school education are 17.8%, and unemployed respondents are 30.5%.

**Table 2.** Frequency distribution of determinants of tb patient adherence

Compliance of TB Patients		Frequency	Percentage
0	Compliant	80	67,8
1	Non-compliant	38	32,2
Age			
0	Adolescent	14	11,8
1	Adult	35	29,6
2	Elderly	59	50,0
3	Senior	10	8,4
Travel to the Health Center			
0	< 5 km	26	22,1
1	> 5 Km	92	77,9
Knowledge			
0	High	77	65,2
1	Low	41	34,7
Attitude			
0	Good	39	33,1
1	Less Good	79	66,9
Information Source:			
0	Adequate	71	60,2

Compliance of TB Patients		Frequency	Percentage
1	Inadequate	47	39,8
Medical History			
0	No History	87	73,7
1	History	31	26,3
income			
0	> Regional Minimum Wage (UMR)	52	44,1
1	< Regional Minimum Wage (UMR)	66	55,9
Family Support:			
0	Available	45	38,1
1	Insufficient	73	61,8
Covid-19			
0	Negatif	99	83,90
1	Positif	19	16,1
Total		118	100

Based on the table above, the univariate results explain that adherent respondents have a larger percentage compared to non-adherent ones, amounting to 67.8%. The respondents who are elderly constitute 50% of the total. Respondents with a distance from home to the health center > 5 km make up 77.9%. Those with less knowledge about TB account for 34.7%. Respondents with a less favorable attitude have a higher percentage, specifically 66.9%. Those who lack information about TB make up 39.8%. Respondents with a positive medical history have a larger percentage of 26.3%. Individuals with an income below the Minimum Wage (UMR) in Aceh account for 55.9%. Respondents with insufficient family support have a higher proportion, specifically 61.8%. The proportion of respondents confirmed positive for COVID-19 is 16.1%.

**Table 3.** Relationship of determinants to TB patient compliance

Factors Influencing	Medication Adherence				Total	OR	CI 95%	P.value
	compliant		Non-compliant					
	n	%	n	%				
Age								
Adolescent	9	64,3	5	35,7	14			
Adult	30	85,7	5	14,3	35	0,3	0,070-1,274	0,102
Elderly	37	62,7	22	37,3	59	1,07	0,317-3,603	0,913
Senior	4	40	6	60	10	2,7	0,507-14,37	0,244
Family suport								
Available	29	64,4	16	35,5	45			
Insufficient	51	69,8	22	30,1	73	0,78	0,355-1,720	0,54
Income								
> Regional Minimum Wage (UMR)	33	63,5	19	36,5	52			
< Regional Minimum Wage (UMR)	47	71,2	19	28,8	66	0,70	0,32-1,525	0,37
Travel to the Health Center								
< 5Km	22	84,6	4	15,4	26			
> 5Km	58	63,0	34	36,9	92	3,22	1,02-10,145	0,045

Based on the analysis results presented in the table above, it can be concluded that there is no significant relationship between age and adherence to Anti-Tuberculosis Drugs (ATD), as the P-value for age is > 0.05. However, interestingly, the Odds Ratio (OR) values indicate that TB patients in the elderly category have higher drug adherence (OR; 2.7 CI 0.50-14.37), suggesting that elderly TB patients are almost 3 times more adherent than adult TB patients. Furthermore, the factor of family support also does not show a significant relationship with drug adherence, as reflected by the P-value of 0.54. The analysis results indicate that respondents who lack family support have an Odds Ratio of 0.78 or nearly 1 time (95% CI: 0.35-1.72) to be non-adherent compared to patients receiving family support. Meanwhile, the income factor also does not have a significant relationship with drug adherence, with a P-value of 0.37. However, the analysis results show a

relationship between the distance to the health center and drug adherence, where respondents with a distance from home to the health center of more than 5 kilometers have an Odds Ratio of 3.2 (95% CI: 1.02-10.14). This indicates that respondents with a longer distance to the health center have a higher chance of non-adherence to ATD compared to respondents whose distance to the health center is less than 5 kilometers.

The knowledge factor shows a significant relationship with drug adherence, with a P-value of 0.002. Respondents with knowledge have an Odds Ratio of 3.7 (95% CI: 1.63-8.37), meaning respondents with less knowledge are almost 4 times more likely to be non-adherent to ATD compared to respondents with high knowledge. Meanwhile, attitude, source of information, history of illness, and COVID-19 status do not show a significant relationship with drug adherence, with P-values of 0.28, 0.12, 0.002, and 0.012, respectively. Although not statistically significant, there is a tendency that respondents with a less favorable attitude, less knowledge, a history of illness, and positive COVID-19 status are more likely to be non-adherent to ATD. Therefore, to improve adherence to ATD, special attention to these factors is needed in designing effective interventions.

### Multivariate Analysis

**Table 4.** Risk factors related to TB patient adherence multivariate analysis with logistic regression test

No.	Adherence to Medication	OR	P-Value	CI (95%)	
				Lower	Upper
1	Covid19	3,80	0,039	1.07	13.49
2	Medical History	5,71	0,003	1.84	17.72
3	Information Source	1.85	0.22	0.68	4.99
4	Age	1.89	0,06	0.96	3.37
5	Knowledge	4.17	0,006	1.49	11,62
6	Travel to Health Center	7.07	0,014	1.48	33.71
7	Income	0.25	0,014	0.08	0.760

Source: (Primary Data - processed in 2021)

The data analysis results reveal several significant findings related to factors influencing medication adherence (OAT) among tuberculosis (TB) patients during the COVID-19 pandemic. Firstly, the variable Covid19 has an Odds Ratio (OR) of 3.80 with a p-value of 0.039, indicating a significant association between being positive for Covid19 and lower adherence to OAT. Similarly, the variable Medical History has an OR of 5.71 with a p-value of 0.003, suggesting that patients with a medical history tend to have higher adherence. However, the variable Information Source does not show a significant relationship with adherence (p-value 0.22), and neither does the Age variable, which approaches significance (p-value 0.06). Furthermore, the Knowledge variable has an OR of 4.17 with a p-value of 0.006, signifying that good knowledge is associated with higher adherence. The Travel to Health Center variable has an OR of 7.07 with a p-value of 0.014, indicating that respondents residing more than 5 km from the health center tend to have lower adherence. Meanwhile, the Income variable shows a significant relationship with an OR of 0.25 and a p-value of 0.014, suggesting that respondents with income below the Minimum Wage tend to have lower adherence.

This study provides a comprehensive and consistent overview of the factors influencing the adherence to tuberculosis (TB) medication during the COVID-19 pandemic in the Primary Health Centers (Puskesmas) of Aceh Besar Regency. The data analysis reveals a significant positive association between adherence to TB medication and two key variables, namely Covid19 and Medical History. TB patients infected with Covid-19 or with a specific medical history tend to exhibit higher levels of adherence, with respective Odds Ratios (OR) of 3.80 (p-value 0.039) and 5.71 (p-value 0.003), highlighting the complex interaction between infectious diseases and adherence to TB treatment. In the context of the COVID-19 pandemic, TB patient management protocols should take precedence, emphasizing the importance of strengthening Medication

Management Programs (MMP) to ensure patients receive medications according to the prescribed schedule (22) Furthermore, the Knowledge variable also plays a crucial role by demonstrating a significant influence on adherence (OR 4.17, p-value 0.006).

This emphasizes that a good understanding of TB treatment can be key to improving patient adherence, indicating the need for emphasis on community-level education and awareness efforts. Additionally, findings related to Travel to Health Centers (OR 7.07, p-value 0.014) and Income (OR 0.25, p-value 0.014) provide important insights into accessibility and economic challenges faced by TB patients. Long travel distances and weak economic conditions can be significant barriers to achieving optimal adherence levels, highlighting the need for improved accessibility and economic support for TB patients. Although the variables Information Source and Age did not show a statistically significant relationship, the p-values close to significance (Information Source: 0.22; Age: 0.06) provide grounds for further research to better understand the impact of these variables on TB patient adherence levels. Several studies have also identified factors influencing the adherence to tuberculosis (TB) treatment during the COVID-19 pandemic at Health Centers, including age, education level, employment status, marital status, residential location, income level, the role of healthcare professionals, and support from Treatment Supervisors (MMP)(Alipanah et al., 2018). The results of multiple logistic regression analysis indicate that the education level is a dominant factor influencing adherence, with respondents having a secondary education level showing a higher tendency for good adherence. The COVID-19 pandemic has had adverse effects on TB patients, increasing psychological stress and non-adherence to treatment [Click or tap here to enter text..](#) Directly Observed Therapy (DOT) has been commonly used for monitoring TB treatment, but the pandemic has led to an increased utilization of Video-dot (vDOT), which has been found to be more effective in verifying treatment adherence(Aderita et al., 2016). Factors influencing adherence also include stigma, discrimination, and transportation disruptions as COVID-19 preventive measures. Good knowledge about TB and strong family support contribute positively to adherence in taking Anti-Tuberculosis Drugs (OAT) (Amran et al., 2021; Widyasrini et al., 2017). These findings align with the results of this study, indicating the significance of the Knowledge variable and reinforcing the perspective that a good understanding of the disease can enhance patient adherence. Additionally, research in urban areas of Indonesia emphasizes the importance of socioeconomic factors, including income, in understanding TB patient adherence(Fitri, 2018; Manurung & Manurung, 2023). The findings related to Income in this study align with the mentioned research, emphasizing the importance of considering economic aspects in designing effective intervention strategies. Additionally, the results of this study also note a significant impact of Covid-19 on the adherence of TB patients. This is consistent with research findings stating the impact of the Covid-19 pandemic on health services and observing a decrease in adherence to TB medication during the pandemic period(Hayati et al., 2022).

The future discussion on adherence to anti-tuberculosis medication (OAT) among TB patients at the Health Centers of Aceh Besar Regency during the COVID-19 pandemic requires a holistic approach that considers several key factors. Studies can further explore the influence of sociodemographic determinants such as age, employment status, and marital status on patient adherence while investigating the pandemic's impact on the psychological aspects of TB patients and efforts to prevent stress. In-depth analysis regarding the level of education is needed to understand how patients' understanding of OAT can be enhanced through education initiatives tailored to their literacy levels. Environmental factors, accessibility, and the utilization of technology such as video Directly Observed Therapy (vDOT) need further exploration to develop solutions that can be effectively applied in the Health Centers context. Research should also pay special attention to the role of healthcare professionals, including Treatment Supervisors (MMP), in providing relevant support and ensuring the continuity of TB patient care. By investigating all

these aspects, the aim is to establish a solid foundation for the development of more effective and focused intervention strategies to enhance TB patient adherence in the future.

## CONCLUSION

There are tuberculosis (TB) patients who are absent or drop out from TB treatment at the Community health center (Puskesmas) in Aceh Besar Regency. A total of 38 TB patients are non-adherent to medication, indicating that the adherence rate to TB treatment at the health center has not reached 100%. Factors influencing adherence to Anti-Tuberculosis Drugs (OAT) among TB patients during the COVID-19 pandemic in Aceh Besar Regency show both significant and non-significant relationships between dependent and independent variables. The percentage of respondents who were non-adherent to OAT during COVID-19 reached 32.2%. Determinant analysis that has a significant relationship with adherence to OAT among TB patients involves variables such as travel to the health center, knowledge, medical history, and COVID-19. Meanwhile, age, family support, income, attitude, and information source do not show a significant relationship with adherence to OAT. Determinant analysis of risk factors indicates that COVID-19, medical history, knowledge, travel to the health center, and income have a P-value < 0.05, signifying a significant relationship. The most risky factor for adherence to OAT is the distance from home to the health center, with an Odds Ratio of 7.07, meaning that respondents with a distance > 5 km are 7.07 times more likely to be non-adherent to OAT. The research findings contribute to scientific knowledge by identifying factors that influence adherence to TB treatment at Community Health Centers in Aceh Besar Regency during the COVID-19 pandemic. The study highlights the significance of variables such as travel to the health center, knowledge, medical history, and COVID-19 in determining adherence to anti-TB drugs. The research has implications for healthcare improvement, public health awareness, and policy development, aiming to enhance TB treatment adherence and improve health outcomes for TB patients.

## References

- 4 *Strategi Pemerintah Kendalikan TB di Indonesia*. (n.d.). Retrieved December 15, 2023, from <https://www.kemkes.go.id/id/rilis-kesehatan/4-strategi-pemerintah-kendalikan-tb-di-indonesia>
- Adane, A. A., Alene, K. A., Koye, D. N., & Zeleke, B. M. (2013). Non-Adherence to Anti-Tuberculosis Treatment and Determinant Factors among Patients with Tuberculosis in Northwest Ethiopia. *PLOS ONE*, 8(11), e78791. <https://doi.org/10.1371/JOURNAL.PONE.0078791>
- Aderita, N. I., Murti, B., & Suryani, N. (2016). Risk Factors Affecting Multi-Drug Resistant Tuberculosis in Surakarta and Ngawi, Indonesia. *Journal of Epidemiology and Public Health*, 1(2), 86-99. <https://doi.org/10.26911/JEPUBLICHEALTH.2016.01.02.02>
- Agyeman, A. A., & Ofori-Asenso, R. (2017). Tuberculosis – an overview. *Journal of Public Health and Emergency*, 1, 7-7. <https://doi.org/10.21037/JPHE.2016.12.08>
- Alipanah, N., Jarlsberg, L., Miller, C., Linh, N. N., Falzon, D., Jaramillo, E., & Nahid, P. (2018). Adherence interventions and outcomes of tuberculosis treatment: A systematic review and meta-analysis of trials and observational studies. *PLoS Medicine*, 15(7). <https://doi.org/10.1371/JOURNAL.PMED.1002595>
- Amran, R., Abdulkadir, W., Farmasi, J., Olahraga dan Kesehatan, F., & Amwan Jurusan Farmasi Fakultas Olahraga dan Kesehatan, R. (2021). Tingkat Kepatuhan Penggunaan Obat Anti Tuberkulosis Pada Pasien Di Puskesmas Tombulilato Kabupaten Bone Bolango. *Indonesian Journal of Pharmaceutical Education*, 1(1), 57-66. <https://doi.org/10.37311/IJPE.V1I1.10123>
- Bagchi, S., Ambe, G., & Sathiakumar, N. (2010). Determinants of Poor Adherence to Anti-Tuberculosis Treatment in Mumbai, India. *International Journal of Preventive Medicine*, 1(4), 223. <https://doi.org/10.1007/s12019-010-0107-7>
- Chakaya, J., Khan, M., Ntoumi, F., Aklillu, E., Fatima, R., Mwaba, P., Kapata, N., Mfinanga, S., Hasnain, S. E., Katoto, P. D. M. C., Bulabula, A. N. H., Sam-Agudu, N. A., Nachega, J. B., Tiberi, S., McHugh, T. D., Abubakar, I., & Zumla, A. (2021). Global Tuberculosis Report 2020 - Reflections on the Global TB burden, treatment and prevention efforts. *International Journal of Infectious Diseases*, 113, S7-S12. <https://doi.org/10.1016/j.ijid.2021.02.107>

- Cilloni, L., Fu, H., Vesga, J. F., Dowdy, D., Pretorius, C., Ahmedov, S., Nair, S. A., Mosneaga, A., Masini, E., Sahu, S., & Arinaminpathy, N. (2020a). The potential impact of the COVID-19 pandemic on the tuberculosis epidemic a modelling analysis. *EClinicalMedicine*, 28, 100603. <https://doi.org/10.1016/j.eclinm.2020.100603>
- Cilloni, L., Fu, H., Vesga, J. F., Dowdy, D., Pretorius, C., Ahmedov, S., Nair, S. A., Mosneaga, A., Masini, E., Sahu, S., & Arinaminpathy, N. (2020b). The potential impact of the COVID-19 pandemic on the tuberculosis epidemic a modelling analysis. *EClinicalMedicine*, 28, 100603. <https://doi.org/10.1016/j.eclinm.2020.100603>
- Erawatyingsih, E., Subekti, H., Kesehatan Kabupaten Dompu, D., Tenggara Barat, N., Studi Ilmu Keperawatan, P., & Ugm, F. (2009). FAKTOR-FAKTOR YANG MEMPENGARUHI KETIDAKPATUHAN BEROBAT PADA PENDERITA TUBERKULOSIS PARU FACTORS AFFECTING INCOMPLIANCE WITH MEDICATION AMONG LUNG TUBERCULOSIS PATIENTS. *Berita Kedokteran Masyarakat*, 25(3).
- Fitri, L. D. (2018). Kepatuhan Minum Obat pada Pasien Tuberkulosis Paru. *Jurnal Ilmu Kesehatan Masyarakat*, 7(01), 33-42. <https://doi.org/10.33221/JIKM.V7I01.50>
- Fitria, E., Ramadhan, R., & Rosdiana, R. (2017). Karakteristik Penderita Tuberkulosis Paru di Puskesmas Rujukan Mikroskopis Kabupaten Aceh Besar. *Sel Jurnal Penelitian Kesehatan*, 4(1), 13-20. <https://doi.org/10.22435/SEL.V4I1.1441>
- Fukunaga, R., Glaziou, P., Harris, J. B., Date, A., Floyd, K., & Kasaeva, T. (2021). Epidemiology of Tuberculosis and Progress Toward Meeting Global Targets – Worldwide, 2019. *Morbidity and Mortality Weekly Report*, 70(12), 427. <https://doi.org/10.15585/MMWR.MM7012A4>
- Gebremariam, R. B., Wolde, M., & Beyene, A. (2021). Determinants of adherence to anti-TB treatment and associated factors among adult TB patients in Gondar city administration, Northwest, Ethiopia: based on health belief model perspective. *Journal of Health, Population and Nutrition*, 40(1), 1-10. <https://doi.org/10.1186/S41043-021-00275-6/TABLES/3>
- Glaziou, P. (2021). Predicted impact of the COVID-19 pandemic on global tuberculosis deaths in 2020. *MedRxiv*, 2020.04.28.20079582. <https://doi.org/10.1101/2020.04.28.20079582>
- Global Tuberculosis Report 2022*. (n.d.). Retrieved March 7, 2024, from <https://www.who.int/teams/global-tuberculosis-programme/tb-reports/global-tuberculosis-report-2022>
- Gupta, R. K., Lucas, S. B., Fielding, K. L., & Lawn, S. D. (2015). Prevalence of tuberculosis in post-mortem studies of HIV-infected adults and children in resource-limited settings: A systematic review and meta-analysis. *AIDS*, 29(15), 1987-2002. <https://doi.org/10.1097/QAD.0000000000000802>
- Hayati, S. M., Purba, J. M., & Siregar, C. T. (2022). Analysis of Factors Affecting Acceptance and Commitment Therapy (ACT) in Pulmonary TB Patients. *Indonesian Journal of Global Health Research*, 4(3), 573-580. <https://doi.org/10.37287/IJGHR.V4I3.1253>
- Ima Afifa Himayati, A., & Matematika dan Ilmu Pengetahuan Alam, F. (2023). ANALISIS REGRESI LOGISTIK BINER PADA FAKTOR RESIKO KEJADIAN TUBERKULOSIS. *Jurnal Matematika Sains Dan Teknologi*, 24(1), 01-14. <https://doi.org/10.33830/JMST.V24I1.4666.2023>
- Keperawatan, J., & Kemenkes Gorontalo, P. (2020). PENGETAHUAN PENDERITA TUBERKULOSIS PARU TERHADAP KEPATUHAN MINUM OBAT ANTI TUBERKULOSIS. *Jambura Health and Sport Journal*, 2(1), 12-18. <https://doi.org/10.37311/JHSJ.V2I1.4560>
- Laporan Program Penanggulangan Tuberkulosis Tahun 2022 KEMENTERIAN KESEHATAN REPUBLIK INDONESIA TAHUN 2023*. (n.d.).
- MacNeil, A., Glaziou, P., Sismanidis, C., Maloney, S., & Floyd, K. (2019). Global Epidemiology of Tuberculosis and Progress Toward Achieving Global Targets – 2017. *Morbidity and Mortality Weekly Report*, 68(11), 263. <https://doi.org/10.15585/MMWR.MM6811A3>
- Manurung, R., & Manurung, R. D. (2023). The relationship between compliance in the treatment of pulmonary TB to lung function in Humbang Hasundutan district. *Jurnal Aisyah : Jurnal Ilmu Kesehatan*, 8(2), 897-902. <https://doi.org/10.30604/jika.v8i3.2058>
- Risk Factors Affecting Multi-Drug Resistant Tuberculosis in Surakarta and Ngawi, Indonesia | Journal of Epidemiology and Public Health*. (n.d.). Retrieved December 15, 2023, from <https://www.jepublichealth.com/index.php/jepublichealth/article/view/13>
- Rusman, R., & K, S. B. (2019). Faktor yang Mempengaruhi Penderita TB Paru Terhadap Kepatuhan Minum Obat Anti Tuberkulosis di Puskesmas Jatisawit Indramayu. *Afiasi : Jurnal Kesehatan Masyarakat*, 4(1), 33-40. <https://doi.org/10.31943/AFIASI.V4I1.10>

- Sanyaolu, A. (2019). Tuberculosis: A Review of Current Trends. *Epidemiology International Journal*, 3(2). <https://doi.org/10.23880/EIJ-16000123>
- Tuberculosis*. (n.d.). Retrieved December 15, 2023, from [https://www.who.int/health-topics/tuberculosis#tab=tab\\_1](https://www.who.int/health-topics/tuberculosis#tab=tab_1)
- Tuberkulosis Paru Fase Lanjutan Kecamatan Umbulsari Jember, P. DI, Ismi Mientarini, E., Sudarmanto, Y., Hasan, M., & Kedokteran Universitas Jember Jl Kalimantan, F. (2018). HUBUNGAN PENGETAHUAN DAN SIKAP TERHADAP KEPATUHAN MINUM OBAT PASIEN TUBERKULOSIS PARU FASE LANJUTAN DI KECAMATAN UMBULSARI JEMBER. *Jurnal Ilmu Kesehatan Masyarakat*, 14(1), 11-18. <https://doi.org/10.19184/IKESMA.V14I1.10401>
- Widyasrini, E. R., Probandari, A. N., & -, R. (2017). Factors Affecting the Success of Multi Drug Resistance (MDR-TB) Tuberculosis Treatment in Residential Surakarta. *Journal of Epidemiology and Public Health*, 2(1), 45-57. <https://doi.org/10.26911/JEPUBLICHEALTH.2017.02.01.05>
- Wulandari, D. H., Administrasi, D., & Kesehatan, K. (2018). Analisis Faktor-Faktor yang Berhubungan dengan Kepatuhan Pasien Tuberkulosis Paru Tahap Lanjutan Untuk Minum Obat di RS Rumah Sehat Terpadu Tahun 2015. *Jurnal Administrasi Rumah Sakit Indonesia*, 2(1). <https://doi.org/10.7454/ARSI.V2I1.2186>
- Yang, F.-F., Dengan, B., Pasien, K., Pengobatan, T., Paru, T., Puskesmas, D., Uki, U.-F., Samory, S., Yunalia, E. M., Perdana, I., Suharto, S., & Eureka Nurseskasatmata, S. (2022). Faktor-Faktor Yang Berhubungan Dengan Kepatuhan Pasien Terhadap Pengobatan Tuberkulosis Paru Di Puskesmas Urei-Faisei (URFAS). *Indonesian Health Science Journal*, 2(1). <https://doi.org/10.52298/IHSJ.V2I1.25>