

## Knowledge of Anti-Tuberculosis Drug Side Effects and Adherence among TB Patients in Sungai Pinyuh

MAGDALENA PATRICIA TIFFANY<sup>1</sup>, ADITYA ARYA DEWANTARA<sup>2</sup>

- 1) Departement of Pharmacy, Faculty of Medicine, Universitas Negeri Semarang, Indonesia Jl. Kelud Utara III, Sampangan, Gajahmungkur District, Semarang City, Central Java 50232. Phone (024) 86008700  
Email: [magdalenapatriciatiffany@students.unnes.ac.id](mailto:magdalenapatriciatiffany@students.unnes.ac.id)
- 2) Departement of Pharmacy, Faculty of Medicine, Universitas Negeri Semarang, Indonesia Jl. Kelud Utara III, Sampangan, Gajahmungkur District, Semarang City, Central Java 50232. Phone (024) 86008700  
Email: [adityaarya@mail.unnes.ac.id](mailto:adityaarya@mail.unnes.ac.id)

### Abstract

Tuberculosis (TB) is an infectious disease that remains a significant public health problem in Indonesia. Adherence to anti-tuberculosis drug (ATD) therapy is a crucial factor in treatment success; however, drug side effects may affect patient adherence. This study aimed to analyze the relationship between the level of knowledge regarding ATD side effects and medication adherence among TB patients in Sungai Pinyuh District. This study used an observational analytic design with a cross-sectional approach. Data were collected through a knowledge questionnaire and secondary data from the Tuberculosis Information System. The sample consisted of 100 TB patients selected using a purposive sampling technique. The results showed that most respondents had a fairly good level of knowledge, although some misconceptions regarding ATD side effects were still found. Medication adherence based on several indicators showed relatively good results, with 89 respondents classified as adherent and 11 respondents as non-adherent, characterized by loss to follow-up and forgetting to take medication. The analysis showed a significant relationship between the level of knowledge regarding ATD side effects and medication adherence among TB patients, with a p-value of 0.045 ( $p < 0.05$ ).

**Key words:** Adherence, anti-tuberculosis drugs, knowledge, side effects, tuberculosis.

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### Introduction

Tuberculosis (TB) remains a major global public health problem, particularly in developing countries, including Indonesia. The disease, caused by *Mycobacterium tuberculosis*, primarily affects the lungs but can also involve other organs. According to the World Health Organization (2024), the global incidence of TB increased from 129 to 134 cases per 100,000 population between 2020 and 2023. Indonesia contributes approximately 10% of global TB cases, making it the second-highest burden country after India.

In Indonesia, the prevalence of TB decreased from 0.42% in 2018 to 0.3% in 2023, indicating progress in TB control. However, this achievement has not yet met the national target of a 50% reduction (Kemenkes RI, 2016). In West Kalimantan, the prevalence declined from 0.36% in 2018 to 0.25% in 2023, but still remains above the expected target (Kemenkes RI, 2024). In Mempawah Regency, treatment success reached only 75.8%, below the national target of 90%, indicating ongoing challenges in treatment adherence. Similarly, in Sungai Pinyuh District, TB cases remain relatively high, highlighting the need for improved control efforts.

Adherence to anti-tuberculosis drug (ATD) therapy is a key factor in treatment success. However, side effects such as nausea, joint pain, visual disturbances, and sleep disorders may reduce patient willingness to continue treatment (PDPI, 2021). These conditions can lead to treatment interruption, increasing the risk of relapse and drug resistance (Pameswari et al., 2016). Patient knowledge about ATD side effects plays an important role in shaping adherence behavior. Previous studies have shown that better knowledge is associated with higher adherence among TB patients (Siampo et al., 2022).

## Methods

This study employed a non-experimental analytic correlational design with a cross-sectional approach to analyze the relationship between knowledge of ATD side effects and treatment adherence among tuberculosis (TB) patients. Data were collected using a structured questionnaire to assess patients' knowledge regarding ATD side effects, as well as secondary data obtained from the Tuberculosis Information System to evaluate treatment adherence. Adherence was measured using indicators including frequency of control visits, treatment outcomes, and patient self-report.

## Population and Sample

The population of this study consisted of all tuberculosis (TB) patients aged  $\geq 18$  years who were undergoing anti-tuberculosis drug (ATD) treatment in Sungai Pinyuh District, West Kalimantan, Indonesia, during the study period from July 2025 to March 2026.

The sample in this study included 100 TB patients who met the inclusion criteria and were selected using a purposive sampling technique. Data collection was carried out using a structured questionnaire to assess respondents' knowledge regarding ATD side effects, as well as secondary data obtained from the Tuberculosis Information System and patient records to evaluate treatment adherence.

## Data Analysis

Data were analyzed using univariate and bivariate analysis. Univariate analysis was used to describe respondent characteristics and the distribution of variables. Bivariate analysis was conducted using the chi-square test to determine the relationship between knowledge of ATD side effects and treatment adherence, with a significance level of  $p < 0.05$  (Surahman et al., 2016).

## Results and Discussion

### Univariate Analysis

The characteristics of respondents in this study comprised age, gender, education level, and occupation. A total of 100 tuberculosis (TB) patients were included in the study.

**Table 1.** Characteristics of Respondents

| Characteristic                   | Tuberculosis (TB) patients |                |
|----------------------------------|----------------------------|----------------|
|                                  | Frequency (n=100)          | Percentage (%) |
| <b>Age (years)</b>               |                            |                |
| 18-25                            | 14                         | 14             |
| 26-35                            | 14                         | 14             |
| 36-45                            | 27                         | 27             |
| 46-55                            | 15                         | 15             |
| 56-65                            | 21                         | 21             |
| >65                              | 9                          | 9              |
| <b>Treatment Status</b>          |                            |                |
| Continued treatment              | 89                         | 89             |
| Loss to follow up                | 11                         | 11             |
| <b>Gender</b>                    |                            |                |
| Female                           | 26                         | 26             |
| Male                             | 74                         | 74             |
| <b>Education level</b>           |                            |                |
| No formal education              | 5                          | 5              |
| Primary school                   | 15                         | 15             |
| Junior high school               | 15                         | 15             |
| Senior high school               | 46                         | 46             |
| Higher education                 | 19                         | 19             |
| <b>Pekerjaan</b>                 |                            |                |
| Unemployed / Housewife           | 25                         | 25             |
| Farmer / Laborer                 | 16                         | 25             |
| Self-employed / Trader           | 16                         | 16             |
| Civil servant / Private employee | 43                         | 43             |

The findings showed that the majority of respondents were aged 36–45 years, indicating that most patients were within the productive age group (<65 years). Individuals in the productive age range tend to have higher levels of mobility and social interaction, which increases their risk of exposure to *Mycobacterium tuberculosis*. This suggests that active daily activities may contribute to the higher incidence of TB in this age group (Sikumbang et al., 2022).

The most of tuberculosis (TB) patients had a complete treatment history, while a smaller proportion had incomplete treatment. This finding suggests that the majority of patients were able to complete their treatment regimen. Treatment completion may be supported by the implementation of the Directly Observed Treatment Short-course (DOTS) strategy, which emphasizes supervision and adherence. In contrast, incomplete treatment may be influenced by factors such as medication non-adherence, side effects, and patients' daily activities.

Most respondents were male, which may be associated with a higher prevalence of smoking among men. From a pathophysiological perspective, cigarette smoke contributes to the development of tuberculosis by impairing airway ciliary function, reducing immune responses, and causing macrophage dysfunction. Nicotine has been shown to decrease the production of tumor necrosis factor-alpha (TNF- $\alpha$ ) by macrophages through the  $\alpha 7$  nicotinic receptor, thereby inhibiting granuloma formation, which plays a crucial role in containing *Mycobacterium*

tuberculosis infection. In addition, cigarette smoke reduces interleukin-12 (IL-12) production and Th1 immune responses, both of which are essential for eliminating TB bacteria. These impairments in host defense mechanisms increase susceptibility to TB infection and progression to active disease, making smoking a key contributing factor to the higher TB incidence among males (Silva et al., 2018).

In terms of education level, most respondents had completed senior high school, indicating that the distribution of respondents was dominated by individuals with a moderate level of education. This condition may be explained by the fact that secondary education represents the most common level of educational attainment in the general population. Furthermore, individuals with this level of education generally have sufficient awareness of the importance of utilizing health services, which may lead to a higher likelihood of seeking medical care. As a result, respondents with secondary education were more frequently represented in this study compared to those with lower or higher educational backgrounds (Oktalina, 2025).

Regarding occupation, most respondents were employed as private sector workers or civil servants. Occupational type can influence an individual's level of activity and mobility in daily life. Individuals with higher mobility and broader social interactions are more likely to come into contact with various environments, thereby increasing the risk of exposure to tuberculosis. However, despite these differences, treatment adherence in this study remained relatively high across occupational groups, suggesting that occupation may not be the primary factor influencing adherence. Other factors, such as knowledge, motivation, and social support, may play a more significant role.

**Tabel 1.** Frequency Distribution of Knowledge Level and Treatment Adherence

| Characteristics            | Frequency (n=100) | Percentage (%) |
|----------------------------|-------------------|----------------|
| <b>Knowledge</b>           |                   |                |
| Poor                       | 31                | 31             |
| Moderate                   | 33                | 33             |
| Good                       | 36                | 36             |
| <b>Treatment Adherence</b> |                   |                |
| Adherent                   | 90                | 90             |
| Non-adherent               | 10                | 10             |

Based on the analysis results, the majority of respondents were categorized as having good knowledge, accounting for 36 respondents (36%). Meanwhile, 33 respondents (33%) had moderate knowledge, and 31 respondents (31%) had poor knowledge. These findings indicate that most respondents had sufficient to good knowledge regarding the side effects of anti-tuberculosis drugs (ATD), although some respondents still demonstrated limited understanding.

In terms of treatment adherence, the majority of respondents were categorized as adherent, accounting for 90 respondents (90%), while 10 respondents (10%) were categorized as non-adherent. These findings indicate that the level of treatment adherence among TB patients was relatively high.

### Bivariate Analysis

Bivariate analysis was conducted to determine the significance of the relationship between knowledge regarding the side effects of anti-tuberculosis drugs (ATD) and treatment adherence. The statistical test used was the Chi-Square test. However, the analysis showed that more than

20% of the cells had an expected count of less than 5, indicating that the assumptions for the Chi-Square test were not fulfilled. Therefore, an alternative test, Fisher's Exact Test, was used to analyze the relationship between knowledge level and treatment adherence.

**Tabel 2.** Association Between Knowledge Level of Anti-Tuberculosis Drug Side Effects and Treatment Adherence

| Tingkat Pengetahuan | Kepatuhan Pengobatan |      |          |      |       |     | <i>p-value</i> |
|---------------------|----------------------|------|----------|------|-------|-----|----------------|
|                     | Non-adherent         |      | Adherent |      | Total |     |                |
|                     | n                    | %    | n        | %    | n     | %   |                |
| Good                | 1                    | 2,8  | 35       | 97,2 | 36    | 100 | 0,045          |
| Moderate            | 3                    | 9,1  | 30       | 90,9 | 33    | 100 |                |
| Poor                | 7                    | 22,6 | 24       | 77,4 | 31    | 100 |                |
| Total               | 11                   | 11   | 89       | 89   | 100   | 100 |                |

The analysis results showed a tendency that respondents with better knowledge levels had higher treatment adherence. In contrast, respondents with lower knowledge levels tended to demonstrate lower adherence to treatment. These findings indicate that knowledge plays an important role in shaping patients' adherence behavior during tuberculosis treatment.

Statistically, the Fisher's Exact Test showed a *p*-value of 0.045 ( $p < 0.05$ ), indicating a significant relationship between knowledge of anti-tuberculosis drug (ATD) side effects and treatment adherence among TB patients in Sungai Pinyuh. These results suggest that higher levels of knowledge are associated with better treatment adherence.

Good knowledge, particularly regarding drug side effects and the importance of completing treatment, can increase patients' awareness to take medication regularly according to healthcare providers' recommendations. In contrast, limited knowledge may lead to misunderstandings about side effects, causing patients to discontinue treatment prematurely.

### Association Between Respondent Characteristics and Treatment Adherence

Several factors other than the main variable may also influence treatment adherence among tuberculosis patients. In this study, the characteristics analyzed included age, gender, educational level, and occupation. Further analysis was conducted to determine the relationship between each respondent characteristic and treatment adherence among TB patients.

**Tabel 3.** Association Between Age and Treatment Adherence

| Age (years) | Treatment Adherence |      |          |      |       | <i>p-value</i> |
|-------------|---------------------|------|----------|------|-------|----------------|
|             | Non-adherent        |      | Adherent |      | Total |                |
|             | n                   | (%)  | n        | %    | n     |                |
| 18-25       | 4                   | 28,6 | 10       | 71,4 | 14    | 0,148          |
| 26-35       | 1                   | 7,1  | 13       | 92,9 | 14    |                |
| 36-45       | 2                   | 7,4  | 25       | 92,6 | 27    |                |
| 46-55       | 0                   | 0    | 15       | 100  | 15    |                |
| 56-65       | 2                   | 9,5  | 19       | 90,5 | 21    |                |
| >65         | 2                   | 22,2 | 7        | 77,8 | 9     |                |

The analysis showed that treatment adherence was relatively high across all age groups. No substantial differences in adherence levels were observed between age categories, indicating

that treatment adherence was distributed relatively evenly among patients of different ages rather than being concentrated in a particular age group.

Statistically, no significant association was found between age and treatment adherence ( $p = 0.148$ ;  $p > 0.05$ ). This finding indicates that age differences did not influence patients' adherence to tuberculosis treatment. The high adherence observed across various age groups may reflect good awareness of the importance of completing therapy, as well as the role of healthcare services in supporting treatment regularity.

These findings are consistent with previous studies reporting that age is not significantly associated with treatment adherence among TB patients. The absence of a significant relationship suggests that adherence may be more strongly influenced by other factors, such as knowledge level, family support, healthcare providers' roles, and patient motivation. In addition, the implementation of TB treatment strategies such as DOTS provides consistent supervision and education for all patients, which may contribute to the relatively high and evenly distributed adherence rates across age groups.

**Tabel 4.** Association Between Gender and Treatment Adherence

| Gender | Treatment Adherence |      |          |      | Total | <i>p-value</i> |
|--------|---------------------|------|----------|------|-------|----------------|
|        | Non-adherent        |      | Adherent |      |       |                |
|        | n                   | (%)  | n        | (%)  |       |                |
| Female | 2                   | 7,7  | 24       | 92,3 | 26    | 0,723          |
| Male   | 9                   | 12,2 | 65       | 87,8 | 74    |                |

The analysis showed that treatment adherence was relatively high among both male and female respondents. No substantial differences were observed between the two groups, indicating that treatment adherence was not influenced by gender.

Statistically, no significant association was found between gender and treatment adherence ( $p = 0.723$ ;  $p > 0.05$ ). This finding suggests that male and female patients had relatively similar levels of adherence in undergoing tuberculosis treatment.

The absence of differences between the two groups may be attributed to equal access to healthcare services and treatment-related information received by both males and females. In addition, the role of healthcare providers in delivering education and monitoring treatment may also contribute to improving adherence regardless of gender.

These findings are consistent with previous studies reporting that gender is not significantly associated with TB treatment adherence. This indicates that adherence is more likely influenced by other factors, such as patient motivation, knowledge, and support from healthcare providers.

**Tabel 5.** Association Between Education Level and Treatment Adherence

| Education Level     | Treatment Adherence |      |          |      | <i>p-value</i> |       |
|---------------------|---------------------|------|----------|------|----------------|-------|
|                     | Non-adherent        |      | Adherent |      |                | Total |
|                     | n                   | (%)  | n        | (%)  |                | n     |
| No formal education | 2                   | 40   | 3        | 60   | 5              | 0,116 |
| Primary school      | 0                   | 0    | 15       | 100  | 15             |       |
| Junior high school  | 2                   | 13,3 | 13       | 86,7 | 15             |       |
| Senior high school  | 6                   | 13   | 40       | 87   | 46             |       |
| Higher education    | 1                   | 5,3  | 18       | 94,7 | 19             |       |

The analysis showed that treatment adherence was relatively high across all educational levels. No substantial differences were observed among the educational groups, indicating that treatment adherence was not directly influenced by formal educational attainment.

Statistically, no significant association was found between educational level and treatment adherence ( $p = 0.116$ ;  $p > 0.05$ ). This finding suggests that educational level was not a determining factor in patients' adherence to tuberculosis treatment. The relatively high and evenly distributed adherence rates across different educational levels indicate that information regarding TB treatment was well understood by respondents regardless of their educational background.

This condition may be influenced by the role of healthcare providers in delivering education that is understandable and accessible to all patients. In addition, structured TB treatment programs may also support the effective dissemination of information to various segments of the community.

These findings are consistent with previous studies reporting no significant association between educational level and TB treatment adherence. The findings suggest that adherence is more strongly influenced by other factors, such as patients' knowledge regarding the disease and its treatment, rather than formal educational attainment. Therefore, educational interventions provided during the treatment process play an important role in improving patient adherence.

**Tabel 6.** Association Beetween Occupation and Treatment Adherence

| Pekerjaan                        | Treatment Adherence |      |          |      |       | <i>p-value</i> |
|----------------------------------|---------------------|------|----------|------|-------|----------------|
|                                  | Non-adherent        |      | Adherent |      | Total |                |
|                                  | n                   | (%)  | n        | (%)  | n     |                |
| Unemployed / Housewife           | 2                   | 8    | 23       | 92   | 25    | 0,971          |
| Farmer / Laborer                 | 2                   | 12,5 | 14       | 87,5 | 16    |                |
| Self-employed / Trader           | 2                   | 12,5 | 14       | 87,5 | 16    |                |
| Civil servant / Private employee | 5                   | 11,6 | 38       | 88,4 | 43    |                |

The analysis showed that treatment adherence was relatively high across all occupational groups. No substantial differences were observed among the different occupations, indicating that occupation did not directly influence treatment adherence.

Statistically, no significant association was found between occupation and treatment adherence ( $p = 0.971$ ;  $p > 0.05$ ). This finding suggests that both employed and unemployed respondents had relatively similar levels of adherence in undergoing tuberculosis treatment.

Occupation may influence adherence through factors such as limited time, restricted access to healthcare facilities, and stigma in the workplace. However, the results of this study indicate that these factors did not become major barriers to treatment adherence. This may be attributed to the accessibility of healthcare services, flexibility in the treatment system, and the role of healthcare providers in delivering education and monitoring throughout the treatment process.

These findings are consistent with previous studies reporting that occupation is not significantly associated with TB treatment adherence. The absence of a significant relationship may reflect the success of TB control programs, particularly through the implementation of the DOTS strategy and the support provided by treatment supervisors (PMO), which help maintain patient adherence regardless of occupational differences.

## Conclusion

Based on the findings of this study, there was a significant relationship between knowledge of anti-tuberculosis drug (ATD) side effects and treatment adherence among TB patients in Sungai Pinyuh, with a p-value of 0.045 ( $p < 0.05$ ). In contrast, respondent characteristics such as age, gender, educational level, and occupation were not significantly associated with treatment adherence.

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