

ARTICLE INFORMATION

Received: January, 10, 2025

Revised: February, 06, 2025

Available online: February, 07, 2025

at : <https://ejurnal.malahayati.ac.id/index.php/minh>

Determinants of treatment success for tuberculosis cases in Sumatra, Indonesia

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Abstract

Background: Mycobacterium tuberculosis, the bacteria that causes tuberculosis (TB), attacks 80% of the lungs and 20% of the extrathoracic area. Tuberculosis is currently a worldwide health problem, and no country is free from this disease. This disease continues to show increasing morbidity and mortality rates, so it needs attention from various parties to support the success of its treatment.

Purpose: To determine the success of tuberculosis treatment in Sumatra, Indonesia.

Method: Quantitative research with a cross-sectional study design to determine the success of Pulmonary Tuberculosis (TB) treatment. The data used are secondary data sourced from the Tuberculosis Information System of the South Sumatra Provincial Health Office in January-December 2023. The sampling technique used total sampling, namely 3.127 respondents. The independent variables in this study include; age, education, employment status, previous health conditions, diabetes status, and HIV status, while the dependent variable is the efficacy of pulmonary TB treatment.

Results: The average age of respondents suffering from pulmonary TB was 45.18 years, male, and not civil servants. New treatment history, standard treatment status, no history of DM, and most of them were HIV negative. There was a significant relationship between previous treatment history ($p = 0.011$), history of DM ($p = 0.009$), and HIV status ($p = 0.0001$) with the success of pulmonary TB treatment. However, the variables of age, gender, occupation and treatment status did not have a significant relationship ($p > 0.05$).

Conclusion: There is a significant relationship between previous treatment history, history of DM and HIV status with the success of pulmonary TB treatment. However, the variables of age, gender, occupation and treatment status do not have a significant relationship.

Suggestion: Health services should periodically evaluate and improve TB treatment program strategies to identify existing problems. Routine data analysis needs to be carried out both descriptively and analytically so that the available data is not just a collection of meaningless data.

Keywords: Determinants; Pulmonary Tuberculosis (TB); Success; Treatmet.

INTRODUCTION

Mycobacterium tuberculosis is a bacterium that causes tuberculosis (TB) which attacks 80% of the lungs and 20% of the body outside the lungs. Currently, tuberculosis is a global health problem and no country is free from this disease. In addition, this disease still has high morbidity and mortality rates (Fahdhienie, Agustina, & Ramadhana, 2020).

According to the World Health Organization (WHO), the Southeast Asia region accounted for 43% of all new tuberculosis cases in 2020. Followed by the African Region (25%) and the WHO Western Pacific Region (18%). Around 1.5 million people died from TB in 2020, including 214,000 people who were HIV-positive. After Covid-19, pulmonary tuberculosis is the second most deadly infectious disease in the world, after HIV/AIDS. Globally, an estimated 10 million people were living with TB in 2020 (World Health Organization, 2022). Although the number of TB sufferers has decreased drastically in the last 20 years, this infectious disease still exists and is a major global health problem, especially in Asia and Africa (World Health Organization, 2021; Imam, Umboh, & Tuda, 2023).

After two years of the Covid-19 pandemic, there has been a significant global increase in TB diagnosis and treatment. According to the global tuberculosis report, an estimated 7.5 million new TB cases were detected in 2022. This finding exceeds the pre-Covid baseline of 7.1 million in 2019, 5.8 million in 2020, and 6.4 million in 2021. It was found that 87% of cases occurred in 30 countries with a high TB burden. These countries include India (27%), India (10%), China (7.1%), the Philippines (7.0%), Pakistan (5.7%), Nigeria (4.5%), Bangladesh (3.6%), and the Democratic Republic of Congo (3.0%). Based on these statistics, Indonesia is ranked second in the world, with an estimated 1,060,000 new cases of tuberculosis and 134,000 deaths each year. The prevalence of pulmonary TB is a significant public health challenge, especially in developing countries such as Indonesia. By 2030, Indonesia aims to reduce the number of pulmonary TB patients to 65 cases per 100,000 population (World Health Organization, 2023).

The target of the TB control initiative in Indonesia in 2020-2024 is to accelerate TB eradication efforts by 2030 and end the pandemic by 2050. However, among the five main causes of the burden of disease

in 2017, one of them was TB (Ministry of Health of the Republic of Indonesia, 2020a). Based on the number of TB cases treated and recorded, the TB control position in Indonesia is 41.7%. A very low percentage compared to the target that has been set, which is >80% (Ministry of Health of the Republic of Indonesia, 2021; Putra & Pradnyani, 2022). One of the steps of the Millennium Development Goals (MDGs) is pulmonary tuberculosis. In addition, because TB continues to be a public health problem in Indonesia and the world, this disease has been included in the Sustainable Health Development Goals (SDGs).

One of the metrics used to assess the effectiveness of tuberculosis treatment is the treatment success rate. The success rate of tuberculosis treatment has reached the target (86.5%) nationally. At least 90% of all tuberculosis cases in four provinces, namely Lampung (96.2%), South Sumatra (91.0%), Riau (90.8%), and South Sulawesi (90.1%) have achieved successful treatment in 2022 (Ministry of Health of the Republic of Indonesia, 2023). The percentage of deaths due to tuberculosis treatment in South Sumatra Province itself in 2022 was 3.2% (436 cases), where there were 164,139 TB suspects who received standard services in 2022 (South Sumatra Provincial Health Office, 2022).

The severity of tuberculosis infection can worsen and result in death (Aldina, Hermanto, & Manggasa, 2020). One aspect of antituberculosis treatment management that can affect effectiveness is patient compliance in undergoing tuberculosis treatment. Patients who follow the treatment plan can complete it regularly and do not stop treatment for at least 6-9 months. Approximately 10.6 million cases of pulmonary tuberculosis have been confirmed, but 4.2 million (39.7%) have not been found, reported or diagnosed and 6.4 million (60.3%) have been reported, treated or are undergoing therapy. Many tuberculosis patients receiving therapy worldwide continue to do so even though they never received treatment after their diagnosis (Samsuri, Najmah, Setiawan, Idrus, Fajri, Aprina, & Murniati, 2024; Pramono & Sudding, 2023).

Factors such as age, HIV positive status, malnutrition and lack of contact are independent predictors of unsuccessful treatment outcomes

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DOI: <https://doi.org/10.33024/minh.v7i11.613>

(Teka, Assegid, Ahmed, Debella, Amentie, Wami, & Eyeberu, 2023). Several other factors that cause unsuccessful treatment are gender, education level, occupation, and economy. Side effects of drugs, family support, health workers, and health services are also factors that support unsuccessful treatment (Pardosi, Nababan, Brahmana, Siagian, & Sipayung, 2024). One of the keys that influences the cure rate of pulmonary TB patients is the persistence of taking anti-tuberculosis drugs and cannot be separated from the role of drug supervisors. When drug supervisors is close to the patient, the patient will be obedient in taking medication because the patient gets the means to meet their needs (Rau & Pramudya, 2022; Surtiawaty, Yunita, Zaman, Zulheri, & Ismainar, 2022).

Among the main causes of the increase in tuberculosis cases are poverty that has not been addressed by the government, the failure of the TB program due to inadequate service organizations, socio-demographic changes due to the increase in the world's population and changes in the age structure of the population, the increasing impact of the HIV pandemic, and finally, inappropriate handling of tuberculosis cases, including clinical diagnosis and inappropriate drug guidelines (Tsani, 2019). The success of TB treatment in Indonesia has not achieved optimal results, so collaborative efforts are needed between patients, health workers, and the government to improve compliance and quality of treatment. Treatment failure refers to cases that have been treated, but still have positive sputum culture results or BTA microscopic examinations that occur five months or more after treatment. Previous studies have shown that failure of tuberculosis treatment is a risk factor for multidrug-resistant tuberculosis (MDR-TB) (Soedarsono, Mertaniasih, Kusmiati, Permatasari, Ilahi, & Anggraeni, 2023). This shows that TB-related problems really need more attention, so that treatment success can be achieved.

RESEARCH METHOD

Quantitative research with a cross-sectional study design to determine the success of pulmonary Tuberculosis (TB) treatment. The data used are secondary data sourced from the Tuberculosis Information System of the South Sumatra Provincial Health Office in January-December 2023. The sampling technique used total sampling, namely 3.127 respondents. The independent variables in this study include; age, education, employment status, previous health conditions, diabetes status, and HIV status, while the dependent variable is the efficacy of pulmonary TB treatment.

Previous treatment history, divided into 2, namely patients who have received previous treatment management/re-treatment (including relapsed patients, patients who failed treatment, patients who could not be followed up, and patients with unknown treatment history) and new patients are patients who have never taken antituberculosis drugs or have taken them < 1 month previously. Treatment status is categorized into two, namely according to standards, namely those undergoing treatment according to the TB management program (using anti-tuberculosis drugs, examinations according to the flow, and there is a drug-taking supervisor) and not according to standards when treatment is not carried out routinely and there is no supervision.

The research data was obtained in the form of an excel soft file and contained individual characteristics and medical history of Pulmonary TB patients. The data was edited to check for errors, then grouped by marking according to the data category. Furthermore, the researcher analyzed the data using univariate analysis and bivariate analysis of the Chi Square test through the SPSS application.

This research has been declared to have passed the ethics of the Health Research Ethics Commission of the Faculty of Public Health, Sriwijaya University with registration number: 361/UN9.FKM/TU.KKE//2024.

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RESEARCH RESULTS

Table Distribution Characteristics of Respondents (N=3127)

Variables	Results	Treatment Success	p-value	OR 95% CI
Age (n/%) (Mean±SD)(Range)(Years)	(45.18±19.087)(0-103)			
≥40	1949/62.3	1.851/95.0	0.361	1.194 (0.843-1.693)
< 40	1178/37.7	1.128/95.7		
Gender (n/%)				
Male	2066/66.1	1.960/94.9	0.170	1.312 (0.911-1.891)
Female	1061/33.9	1.019/96.0		
Occupation (n/%)				
Civil Servant	47/1.5	44/93.6	0.486	1.380 (0.424- 4.497)
Private Sector	3080/98.5	2935/95.3		
Previous Medical History (n/%)				
Re-treatment	65/2.1	57/87.7	0.011	2.929 (1.371-6.258)
New	3062/97.9	2922/95.4		
Treatment Status (n/%)				
Unstandard	75/2.4	74/98.7	0.263	0.267 (0.037-1.934)
Standard	3052/97.6	2905/95.2		
History of DM (n/%)				
Yes	177/5.7	161/19.0	0.009	2.122 (1.233-3.650)
No	2950/94.3	2818/95.5		
HIV Status (n/%)				
Positive	34/1.1	25/73.5	0.0001	7.651 (3.505-16.701)
Negative	3093/98.9	2954/95.5		

Based on the table above, the average age of respondents suffering from pulmonary TB is 45.18 years with a standard deviation of 19.087 in the age range of 1-103 years. The results of statistical analysis with the Chi Square test showed a p value of 0.361 ($\alpha > 0.05$), meaning that there is no significant relationship between age and the success of pulmonary TB treatment. Most of the respondents were male, namely 2066 (66.1%) with a p-value of 0.170 ($\alpha > 0.05$), meaning that there was no significant relationship between gender and the success of pulmonary TB treatment. The majority of

respondents' occupation were private sector, as much as 3080 (98.5)% and the p-value was 0.486 ($\alpha > 0.05$), so it can be concluded that there is no significant relationship between occupation and the success of pulmonary TB treatment.

Previous treatment history of 3062 respondents (97.9%) came from new treatment with a p value of 0.011 ($\alpha < 0.05$), so it can be concluded that there is a significant relationship between previous treatment history and the success of pulmonary TB treatment. In addition, the treatment status is in accordance with the standard of 3052 respondents (97.6%) with

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a p value of 0.263 ($\alpha > 0.05$), so it can be concluded that there is no significant relationship between treatment status and the success of pulmonary TB treatment.

Most respondents did not have a history of DM as many as 2950 respondents (94.3%) with a p value of 0.009 ($\alpha < 0.05$) and OR (95% CI 1.233-3.650), so it can be concluded that there is a significant relationship between a history of DM and the success of pulmonary TB treatment. The majority of HIV status was negative as many as 3093 respondents (98.9%) with a p value of 0.0001 ($\alpha < 0.05$) and (95% CI 3.505-16.701), meaning that there is a significant relationship between HIV status and the success of pulmonary TB treatment.

DISCUSSION

The results of the statistical analysis on the age variable obtained a p-value of 0.361 (> 0.05), which means that there is no significant relationship between age and the success of pulmonary TB treatment. Other studies also found that the results of the analysis of the age of respondents in the Kolmogorov-Smirnov test obtained a p value (0.775) (Maulidya, Redjeki, & Fanani, 2017). Age does not affect the stages of fighting infection. At any age, the body can only fight infection if given sufficient nutritious food. If the body is not given sufficient nutrition, the body will experience malnutrition and decreased immunity (Nasution, Permayasa, & Habibah, 2022).

The discovery of new cases mostly occurs in the productive age group. Productive age will allow individuals to tend to have contact with many people and be in a dense work environment. This will make it easier for someone to suffer from pulmonary TB (Ministry of Health of the Republic of Indonesia, 2022). However, on the other hand, productive age patients tend to have high motivation and enthusiasm to recover, this is possible because productive age patients try to recover in the midst of a busy routine (Putra & Pradnyani, 2022). Another study also found that the incidence of pulmonary TB was highest in the productive age (15-65 years) at 57.4% (Fitrianti, Wahyudi, & Murni, 2022). In addition, the younger population has the ability to reach health facilities, is interested in complying with follow-up treatment, and has better immunity compared to the elderly and children (Tesema,

Seyoum, Ejeta, & Tsegaye, 2020). The results of a study conducted at a hospital in Semarang Regency showed that the age of TB patients did not have a significant relationship with the length of TB treatment until recovery (Azizah, 2020).

Age can indeed be a risk factor that affects the severity of TB in a person because it is related to the immune system. The immune system in the young adult age group is generally stronger than the elderly. In old age, the body experiences a decline in physiological function and the immune system also decreases, so the elderly are more susceptible to disease. However, this can still be controlled by conducting strict supervision of TB patients who are susceptible to taking drugs in the elderly. In addition, screening programs and health promotion related to TB are also often carried out in conjunction with basic health programs for the elderly. This aims to ensure that the elderly get good information about TB, its prevention and treatment.

Based on the results of the study, females (96.0%) have a greater chance of successful treatment of pulmonary TB than male respondents. The results of statistical analysis using the Chi Square test showed a P value of 0.170 ($\alpha > 0.05$), so it can be concluded that there is no significant relationship between gender and the success of pulmonary TB treatment. In line with the results of previous studies which showed that there was no relationship between gender and the success of pulmonary TB treatment in one of the health centers, Grobogan Regency with a p value of 0.879 (> 0.05) (Harnanik & Ruhyana, 2014).

Other studies state that patients with pulmonary TB are more male. Pulmonary TB patients who are successfully treated are more male than female because women rarely come to health facilities on time compared to men. One of the causes is that women often consider pulmonary TB disease as a disgrace and shame if it is known to many people, so women with pulmonary TB are often late in seeking medical help (Nyasulu, Phiri, Sikwese, Chirwa, Singini, Banda, & Munthali, 2016). Women are often worried that their families and communities will reject them because they have pulmonary TB, so women with pulmonary TB need high motivation and support from the people around them (Sari, Purwanto, & Rofi'i, 2022).

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The findings in this study indicate that respondents whose jobs are not civil servants have a greater chance of successful pulmonary TB treatment than respondents whose jobs are civil servants. The results of statistical analysis using the Chi Square test showed a P value of 0.480 ($\alpha > 0.05$) so it can be concluded that there is no significant relationship between work and the success of pulmonary TB treatment. The type of work determines what risk factors each individual must face. If workers work in a dusty environment (construction workers, miners, traders and so on), exposure to dust particles in the exposed area will affect the occurrence of respiratory tract disorders. Chronic exposure to polluted air can increase morbidity, especially the occurrence of symptoms of respiratory tract disease and generally pulmonary TB (Park, Ahn, & Kim, 2021; Bălă, Râjnoveanu, Tudorache, Motișan, & Oancea, 2021). This study is in line with previous studies that showed no relationship between occupation and the success of pulmonary treatment at the health centers, Grobogan Regency (Harnanik & Ruhyana, 2014).

Respondents who have a history of new treatment have a greater chance of successful treatment compared to respondents who have previously undergone treatment. The results of statistical analysis using the Chi Square test showed a p value of 0.011 ($\alpha < 0.05$), so it can be concluded that there is a significant relationship between treatment history and the success of pulmonary TB treatment. New patients are patients who have TB germs in their bodies, sputum examination and culture (+), and extrapulmonary patients, while old patients are patients who have been given previous treatment management including relapsed patients, patients who failed treatment, patients lost to follow up, and patients with unknown treatment history. New patients are patients who have never taken anti-tuberculosis drugs or have taken them < 1 month previously.

There are many factors why new cases of pulmonary TB are still found, including low patient knowledge, many patients who do not undergo treatment, and also patients who relapse (Gashu, Gelaye, & Tilahun, 2021). At the age of 5 months or more, for new patients if the sputum examination results are (+), then the treatment is declared a failure. Failed treatment should be given category 2

treatment or re-treatment from the beginning and must complete the treatment. Meanwhile, for patients with re-treatment, if the sputum examination results are (+) and declared a failure, then an Anti-Tuberculosis Drug sensitivity test must be carried out and if the sensitivity test cannot be carried out, an explanation of pulmonary TB disease is given and the patient is always monitored whether he or she complies with prevention efforts, infection control (Sari et al., 2022).

Other research findings state that newly diagnosed TB patients are 2.26 times more likely to achieve successful treatment (Audina, Andarini, Faisal, Prasenohadi, Zaini, & Hidajat, 2023). Based on previous studies, almost all respondents were new pulmonary TB patients who had TB germs in their bodies, sputum examination and culture results (+), and extrapulmonary patients, while old patients were patients who had been given previous treatment management including relapsed patients, patients who failed treatment, patients who discontinued treatment, and patients with unknown treatment history (Sari et al., 2022).

From the results of this study, it is known that respondents whose treatment status is not up to standard (98.7%) have a greater chance of successful pulmonary TB treatment than respondents whose treatment status is up to standard (95.2%). The results of statistical analysis using the Chi Square test showed a P value of 0.263 ($\alpha > 0.05$) so it can be concluded that there is no significant relationship between treatment status and treatment success. The success of TB treatment is highly dependent on the patient's commitment to taking Anti-Tuberculosis Drugs regularly. In addition, the side effects caused are also often felt by TB sufferers, this condition will certainly greatly interfere with the productivity of sufferers when going about their days and finally sufferers choose not to consume it regularly (Putra & Pradnyani, 2022).

In accordance with the Directly Observed Treatment Shortcourse (DOTS) strategy, every newly found and treated patient must be supervised to take medication every day, to ensure healing, prevent drug immunity or resistance. Before treatment begins, patients and supervisors who take medication must be given brief counseling regarding the need to take medication every day with supervision. The counseling includes TB symptoms,

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signs of drug side effects, and knowing how to deal with side effects, how to refer, the use of repeat sputum examinations, and how to provide TB counseling (Lange, Dheda, Chesov, Mandalakas, Udwadia, & Horsburgh, 2019; Ulfah, Windiyaningsih, Abidin, & Murtiani, 2018). Many factors can affect the success of TB treatment, such as factors from the patient themselves including: patients are not compliant in taking anti-tuberculosis drugs, patients move health care facilities, and the TB they suffer from is resistant to anti-tuberculosis drugs. Treatment supervisor factors include; no supervisor and there is supervision but less supervision. Drug factors: limited drug supplies, so that patients delay or do not continue their treatment and the quality of anti-tuberculosis drugs decreases due to storage that does not meet standards (Ministry of Health of the Republic of Indonesia, 2020b).

The majority of respondents did not have a history of DM (95.5%), this condition has a greater chance of successful treatment compared to respondents who have a history of DM (91%). The results of statistical analysis using the Chi Square test showed a p value of 0.009 ($\alpha < 0.05$), so it can be concluded that there is a significant relationship between a history of DM and the success of pulmonary TB treatment. Previous studies have found that DM weakens a person's immune system and increases the risk of developing active TB. During TB treatment, DM sufferers have a 2 times higher risk of experiencing residual positive cultures, 4 times higher risk of relapse after completing treatment, and 5 times higher risk of death, compared to those without DM (Jeon & Murray, 2008). Similar to other studies stating that TB sufferers with DM have a 3 times higher risk of experiencing unsuccessful TB treatment outcomes compared to TB sufferers without DM (95% CI 2.47-3.58; $p = 0.012$) in multivariable analysis (Ahmad, Yaacob, Jaeb, Hussin, & Mohammad, 2020).

Previous studies have also shown that blood glucose levels determine the success of pulmonary TB treatment in patients with type 2 DM. The risk of treatment failure in TB patients with abnormal HbA1c levels is 3 times higher than in patients with normal HbA1c levels. Complications of the disease in pulmonary TB patients cause a decline in the patient's physical condition, so that recovery will be difficult to achieve (Chen, Yu, Smith, Liu, Gao,

Diacon, & Barry, 2021). The results of this study indicate that respondents who are HIV negative (95.5%) have a greater chance of successful pulmonary TB treatment than respondents who are HIV positive (73.5%). The results of statistical analysis using the Chi Square test showed a P value of 0.0001 ($\alpha < 0.05$), so it can be concluded that there is a significant relationship between HIV status and the success of pulmonary TB treatment. Patients infected with HIV have a higher risk of developing TB compared to people who are not infected with HIV. The incidence is higher in patients with lower CD4+ T cell counts and detectable viral loads, but other risk factors may play a role such as diabetes, alcohol, malnutrition, homelessness, injection drug use, hepatitis C, and tobacco smoke (Duarte, Lönnroth, Carvalho, Lima, Carvalho, Muñoz-Torrico, & Centis, 2018).

The impact of TB/HIV co-infection is reciprocal. As the viral load increases, tuberculosis will accelerate the progression of HIV infection to AIDS and thus increase mortality. HIV infection will decrease the number of CD4 lymphocytes which has an impact on the clinical presentation and course of tuberculosis, after HIV infection (Du Bruyn & Wilkinson, 2016). HIV causes progressive immunodeficiency and increased susceptibility to infection. Unlike many other infectious diseases that only appear when the CD4 count falls below 200/mm³, the risk of TB increases during the first year of HIV infection. As a result, TB can be diagnosed long before HIV in infected patients (Engelbrecht, Kigozi, Chikobvu, Botha, & Van Rensburg, 2017).

TB in HIV is a very common condition, so all patients with TB should be screened for HIV and vice versa. TB infection in HIV can accelerate the increase in viral load so that HIV patients will quickly progress to AIDS. Conversely, HIV infection causes a decrease in CD4 count, making TB infection easier. In HIV patients with low CD4 counts, TB symptoms are often atypical; CD4 count <200 tends to indicate TB lymphadenitis and TB deseminis. Conversely, CD4 >200 gives a picture like TB in patients without HIV. A typical chest X-ray of TB is seen in patients with CD4 >200, no cavity is seen in patients with CD4 <200. Treatment of pulmonary TB in patients with HIV is no different from patients without HIV. However, ARV administration should be

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postponed for 2-8 weeks of OAT administration (Hapsah, 2024).

CONCLUSION

There is a significant relationship between previous treatment history, history of DM and HIV status with the success of pulmonary TB treatment. However, the variables of age, gender, occupation and treatment status do not have a significant relationship. The most dominant risk factor affecting the success of pulmonary TB treatment is the HIV status variable with an OR of 7.460 (95% CI 3.370-16.518).

SUGGESTION

Health services should periodically evaluate and improve TB treatment program strategies to identify existing problems. Routine data analysis needs to be carried out both descriptively and analytically so that the available data is not just a collection of meaningless data. In addition, there needs to be socialization of the TB program to both health agencies and the community, dissemination of understanding about prevention, and not isolating family members who suffer from pulmonary TB. Further research can analyze other variables that are suspected of influencing TB patient treatment such as family knowledge, sufferers and environmental conditions. In addition, using primary data so that the condition of the sufferer, family and environment can be observed directly.

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DOI: <https://doi.org/10.33024/minh.v7i11.613>

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DOI: <https://doi.org/10.33024/minh.v7i11.613>