# Children Under Five Years of Age: Factor Analysis of Tuberculosis Preventive Therapy's Success in Controlling Childhood Tuberculosis

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**Abstract**

Tuberculosis (TB) is a global disease that poses a significant public health threat, capable of causing death and affecting individuals of all ages. By the year 2020, Indonesia is the top three countries number of tuberculosis (TB) cases identified, including among both adult and child populations. Jember district has the second-highest number of TB cases in East Java, after Surabaya City, with a total of 5,244 cases in adults and 478 cases in children. The identification of pediatric TB cases is imperative for the management of the disease, as children under the age of 14 represent 12% of the population. However, the implementation of Tuberculosis Preventive Therapy (TPT), a government program aimed at strengthening the management of Infectious Latent Tuberculosis (ILTB), remains inadequate. Infants who have close contact with drug-sensitive TB (SO TB) patients are at elevated risk of infection and, as a result, require TPT. The objective of this study was to analyze the factors of drivers, enablers, reinforcers, and the role of Drug Swallowing Supervisors (PMOs) on adherence to medication in the TPT program for TB close contact toddlers in Jember District. The present study employed an explanatory method to test hypotheses and to ascertain relationships between variables. The findings indicated that predisposing factors (p-value 0.000), enabling factors (p-value 0.013), reinforcing factors (p-value 0.049), and the role of PMO had a significant effect on medication adherence. The success of the TPT program is primarily attributable to two factors: family support and the role of PMO.

**Keywords**: Tuberculosis Prevention Therapy (TPT), Children's TB, Close Contact Toddlers

## Introduction

In the year 2023, the district of Jember documented 5,244 cases of tuberculosis (TB) among adults and 478 cases among children, thereby ranking it as the second-highest district in the province of East Java, Indonesia, in terms of the number of TB cases identified. The identification of tuberculosis (TB) cases in children constitutes a pivotal element in the management of this disease, particularly given that children under the age of 14 constitute 12% of the total population. Terapi Pencegahan Tuberkulosis (TPT) is a type of treatment that is administered to individuals infected with the bacterium (Hendri, Yani, & Edison, 2021). The objective of the TPT is to reduce the incidence of TBC cases, thereby reducing the burden of disease. In accordance with Permenkes RI No. 67 of 2016, the following individuals are eligible for TPT: (1) children under five years of age with close contact to a TBC patient, (2) individuals with HIV/AIDS who have not yet been diagnosed with TBC, or (3) specific populations

(Kemenkes RI, 2021). Despite the efforts to implement TPT as a strategy to enhance the management of latent tuberculosis infection (LTBI), its implementation remains inadequate (Kemenkes RI, 2020). According to the 2020 report by the Direktorat Pencegahan dan Pengendalian Penyakit (P2P), infants with close contact to patients with latent tuberculosis infection (LTBI) are at elevated risk of infection and subsequent development of tuberculosis (TB).

The implementation of the TPT program in Jember District has encountered various obstacles, particularly the failure to administer preventive medications to all children under five who have close contact with TB patients. This phenomenon is influenced by several factors, including the dearth of information and education that parents receive regarding TB, as well as the lack of support from family and community members in supporting TPT treatment in children. The role of the Drug Swallowing Supervisor (PMO) is also instrumental in ensuring

treatment adherence (Grace, 2019). Furthermore, the efficacy of treatment is influenced by a multitude of factors, including health system policy, health worker readiness, socioeconomic conditions, logistics availability, and budget allocations. The objective of this study is to identify and analyze the factors of drivers, enablers, reinforcers, and the role of PMOs on adherence to medication in the TPT program for toddlers with close contact TB in Jember District. The objective of this study is to elucidate the factors that influence adherence in the TPT administration program for close-contact toddlers.

**Method**

The present study employed the explanatory research method, which is a type of research that aims to analyze the relationship and influence between variables by testing hypotheses. The population of this study was comprised of mothers of toddlers who had close contact with TB patients. These patients were the target of the TPT program in 10 selected health centers in 2023 in Jember District. The health centers were divided into two groups: five high-performing health centers (Panti, Paleran, Silo1, Rambipuji, and Jombang) and five low-performing health centers (Sumberjambe, Lojejer, Banjarsengon, Tanggul, and Sabrang). The sample in this study was obtained using a purposive sampling method, which was determined based on the presence of 73 toddlers undergoing TPT in the study location.

The present study employed both primary and secondary data. The primary data set comprised the identity of the respondents and the results of the questionnaire answers that were completed by mothers of toddlers participating in the TPT

program for TB close contact toddlers in Jember District. The dependent variables measured included knowledge (X1.a), motivation (X1.b), communication, information, and education (IEC) strategy (X1.c), health worker attitude (X2.a), logistics availability (X2.b), program policy (X3.a), family support (X7), cadre support (X8), mother's role (Z), and medication adherence (Y). Concurrently, secondary data was utilized as a complement, derived from indirect sources such as TPT distribution registers of health centers, TB 01P forms, and Tuberculosis Information System (SITB) reports of Jember District. The data were collected through the administration of questionnaires, which were designed as lists of questions and distributed to mothers of toddlers participating in the TPT program.

The validity of the instruments was assessed through Pearson's correlation coefficient, while the reliability was determined using the Cronbach Alpha ($\alpha$) method. The data analysis was conducted using the Partial Least Square (PLS) approach, a methodology employed to predict the relationship between variables and calculate the value of latent variables. This latent variable is the result of a linear combination of each indicator. The model employed incorporates the inner model, defined as a structural model that elucidates the relationship between latent variables, and the outer model, designated as a measurement model that delineates the relationship between indicators and constructs (Ghozali, 2021). The ethical test was carried out at the Health research Ethics Committee of dentistry Faculty Jember University No. 2259/UN25.8/KEPK/DL/2024 on May 22, 2024.
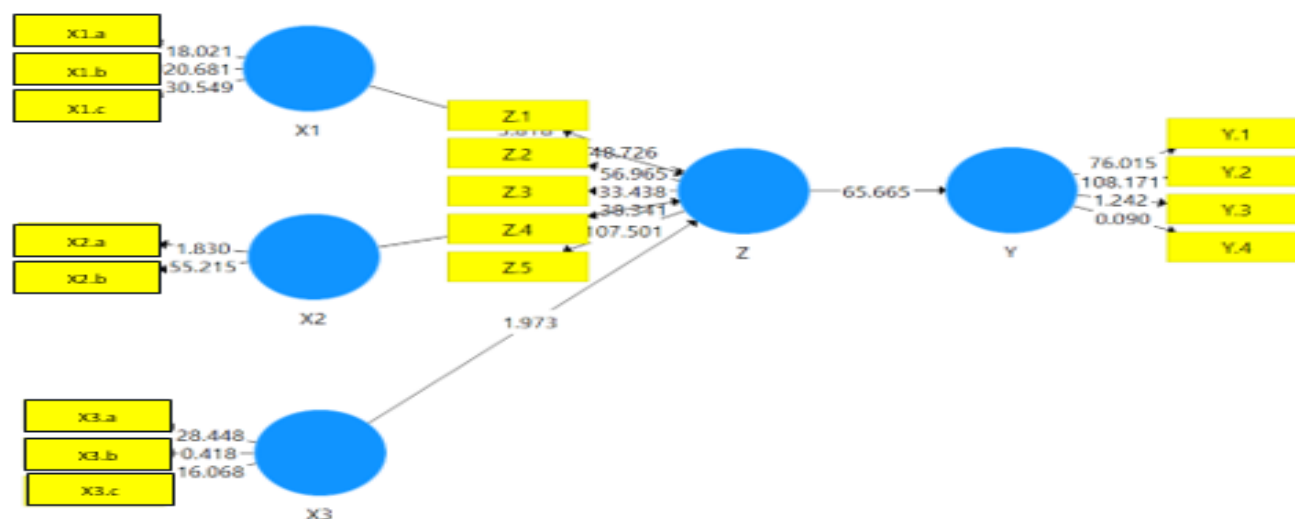


**Figure 1.** Bootstraping Technique

Source: Sumber: Primary Data Processed, 2024

**Result**

A total of 73 children were included in the study, with data collected from the study site. This group consisted of children who had successfully completed TB preventive therapy (TPT) as well as those who had not. The present study involved 73 drug-swallowing supervisors (PMOs).

Seven other PMOs could not be contacted because they

were working outside the city. The final results indicated that 67 children under five were in the complete treatment category, while 6 children were in the failure/dropout category.

The outcomes of the evaluation of the direct effect can be discerned through the path coefficient that links the independent variable to the dependent variable. Direct influence occurs when the independent variable affects the

dependent variable without going through intermediary variables. In contrast, indirect influence arises if the influence of the independent variable on the dependent variable is mediated by other variables.

The Partial Least Square (PLS) method was employed to evaluate hypotheses concerning direct effects, yielding five hypotheses. The objective of this experiment is to ascertain the extent to which the independent variable exerts an

influence on the dependent variable. The significance value is obtained through the use of bootstrapping techniques (Ghozali, 2018). The t-test between variables is a statistical test that is used to verify a hypothesis. The outcomes of direct effect testing, which was conducted using bootstrapping in PLS analysis, are presented in Figure 1 and Table 1.

**Table 1.** Results of Influence Tests Between Variables

| Variabel | Original Sample (O) | T Statistics (|O/STDEV|) | P Values |
|---|---|---|---|
| X1 -> Z | 0.435 | 5.818 | 0.000 |
| X2 -> Z | 0.258 | 2.492 | 0.013 |
| X3 -> Z | 0.219 | 1.973 | 0.049 |
| Z -> Y | 0.947 | 65.665 | 0.000 |
| X1 -> Z -> Y | 0.411 | 5.848 | 0.000 |
| X2 -> Z -> Y | 0.245 | 2.483 | 0.013 |
| X3 -> Z -> Y | 0.207 | 1.992 | 0.047 |

Source: Sumber: Primary Data Processed, 2024

**Table 2.** Results of Respondents Characteristic

| Descriptive Category | Category | Abs | % |
|---|---|---|---|
| Age | 21- 30 years | 37 | 50.6 |
| | 31-40 years | 23 | 31.2 |
| | 41-50 years | 11 | 10.1 |
| | 51-60 years | 2 | 2.1 |
| | **Total** | **73** | **100** |
| Education | Elementary School | 15 | 20.5 |
| | Junior High School | 23 | 31.5 |
| | Senior High School | 32 | 43.9 |
| | Diploma Graduate | 3 | 4.1 |
| | **Total** | **73** | **100** |
| Job | Private Job Officer | 1 | 1.1 |
| | Self Employed | 7 | 9.5 |
| | Housewives | 58 | 79.2 |
| | Others | 7 | 9.2 |
| | **Total** | **73** | **100** |
| Income | ≤ Rp 1,000,000 | 40 | 54.7 |
| | Rp 1,000,000 - Rp 2,000,000 | 24 | 32.8 |
| | Rp 2,000,000 – Rp 3,000,000 | 8 | 10.9 |
| | ≥ Rp 3,000,000 | 1 | 1.4 |
| | **Total** | **73** | **100** |

Source: Sumber: Primary Data Processed, 2024

The analysis indicated a positive path coefficient between predisposing factors (X1) and medication control (Z), with a β value of 0.435 and a p-value of 0.000. Given that the p-value is less than 0.05, this outcome is deemed to be statistically significant. This indicates that predisposing factors (X1) have a demonstrable impact on medication control (Z). Moreover, the path coefficient between enabling factors (X2) and medication control (Z) is also significant, with a value of β = 0.258 and a p-value of 0.013, indicating that enabling factors (X2) have an effect on medication control (Z). Concurrently, the path coefficient between reinforcing factors (X3) and medication control (Z) demonstrates a positive relationship, with β = 0.219 and p-value 0.049, which is also significant. Pursuant to the foregoing computations, it can be concluded that the reinforcing factors (X3) exert an influence on medication control (Z).

The path coefficient between medication monitoring (Z) and TPT adherence (Y) demonstrates a positive value of β = 0.947 with a p-value of 0.000, which is significant because it is below 0.05. This finding serves to substantiate the notion that medication monitoring (Z) exerts a substantial influence on TPT adherence (Y). Furthermore, the path coefficient of predisposing factors (X1) on TPT adherence (Y) through medication monitoring (Z) was found to be positive, with a value of β = 0.411, and a p-value of 0.000, indicating a significant effect. Therefore, predisposing factors (X1) were demonstrated to exert an indirect influence on TPT adherence (Y) through medication monitoring (Z).

The path coefficient of Enabling Factors (X2) on Adherence to Taking TPT Medication (Y) through Medication Monitoring (Z) demonstrates a positive value of β = 0.245 with a p-value of

0.013, which is significant because it is less than 0.05. This finding indicates that the Enabling Factor (X2) exerts an indirect influence on TPT medication adherence (Y) through the mechanism of medication monitoring (Z). Furthermore, the path coefficient of Reinforcing Factors (X3) on TPT Adherence (Y) through Medication Monitoring (Z) is also positive, with β = 0.207 and p-value 0.047, indicating a significant effect. Therefore, Reinforcing Factors (X3) have also been proven to influence Adherence to Taking TPT (Y) through Monitoring of Taking Medication (Z).

## Discussion

### *Demographics of PMO Toddlers in Close Contact in Jember Regency*

Based on the findings obtained, it shows that the majority of mothers of toddlers with close contact in Jember Regency are aged 21-30 years. In their 20s, many people experience better emotional development, allowing them to face challenges in marriage better and are able to think and make decisions in the family. The research data also shows that the majority of mothers of close contact toddlers in Jember Regency have a high school education level, which can be interpreted that respondents are included in the higher education category. This can have a positive impact on the quality of their children's education, because educated mothers tend to be more involved in their children's education and development. the majority of mothers of close contact toddlers in Jember Regency have a working level as housewives also shown. In Jember Regency, most mothers act as housewives, so more time is spent serving the family. Housewives play an important role in childcare and household management, which has a direct impact on family development.

The research data shows that the majority of mothers of toddlers with close contact in Jember Regency are classified as low-income families, which can be caused by various factors including low access to decent work, limited education, and economic opportunities. These limitations often affect the quality of life and education of children. However, these mothers are often important pillars in the family, playing a role in caring for and managing the household. Increasing access to education and skills training for them can help maximize family income and overall well-being by helping the family's finances without having to leave the house.

### *The Influence of Predisposing Factors on Compliance in Taking TPT Medication in Toddlers with Close Contact with TB*

Predisposing factors, including knowledge, motivation, and educational strategies employed by PMOs, have been identified as significant contributors to adherence to TPT medication regimens. These driving factors include aspects that facilitate a person's behavior, such as knowledge, attitudes, beliefs, values, and social and cultural norms (Janz & Becker, 2020). Motivating variables serve as benchmarks for individuals or groups during a learning experience. These references can facilitate or inhibit a health behavior.

The analysis demonstrates that the path coefficient of Predisposing Factors (X1) on Adherence to Taking TPT (Y) through Monitoring of Taking Medication (Z) is positive at β =

0.411 with a p-value of 0.000, which is significant because it is smaller than 0.05. Therefore, it can be concluded that predisposing factors (X1) have a significant effect on adherence to taking TPT (Y) through the role of monitoring taking medication (Z). It can be interpreted that all respondents gave positive values to the driving factors both in low and high achievement health centers.

Individual experiences influence decision making or attitudes regarding health behavior for themselves and their families. However, in reality, what was found in this study was that health centers with low performance in providing TPT could be influenced by the environment with the same problems. The findings of this study are similar to those of (Herawati, Abdurakhman, & Rundamintasih, 2020), (Bukan, Limbu, & Ndoen, 2020), (Fentahun, Wasihun, Mamo, & Gebretsadik, 2020), reporting that knowledge influences attitudes and behaviors in individual health.

The choice of educational strategies could be done in various forms, through posters, leaflets, educational videos or personal communication. Although education obtained from health provider still encounters obstacles in its implementation. It is proven during home visits that sick families are found not using any mask and implementing cough etiquette at home. this could be caused by the education is not properly being understood and not considered important. It is necessary to always monitor and continue to remind the families, because the personal equipment like mask and cough etiquette was being considered as one of the most important factors in the provision of TPT drugs.

### *The Influence of Enabling Factors on TPT Medication Compliance in Toddlers with Close Contact with TB*

Enabling factors are defined as elements that facilitate the emergence of a particular behavior. These factors encompass a wide range of aspects, including but not limited to, health facilities and infrastructure. This factor serves as the underlying principle that enables the emergence of motivation or encouragement to take action. (Green, 2016) posits that enabling factors include the potential and resources present within the community, such as the state of the physical environment and the availability of health facilities. Furthermore, this factor encompasses the accessibility of resources, including cost, distance to health facilities, staff skills, and other pertinent factors (Jamaluddin, 2019). The findings of the analysis indicate that the path coefficient of Enabling Factors (X2) on Medication Control (Z) is β = 0.258 with a p-value of 0.013, which is significant because the value is below 0.05. Consequently, the enabling factors (X2) have been demonstrated to exert an influence on medication control (Z).

Attitude is not an action or activity; it is a tendency towards behavior. That the attitude of PMO towards the TPT program is given a good result. PMO also has a good perception regarding TPT because they know the function of TPT (Pratama & Indarjo, 2021). The attitude of health workers when providing services affects patients' acceptance in making decisions. understanding the program will foster a sense of empathy that is owned so that it will have an impact on the success of a program, because it can increase patient trust.

The availability of drugs in health facilities and the access of

obtaining drugs will affect a person in undergoing treatment because this is an enabling factor that can facilitate individuals to show certain behaviors. Datiko et all, (2017) showed that out of 3,027 children without symptoms of TB aged 5 years who were eligible to be given TPT, only 1,761 (58%) received TPT, the remaining 1,266 (42%) did not receive TPT due to a lack of TPT drug stock, this was caused by logistical problems in procuring TPT drug stock.

The availability of drugs in the service also affects the continuity of services, especially program drugs because program drugs are packaged in the form of treatment packages and are not sold freely. In addition, the choice of treatment package also affects compliance with taking medication and minimizing side effects. From the data, it was found that 69 toddlers used the 6H regimen, meaning that toddlers had to take Isoniazid for 6 consecutive months without a break. This preparation was chosen because it has minimal side effects but a long treatment period (SITB Jember district, 2023). The availability of drugs provides confidence to families to comply with taking and can protect children from TB.

### The Influence of Reinforcing Factors on TPT Medication Compliance in Toddlers with Close Contact with TB

Reinforcing factors are defined as elements that encourage or strengthen the occurrence of a behavior. This factor is reflected in the attitudes and actions of officers, family members, friends, officials, or reference groups who are trusted as role models. This factor focuses on individuals who are able to influence others to take action or engage in health behaviors (Herawati, Abdurakhman, & Rundamintasih, 2020). The analysis indicates that the path coefficient of Reinforcement Factor (X3) on Medication Control (Z) is positive at $\beta = 0.219$ with a p-value of 0.049, which is significant because it is less than 0.05. Therefore, the Reinforcement Factor (X3) has been demonstrated to exert an influence on the Control of Taking Medication (Z). However, the presence of inadequate family support can hinder the efficacy of the program, potentially contributing to its failure.

The impact of family support elements can be beneficial or detrimental, depending on the family's attitudes and behaviors. Family support is very important because it greatly affects the PMO's psyche during treatment. With family support, toddlers and mothers will receive attention both materially and psychologically which will have an impact on medication adherence and treatment success. This study found that family support in health centers with high achievement was in health centers with Javanese ethnicity, this was different from health centers with Madurese ethnicity, which provided less support because they were more obedient to the elders in the family. This element highlights individuals who are able to persuade others to engage in certain health actions or practices.

The role of health workers in this regard is significant, as they have the capacity to influence patient behavior in a positive direction. Healthcare professionals play a pivotal role in enhancing the quality of healthcare services within communities, which significantly contributes to the efforts to prevent pulmonary tuberculosis (PTB), particularly in ensuring adherence to treatment with directly observed therapy (DOT) (Lawrence, Green, & Ottoson, 2016). Mothers who provide

exclusive breastfeeding receive support from health workers, which in turn encourages them to continue this practice with their infants. Furthermore, the support of officers has been shown to enhance PMO confidence in executing TPT and to cultivate the belief that assistance will be provided in the event of encountered impediments during implementation (Budiana, Woge, & Paschalia, 2021).

### The influence of the role of PMO on compliance with taking TPt medication in toddlers with close contact with TB

It is imperative to acknowledge the pivotal function of drug supervisors in the realm of anti-tuberculosis treatment (ATT). These individuals play a pivotal role in ensuring that patients with tuberculosis adhere to the prescribed regimen of anti-tuberculosis drugs (OAT) in a timely and consistent manner, as outlined by the attending physician, until the patient is declared cured. The Indonesian Ministry of Health (2021) stipulates that patients can be considered cured if the BTA test results show negative. The role of Drug Ingestion Supervisor (PMO) can be fulfilled by health workers, health cadres, or family members. The family designated to serve as PMO must possess certain qualities, including being known, trusted, and approved by health workers and patients (Fitriani, Pratiwi, & Betty, 2020). The findings of the analysis indicate that the coefficient of the path of monitoring drug swallowing (Z) on compliance with taking TPT (Y) is positive with $\beta = 0.947$ and a p-value of 0.000, which is significant because it is less than 0.05. Consequently, the monitoring of medication swallowing (Z) has been demonstrated to exert a substantial influence on adherence to TPT (Y).

PMO would monitor and accompany clients in taking medication and also monitor side effects and obstacles during treatment. Everyone who takes long-term medication needs a monitor and companion to ensure that this treatment is for their health and prevents illness and disability. The findings of this study are the same as those of (Hendri, Yani, & Edison, 2021) (Herawati, Abdurakhman, & Rundamintasih, 2020) showing that reinforcement and health promotion efforts have an effect on medication adherence in the tuberculosis prevention therapy (TPT) program. In addition, the role of program supporters (cadres) is very important in assisting family PMOs in overcoming obstacles to program implementation because they have time flexibility compared to health workers. The health office collaborates with partners (Yabisha and Sekawan) in assisting TB SO and RO patients and families in compliance with taking OAT and close contact TPT programs in all sub-districts throughout Jember Regency.

### Conclusion

The analysis indicates that predisposing factors exert a substantial influence on medication adherence. However, it is imperative to enhance communication and education strategies to augment knowledge and prevent family TB transmission. The factors that enable the process also influence medication control, especially through the role of health workers and the logistics that must be maintained to ensure TPT compliance. Research has demonstrated that reinforcing factors, particularly family support, play a significant role in medication control. Consequently, Puskesmas in Jember District are advised to optimize the empowerment of cadres for

education, motivation, and mentoring of mothers of children under five with TB. The involvement of family members as supporters during TPT is of significant importance. Furthermore, cadres are tasked with conducting home visits for toddlers encountering difficulties, with the objective of minimizing treatment failure rates. The dissemination of educational media, such as videos, and the propagation of information through social media channels, is also recommended to enhance public awareness.

## Conflict of Interest

The authors declare that they have no conflict of interest.

## Author contribution

The first author was responsible for the conceptualization and design of the research, the collection and analysis of data, the supervision of field data collection, and the preparation of the manuscript. The second and third authors contributed to the analysis and interpretation of the data, revised the final manuscript for publication, and gave final approval to the published version.

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