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Pulmonary Tuberculosis Transmission and Family-Based Prevention Efforts: Evidence from Samarinda, Indonesia

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ABSTRACT

Background: Pulmonary tuberculosis (TB) remains a major public health concern in Indonesia, including Samarinda, where transmission often occurs within families due to close contact with patients. Family-based interventions are essential to strengthen preventive behaviors and reduce transmission risk; however, limited family participation continues to hinder their effectiveness. Purpose: This study aimed to analyze the relationship between family roles and pulmonary TB prevention behavior in the working areas of Karang Asam, Wonorejo, and Loa Bakung Health Centers, Samarinda. Methods: A cross-sectional quantitative design was employed involving 80 respondents selected through purposive sampling. Data on family participation in TB prevention were collected via questionnaires and analyzed using the Chi-Square test. Results: A significant relationship was found between family roles and TB prevention behavior ($p = 0.001 < 0.05$). Families actively involved in prevention demonstrated better practices, including consistent mask use, maintaining ventilation, and treatment adherence. Conclusion: Family-based interventions play a vital role in TB prevention. Strengthening family education, counseling, and empowerment—alongside collaboration among health workers, community cadres, and policymakers—is crucial. Implementing structured psychoeducation and community engagement strategies can effectively reduce stigma, improve adherence, and enhance TB prevention efforts.

Keywords: *Pulmonary Tuberculosis, Family Role, Prevention, Family-Based Intervention*

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INTRODUCTION

Pulmonary tuberculosis (TB) is an infectious disease caused by Mycobacterium tuberculosis, which primarily affects the lungs and remains a major global health challenge (Izumi et al., 2019; Pramono et al., 2024). According to the World Health Organization (WHO, 2023), there were an estimated 10.6 million new TB cases worldwide in 2023, with more than 1.5 million deaths. Indonesia ranks second in the world after India in terms of TB burden, making the disease a persistent public health concern.

Transmission of pulmonary TB occurs through airborne droplets when an infected individual coughs or sneezes, which places household members at high risk (Pramono, 2021). Families play a crucial role in prevention, not only as emotional supporters but also as supervisors of patient adherence to medication and implementation of preventive behaviors (Ghanaiee et al., 2022). Studies show that optimal family support contributes significantly to treatment success, where family members acting as Drug Swallowing Supervisors (PMO) increase compliance and recovery outcomes (Jufrizal et al., 2016; Nasution et al., 2020; Pramono et al., 2023).

Family attitudes and behaviors strongly influence the risk of household transmission. Families with better knowledge and positive attitudes are more likely to implement preventive measures such as mask use, maintaining good ventilation, and ensuring household cleanliness (Nurliani et al., 2024). Family-based interventions, including health education and empowerment programs, have proven effective in strengthening family roles in TB care and transmission prevention (Tri Wahyuni et al., 2020; Mariani et al., 2022; Sunaryo et al., 2020). Support is also essential in preventing multidrug resistance by ensuring treatment completion (Arini et al., 2024).

Nevertheless, several challenges hinder the implementation of family-based interventions, such as limited knowledge, social stigma, and restricted access to health services (Rachmawati et al., 2018). Collaborative approaches between health workers and families are needed to address these barriers (Stang et al., 2021; Stang et al., 2023). Evidence suggests that psychoeducation improves knowledge, reduces family anxiety, and enhances self-efficacy in caring for TB patients (Maryatun, 2020; Heri et al., 2020; Setiyaningrum & Alfian, 2023; Cahyawati et al., 2023).

In Samarinda, the incidence of pulmonary TB remains high, while family involvement in prevention is still suboptimal. This study aims to analyze the relationship between family roles and preventive behaviors against TB transmission in the working areas of Karang Asam Community Health Center, Wonorejo Community Health Center, and Loa Bakung Health Center Community Health Center, Samarinda. The findings are expected to contribute to the development of more effective family-based prevention programs through empowerment strategies.

METHODS

This study examines the association between family roles and preventative behavior of pulmonary tuberculosis transmission using a quantitative approach with a cross-sectional design. The study was carried out between January and March 2025 in the working areas of three Community Health Center health center: Karang Asam Community Health Center, Wonorejo Community Health Center, and Loa Bakung Community Health Center, Samarinda. The population

of this study was families with a family member with pulmonary tuberculosis. A total of 80 respondents were used for the sample. The sample was drawn using a purposive sampling method. The inclusion criteria were that families with members receiving treatment for pulmonary tuberculosis must be willing to participate in the study.

Data were collected using a structured questionnaire that measured the role of families and prevention behaviors of pulmonary TB transmission. The validity and reliability of the instrument are tested before use. The collected data was analyzed using the Chi-Square statistical test to see the relationship between the variables. The results of the analysis are presented in the form of frequency and percentage distribution tables for categorical variables and are equipped with the interpretation of statistical test results. The presentation of data was carried out in a descriptive and analytical manner to provide an in-depth picture of role of family in the prevention of pulmonary TB transmission.

This research has received ethical approval from the Health Polytechnic of the Ministry of Health of East Kalimantan number DP.04.03/F.XXXIV.25/0289/2025

RESULTS

This study was conducted on 80 respondents who are family members of pulmonary tuberculosis patients in the Working Area of the Karang Asam Community Health Center, Wonorejo Community Health Center, and Loa Bakung Community Health Center, Samarinda

1. Characteristics Respondent

Table 1. Characteristics of Respondents

Characteristic	Frequency (n=80)	Percentage (%)
Age		
15-60 years old	70	87.5
≥60 years	10	12.5
Gender		
Man	39	48.75
Woman	41	51.25
Education		
Primary school	3	3.75
Junior High School	20	25
High School	47	58.75
College	10	12.5
Work		
Not Working	12	15
Housewives	28	35
Private Employees	24	30
Self-employed	11	13.75
Civil Servants	5	6.25

Based on the results of the respondents' characteristics, the majority of the study participants were in the adult age group of 15–60 years (87.5%), while only 12.5% were over 60 years old. This shows that most of the respondents are of productive age. The number of female respondents was more (51.25%) than male respondents (48.75%). This indicates that women are more involved in research, likely because of their role in family and health.

Most respondents had a last high school education (58.75%), followed by a bachelor's degree (12.5%), and a lower pondents worked as private employees (30%), followed by housewives (30%), non-working (15%), entrepreneurs (13.75%), and civil servants (6.25%). This type of work may contribute to different levels of risk of exposure to tuberculosis in the community.

Table 2. Family Member Roles

Categories	f	%
Good	49	61.25
Not Good	31	38.75
Total	80	100

Table 2 shows that most of the respondents have a good family role in efforts to prevent the transmission of pulmonary TB as many as 49 people (61.25%), while the other 31 people (38.75%) have a poor family role.

Table 3. Behavior of Efforts to Prevent TB Transmission

Categories	f	%
Good	48	60.0
Not Good	32	40.0
Total	80	100

Table 3 illustrates that good prevention behavior of pulmonary TB transmission was also found in 48 people (60.0%), while 32 people (40.0%) had poor preventive behavior.

Table 4. The relationship Between the Role of Family Members and Tuberculosis (TB) Transmission Prevention Behaviors

Role Family Members	Behavior to Prevent TB Transmission				Total		p-value	OR 95% CI
	Good		Not Good					
	N	%	N	%	N	%		
Good	47	56.75%	2	2.5%	49	61.25%	0.001	705,000 61.218-8118.975
Not Good	1	1.25%	30	37.5%	31	38.75%		
Total	48	60%	32	40%	80	100%		

Table 4 shows the relationship between the role of family members and the prevention behavior of tuberculosis (TB) transmission. of the total 80 respondents, the majority (61.25%) had family members with good roles, while the other 38.75% had family members with poor roles.

In the group with good family member roles, as many as 47 respondents (56.75%) had good TB prevention behavior, while only 2 respondents (2.5%) showed bad behavior. On the other hand, in the group with poor family member roles, only 1 respondent (1.25%) had good TB prevention behavior, while 30 respondents (37.5%) had poor behavior.

The results of the statistical test showed a *p-value* of 0.001, which means that there was a significant relationship between the role of family members and TB prevention behavior ($p < 0.05$). In addition, an *Odds Ratio (OR)* value of 705.000 with a confidence interval of 95% (61.218–8118.975) suggests that individuals with a family member who has a good role have a much greater likelihood of having good TB prevention behavior compared to individuals whose family members have a bad role.

These findings indicate that family support plays a very important role in TB prevention. The role of a good family, such as providing motivation, reminding medication schedules, and ensuring a healthy environment, contributes to improved TB prevention behavior. Therefore, TB prevention efforts can be more effective if families are involved as part of public health interventions.

DISCUSSION

The central finding of this study is the very strong relationship between family roles and tuberculosis (TB) prevention behaviors. Statistical analysis showed that families with good roles were 705 times more likely to practice effective prevention compared to those with poor roles. This exceptionally high Odds Ratio underscores that family involvement is the single most decisive determinant of prevention behavior in this study population. Families that actively supervise treatment, encourage mask use, ensure adequate ventilation, and maintain household cleanliness create an environment that significantly reduces TB transmission risk. This aligns with prior studies demonstrating that family support is critical for treatment adherence and household-level prevention (Jufrizal et al., 2016; Nasution et al., 2020; Soleman et al., 2021).

While demographic characteristics such as age, gender, and occupation provide useful background context, they were not the primary focus of the analytical findings. Their relevance lies in shaping the conditions under which family roles are exercised. For example, productive-age respondents may face greater exposure risks due to mobility (Mia et al., 2022), and women often take on caregiving responsibilities that strengthen family engagement in prevention (Paneo & Nursasi, 2019; Chee et al., 2022). However, the results of this study emphasize that regardless of these demographic factors, it is the quality of the family's role that most strongly determines whether preventive behaviors are im plemented.

These findings have critical implications for TB control in Samarinda. Interventions should prioritize empowering families through education, counseling, and capacity building to maximize their preventive role. Programs that integrate family-centered approaches into existing TB strategies could substantially reduce household transmission, especially in high-burden urban areas. In this

way, demographic characteristics serve more as contextual modifiers, while the family's role remains the primary driver of prevention behavior as demonstrated by the statistical analysis in this study.

The study also confirmed that family involvement is crucial in TB prevention. A majority of respondents demonstrated good family roles in providing psychosocial support, ensuring treatment adherence, and creating a healthy household environment. Previous research has consistently shown that family support improves treatment outcomes and enhances adherence to TB medication (Alis Setiyadi & Setyowati, 2022; Chen et al., 2020; Soleman et al., 2021). Families who act as Drug Swallowing Supervisors (PMO) contribute significantly to treatment success by reminding patients of medication schedules and monitoring preventive practices (Jufrizal et al., 2016; Nasution et al., 2020).

Despite these positive findings, 38.75% of families in this study still had poor roles in TB prevention. In the context of Samarinda, several underlying factors may explain this situation. First, variations in education levels remain a major barrier, as families with limited formal education often lack adequate knowledge of TB transmission and prevention, leading to misconceptions and inconsistent practices. This is consistent with evidence that low community literacy significantly reduces TB prevention behavior in Indonesian settings (Yuantari et al., 2024). Second, the persistence of stigma around TB in Samarinda communities contributes to reluctance in openly discussing the illness or supporting preventive measures at the household level. Stigmatization may cause families to hide the patient's condition, thereby limiting opportunities for effective prevention. Similar findings were reported in a multi-site study in Indonesia, where more than 60% of TB patients experienced moderate stigma that negatively affected mental health and quality of life (Fuady et al., 2024). Third, socioeconomic constraints are evident, particularly in densely populated urban areas where many families live in substandard housing with poor ventilation.

These conditions increase the risk of household transmission and make it more difficult for families to implement recommended practices such as adequate airflow and patient isolation. Studies have shown that low-income households in Indonesia face significant challenges in TB management due to limited financial capacity and restricted access to health services (Deniati et al., 2022), and similar patterns have been observed internationally, where socioeconomic hardship contributes to poor treatment outcomes (Nidoi et al., 2021).

These contextual barriers are consistent with, but also expand upon, findings from other regions (Msoka et al., 2021), emphasizing that local socioeconomic disparities, stigma, and environmental challenges uniquely shape the role of families in Samarinda. Addressing these issues requires tailored interventions, such as community-based education adapted to literacy levels, stigma reduction campaigns, and targeted social support for vulnerable households.

This study provides strong evidence of the critical influence of family roles on tuberculosis (TB) prevention behaviors. The statistical analysis showed an exceptionally high Odds Ratio (OR = 705), indicating that families with good roles were more than 700 times more likely to demonstrate effective prevention behaviors compared to families with poor roles. This magnitude far exceeds associations typically reported in similar studies, highlighting the powerful effect of family support

in shaping health behaviors. The finding suggests that even small improvements in family engagement can yield disproportionately large benefits in TB prevention.

While the majority of respondents practiced preventive measures such as mask use, adequate household ventilation, and treatment adherence, 40% still exhibited poor prevention behaviors. This gap underscores persistent challenges such as limited education, stigma, and restricted access to health services (Sejie & Mahomed, 2023). Within the Samarinda context, where high TB incidence intersects with varying socioeconomic conditions, these barriers may limit families' ability to consistently apply prevention strategies.

Importantly, the results reinforce that strong family involvement not only provides emotional and logistical support but also acts as a decisive determinant of whether preventive practices are adopted. Previous studies also show that families with active roles, such as supervising medication and promoting healthy living conditions, significantly improve adherence and reduce household transmission (Wen et al., 2020). Therefore, family-centered interventions must be prioritized in Samarinda's TB control strategies, including cadre-led education, counseling, and empowerment programs that directly target households.

Overall, the exceptionally high OR found in this study provides compelling evidence that strengthening family roles is not merely beneficial but essential for accelerating TB prevention efforts in high-burden regions.

1. Research Limitations

When interpreting the findings, it is important to take into account the many limitations of this study. First, the research design used is cross-sectional, so it can only describe the relationship between family roles and tuberculosis (TB) prevention behavior at one point in time without being able to determine the causal relationship. Longitudinal studies are needed to understand long-term preventive behavioral change and the effectiveness of family-based interventions in greater depth.

Second, the data collected depends on self-reporting, which has the potential to cause information bias due to the subjectivity of the respondents or the tendency to give answers that are considered more socially desirable (social desirability bias). Future research may consider the use of observation methods or data triangulation to improve the validity of the findings.

Third, the research was conducted within a specific region, so the results may not be generalized to a wider population with different social and cultural characteristics. Comparative studies in different regions with diverse socioeconomic backgrounds can provide more comprehensive insights into the factors that influence the role of families in TB prevention.

Finally, this study has not explored other factors that can influence TB prevention behavior in families, such as education levels, access to health services, and social stigma that may be barriers to the implementation of prevention efforts. Further research can include these variables to provide a more holistic understanding of the determinants of TB prevention behavior in the family context.

2. Research Implication

The findings of this study emphasize the importance of integrating family-based interventions into tuberculosis (TB) control programs. Optimal family involvement not only enhances patient adherence to treatment but also supports the creation of a healthy household environment, thereby reducing the risk of transmission (Chen et al., 2020; Soleman et al., 2021).

From a programmatic perspective, TB control strategies should incorporate structured family education, capacity building, and counseling to address gaps in knowledge, stigma, and treatment adherence. Empowering families to serve as supervisors and supporters in TB management is essential to ensure continuity of care (Jufrizal et al., 2016; Nasution et al., 2020).

The study also highlights the need for a collaborative and multidisciplinary approach. Health workers, community cadres, and policymakers should strengthen partnerships with families to develop sustainable prevention strategies. This includes policy frameworks that support psychoeducation, community engagement, and social protection for families affected by TB (Stang et al., 2021; Maryatun, 2020).

In practice, prioritizing family-centered approaches within national TB programs could accelerate progress toward TB elimination in high-burden areas such as Samarinda. Such strategies may also serve as a model for other regions facing similar epidemiological and social challenges.

CONCLUSIONS

This study show significant association between family roles and preventive behaviors against pulmonary tuberculosis (TB) transmission. Respondents with strong family involvement were more likely to implement effective preventive measures, including adherence to treatment, consistent mask use, and maintaining proper household ventilation. These findings reinforce the critical role of families not only as emotional supporters but also as active supervisors in ensuring treatment compliance and creating a healthy home environment.

The results highlight the necessity of strengthening family-based interventions as an integral component of TB control strategies. Continuous education for families is essential to improve understanding of TB prevention, while the active role of health workers and cadres in mentoring and supporting families is crucial for sustaining treatment adherence. Furthermore, government and health organizations need to develop supportive policies that promote family empowerment through structured counseling, peer-support groups, and community-based programs

In conclusion, empowering the role of families in preventing pulmonary tuberculosis (TB) transmission is crucial, as active family involvement can substantially reduce the spread of the disease both within households and across communities. Comprehensive and sustainable family-centered interventions should therefore be prioritized as part of broader TB elimination efforts in Indonesia.

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