



Determinants Of Family Behavior In Tuberculosis Prevention: A Cross-Sectional Study In Baturraden II Health Center, Indonesia

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Abstract

Introduction: Tuberculosis (TB) remains a major global health challenge until now. Indonesia's ranking is among the top three high-burden countries. Banyumas Regency reported 3,042 cases in 2021, the highest in Central Java. Families play a critical role in TB prevention, yet their involvement remains suboptimal. This study explores factors influencing family behavior in TB prevention within the Baturraden II Community Health Center area to strengthen prevention strategies.

Method: This quantitative study employed a cross-sectional approach. A total sampling technique was used to include all 56 families with TB cases in the Baturraden II Community Health Center working area. Data collection was conducted through interviews using structured questionnaires. Data analysis was done through Chi-Square tests and logistic regressions.

Results: The bivariate analysis revealed that knowledge ($p=0.001$), attitudes ($p=0.022$), and access to information ($p=0.025$) were significantly related to TB prevention behavior. The multivariate analysis further indicated that knowledge ($p=0.003$), attitudes ($p=0.010$), and access to information ($p=0.021$) significantly associated to family behavior in preventing tuberculosis. Knowledge emerged as the strongest factor, with an odds ratio (OR) of 10.2, indicating that respondents with low knowledge were 10.2 times more likely to fail in adopting preventive behavior.

Conclusion: Family with low knowledge about TB were at a higher risk of not practicing TB prevention in Baturraden II primary healthcare center working area. Enhancing knowledge and promoting appropriate preventive practices are essential strategies for increasing preventive family behavior.

Keywords: Tuberculosis; prevention; family behavior; knowledge; attitude.

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Introduction

Tuberculosis (TB) is an infectious disease caused by *Mycobacterium tuberculosis*, primarily affecting the lungs. Despite being preventable and treatable, TB remains a significant global health challenge and one of the leading causes of

death from infectious diseases, claiming 1.5 million lives annually.¹ Each year, approximately 10 million people are infected with TB. Indonesia ranked among the top three high-burden countries, following India and China. In 2020 alone, Indonesia recorded 824,000 TB cases and

93,000 TB-related deaths.¹ Indonesia is one of eight countries contributing to two-thirds of the global TB burden, underscoring the urgent need for comprehensive prevention and control strategies aligned with the Sustainable Development Goals (SDGs) and the World Health Organization's (WHO) targets to reduce TB-related mortality.

The Indonesian government has prioritized TB control through innovations, acceleration, and the expansion of national programs. However, challenges remain at the community level, particularly among families. Factors such as inadequate knowledge, attitudes, and preventive practices contribute to the continued spread of TB. According to Indonesia's Ministry of Health (2020), TB prevention is guided by four pillars: managerial, administrative, environmental, and self-control measures.² Despite this framework, studies reveal substantial gaps in family knowledge and behaviors related to TB prevention. For instance, research in Magelang found that only 66% of respondents practiced good prevention measures, while 34% had poor preventive practices.³ Similarly, a study in Jambi showed that 54 out of 68 TB patients exhibited inadequate preventive behaviors, with knowledge significantly associated with preventive efforts ($p = 0.002$). These findings highlight the critical role of family education in TB control.⁴

In Central Java Province, TB case detection rates declined between 2019 and 2020, with the Case Notification Rate (CNR) dropping from 211 to 113 per 100,000 population. A similar trend occurred in Banyumas Regency, where the CNR decreased from 232 to 166 per 100,000 in the same period. By 2021, the CNR increased to 179 per 100,000 but remained below pre-pandemic levels. Banyumas Regency reported the highest TB incidence in Central Java, with 3,042 cases recorded in 2021.⁵ Despite these concerning trends, there is limited research on the behavioral and knowledge-related factors contributing to TB transmission at the community level, particularly in high-incidence areas. A preliminary survey at Baturraden II Health Center—located in Banyumas Regency, the region with the

highest TB burden in Central Java—revealed 56 TB cases across six villages. The findings indicated that limited family knowledge and poor preventive practices, such as inconsistent mask usage, improper coughing etiquette, and inadequate access to TB prevention information were key drivers of transmission. Furthermore, observations confirmed that many families did not adhere to Clean and Healthy Living Behaviors (PHBS), exacerbating the spread of TB. Given Baturraden's high case load within the most affected regency and the evident gaps in community awareness and preventive practices, this study selects Baturraden as a critical location to investigate the knowledge and behavioral factors influencing TB transmission. The findings will help design targeted interventions to improve prevention and reduce TB incidence in high-risk communities.

Existing studies highlight the critical role of family behavior in TB prevention. For instance, Kristini and Hamidah (2020) found that despite adequate housing conditions and low smoking rates among families of TB patients, close contact with infected individuals (71.4% for >8 hours/day) increased exposure risk.⁶ Similarly, previous study also demonstrated that higher knowledge levels (61.2%) correlated with greater participation in prevention (51%), reinforcing the importance of health education ($p = 0.002$).⁷ Interventions such as family-centered education and nurse-supported household modifications have shown promise in improving knowledge and practices. However, these efforts often face limitations, including the slow pace of behavioral change during long treatment periods and uneven program implementation due to resource constraints.^{8,9}

Despite ongoing TB control efforts, programs in high-burden regions like Baturraden continue to face critical challenges. First, health education efforts remain fragmented, with inconsistent messaging that often fails to reach the most vulnerable households. Second, there is little follow-up to ensure families maintain prevention practices outside of clinical settings. Third, programs rely too heavily

on passive approaches—like posters or occasional counseling sessions—rather than active, culturally adapted engagement with communities. While existing research confirms that health education can improve knowledge, attitudes, and practices (KAP), important gaps remain. We still lack a clear understanding of which factors—such as cultural beliefs, financial limitations, or family dynamics—have the strongest influence on prevention behaviors in high-risk communities like Baturraden.

This study directly addresses these gaps by examining the real-world factors shaping family behaviors in Baturraden, where TB rates stay alarmingly high despite current interventions. By uncovering local barriers (such as misinformation, economic hardship, or distrust in healthcare) and exploring how families and health workers can work together more effectively, our research provides practical insights for improving TB prevention strategies. Rather than taking a broad KAP approach, we focus on actionable, community-specific solutions that can strengthen Indonesia's TB control efforts while meeting national health targets. Ultimately, this study seeks to identify the key drivers of family prevention behaviors in the Baturraden II Health Center area. The results will help design more effective strategies to engage families in TB control—a critical step toward Indonesia's goal of eliminating tuberculosis.

Methods

This study utilized a quantitative cross-sectional design to examine the determinants of tuberculosis prevention behavior among families in the catchment area of Baturraden II Health Center, Banyumas Regency. The selection of Baturraden II was based on its status as the highest TB-burden area within the region, with preliminary data from the District Health Office (2023) identifying 56 active cases across six villages (Rempoah, Pandak, Kemutug Kidul, Kemutug Lor, Karangsalam, and Karangmangu) - making it an ideal setting to investigate gaps in family-level prevention practices. The study employed a total sampling approach by including all 56 registered family caregivers of TB patients under the health

center's supervision. After applying exclusion criteria (current TB-positive status or undergoing tuberculosis preventive therapy), the final sample comprised 52 respondents. While this sample size may appear limited, it represents 93% of the target population in this specific high-transmission setting, which is considered adequate for focused behavioral studies in localized high-burden areas, as demonstrated in similar TB research.

Data collection was conducted over four months (September-December 2023) to accommodate several methodological considerations. The extended duration allowed for comprehensive household visits that required coordination with local health workers to locate dispersed families, particularly in remote areas of the health center's coverage. Additionally, this timeframe incorporated a crucial pilot testing phase in Kutasari Village, a demographically comparable area, which revealed the need to adjust questionnaire items for cultural appropriateness and clarity. The research instrument was developed through a rigorous process that included: (1) adaptation of validated items from established TB behavior studies (Rizana & Tahlil, 2016; Paneo & Nursasi, 2019); (2) expert review by two TB program coordinators and an epidemiologist; and (3) statistical validation showing acceptable reliability (Cronbach's Alpha ≥ 0.6 for all scales except knowledge, which was subsequently improved through item refinement).

To assess TB prevention behavior - the dependent variable - we developed a comprehensive categorization system based on adherence to Clean and Healthy Living Behaviors (PHBS) specific to TB prevention. Good prevention behavior was operationally defined as consistent practice ($\geq 80\%$ frequency) of five key indicators: (1) proper mask usage when caring for patients, (2) adherence to coughing etiquette, (3) maintaining adequate room ventilation, (4) ensuring sunlight exposure in living spaces, and (5) regular disinfection of patient areas. Poor prevention behavior was categorized as failing to meet at least three of these five indicators or demonstrating less than 50% compliance

overall. This threshold was established through expert consultation with TB program coordinators and aligned with Indonesia's Ministry of Health guidelines on household TB prevention.

The study collected both primary data through face-to-face interviews using the validated questionnaire and secondary data from health center records. Analytical approaches included univariate analysis to describe respondent characteristics, bivariate analysis using chi-square tests to examine relationships between variables, and multivariate logistic regression to identify key predictors while controlling for potential confounders. Ethical approval was obtained from the Health Sciences Faculty Ethics Committee (Approval No. 1274/EC/KEPK/XI/2023), with particular attention to informed consent procedures, participant anonymity, and equitable treatment of all respondents throughout the research process. The methodological design and implementation were specifically tailored to address the unique challenges of studying TB prevention behaviors in this high-prevalence, resource-limited setting while ensuring scientific rigor and ethical compliance.

Results

A total of 52 families of TB patients participated in this study. The characteristics of the respondents are presented in Table 1, while the characteristics of TB patients are detailed in Table 2.

Based on the univariate analysis conducted, the majority of respondents were in the early elderly age group (46–55 years), accounting for 36.5%. The youngest respondent was 22 years old, while the oldest was 59 years old. In terms of gender, 28.8% of the respondents were male, while 71.2% were female. The highest number of respondents had completed high school education, with a total of 20 respondents (38.5%), while the lowest number had completed a diploma or bachelor's degree, with only 5 respondents (9.8%). It was also observed that the most common occupation among respondents was being a housewife (44.2%), while the least common was being an entrepreneur (3.8%).

The majority of respondents demonstrated good knowledge about tuberculosis prevention, with a percentage of 51.9%, compared to 48% who had poor knowledge. In terms of attitude, 55.8% of respondents exhibited a positive attitude, making it the highest percentage within this variable, while 44.2% had a negative attitude. Regarding access to information, the majority of respondents (63.5%) reported easy access to information, whereas 36.5% faced difficulty accessing information. For the health worker support variable, 51.9% of respondents indicated good support, while 48% perceived poor support. Finally, the prevention behavior variable showed that 51.9% of respondents practiced good prevention behavior, while 48% displayed poor prevention behavior.

Based on the univariate analysis of the characteristics of TB patients, the majority of patients belong to the late elderly age group (56–65 years), accounting for 30.8%, followed by the early elderly age group (46–55 years) at 21.2%. The youngest patient is 3 years old, and the oldest is 65 years old. Regarding the history of TB, most patients (92.3%) suffer from pulmonary TB, while only 7.7% have extrapulmonary TB. In terms of occupation, the largest proportion of patients are housewives (32.7%), followed by unemployed individuals (25.0%) and laborers (17.3%). Entrepreneurs constitute the smallest group at 3.8%, and traders at 1.9%. The gender distribution is evenly divided, with 50% male and 50% female patients. These findings indicate that TB predominantly affects older adults and housewives, with pulmonary TB being the most common type.

Based on Table 3, it can be observed that the variables associated with family behavior in preventing TB in the Baturraden II Health Center's working area, as determined by the chi-square test, are knowledge (p -value = 0.001), attitude (p -value = 0.022), and access to information (p -value = 0.025). Meanwhile, the variable of healthcare provider support is not associated with family behavior in TB prevention in the Baturraden II Health Center's working area (p -value = 0.545). Subsequently, a multivariate analysis was conducted to determine the most influential

factor affecting family behavior in TB prevention. The results of the multivariate analysis using multiple logistic regression are presented in Table 4 below

Based on Table 4, the logistic regression analysis shows that all three variables have a p-value < 0.05, indicating that they significantly influence family

behavior in TB prevention. The variable with the greatest impact is knowledge (p-value = 0.003) with an OR value of 10.228. This means that respondents with low knowledge are 10.228 times more likely to not engage in preventive behaviors against tuberculosis.

Table 1. Respondents' Characteristics

Respondent Characteristics	Frequency	Percentage (%)
Age		
Late Adolescence (17–25 years)	6	11.5
Early Adulthood (26–35 years)	12	23.1
Middle Adulthood (36–45 years)	13	25.0
Early Elderly (46–55 years)	19	36.5
Late Elderly (56–65 years)	2	3.9
Gender		
Male	15	28.8
Female	37	71.2
Education		
Primary School	18	34.6
Middle School	9	17.3
High School	20	38.5
Diploma/Bachelor's Degree	5	9.8
Occupation		
Housewife	23	44.2
Trader	8	15.4
Laborer	7	13.5
Farmer	1	1.9
Entrepreneur	2	3.8
Private Employee	11	21.2
Knowledge		
Good	27	51.9
Poor	25	48
Attitude		
Good	29	55.8
Poor	23	44.2
Access to Information		
Easy	33	63.5
Difficult	19	36.5
Health Worker Support		
Good	27	51.9
Poor	25	48
TB Prevention Behavior		
Good	27	51.9
Poor	25	48
Total	52	100.0

Table 2 Characteristics of TB Patients

Patient Characteristics	Frequency (N)	Percentage (%)
Age		
Infants (0–5 Years)	3	5.8
Children (6–11 Years)	6	11.5
Early Adolescents (12–16 Years)	1	1.9
Late Adolescents (17–25 Years)	6	11.5
Early Adults (26–35 Years)	9	17.3
Early Elderly (46–55 Years)	11	21.2
Late Elderly (56–65 Years)	16	30.8
History of TB		
Pulmonary TB	48	92.3
Extrapulmonary TB	4	7.7
Occupation		
Laborer	9	17.3
Housewife	17	32.7
Trader	1	1.9
Government/Private Employee	5	9.6
Student/University Student	5	9.6
Entrepreneur	2	3.8
Unemployed	13	25.0
Gender		
Female	26	50.0
Male	26	50.0

Table 3 Crosstabs between the factors and family behavior in TB prevention

Independent Variable		Category	Prevention Behavior						p-value
			Good		Poor		Total		
			N	%	N	%	N	%	
Knowledge		Good	18	81.8%	4	18.2%	22	100%	0.001*
		Poor	9	30%	21	70%	30	100%	
Attitude		Good	16	72.7%	6	27.3%	22	100%	0.022*
		Poor	11	36.7%	19	63.3%	30	100%	
Access to Information		Easy	17	70.8%	7	29.2%	24	100%	0.025*
		Difficult	10	35.7%	18	64.3%	28	100%	
Health Worker Support		Good	13	59.1%	9	40.9%	22	100%	0.545
		Poor	14	46.7%	16	53.3%	30	100%	

Table 4 Multivariate Logistic Regression Modeling Results

Variable	Odds Ratio (OR)	p value
Knowledge	10.228	0.003
Attitude	8.617	0.010
Access to Health Information	6.523	0.021

Discussion

The multivariate analysis revealed knowledge as the most powerful predictor of TB prevention behaviors, with families demonstrating low knowledge levels being

ten times more likely to engage in inadequate prevention practices (OR = 10.228). This robust association aligns with and strengthens the existing evidence base, including previous studies that

identified significant correlations between knowledge deficits and poor prevention practices.¹⁰ The consistency of this relationship across multiple studies suggests that knowledge operates as a fundamental prerequisite for behavioral change in TB prevention, forming the cognitive foundation upon which attitudes and practices develop.^{11,12} Previous studies have consistently established this connection, with Frisilia et al. (2021) demonstrating how knowledge gaps lead families to underestimate prevention importance, and Gunawan et al. (2022) highlighting how cultural beliefs can displace medical understanding when knowledge is insufficient.^{13,14} Our results not only confirm these earlier findings but extend them by quantifying the substantial magnitude of knowledge's influence in our specific high-burden setting.

Interestingly, our data reveal a complex relationship between information access and knowledge acquisition that merits careful consideration. While a substantial majority of respondents (72.3%) reported relatively easy access to TB-related information through various channels, we observed notable disparities in the depth and practical application of this knowledge. This apparent paradox suggests that the current challenges in our study area have evolved from basic information accessibility to more nuanced issues of information quality, comprehension, and contextual relevance. Many families reported encountering health messages that, while technically accurate, were presented in formats or language that limited their practical utility in daily life. Furthermore, the proliferation of information sources has introduced new challenges, as families must now navigate sometimes conflicting messages from traditional health providers, digital platforms, and community networks.

These findings build upon but also refine the observations of Madebo et al. (2023), whose documentation of limited utilization of printed and social media for health information may reflect not physical access barriers, but rather preferences for interpersonal communication channels, literacy limitations, or skepticism toward certain media formats.¹⁵ Our study

suggests that in the current information environment, the mere availability of multiple information channels does not automatically ensure adequate knowledge transfer or behavioral change. Rather, the effectiveness of TB education depends critically on how information is packaged, delivered, and reinforced within specific community contexts.

The strong and consistent association between knowledge and prevention behaviors underscores the need for TB education programs to evolve beyond basic information dissemination. Future interventions should prioritize the development of more sophisticated, contextually-grounded communication strategies that address not just what families need to know, but how they can most effectively learn and apply this knowledge. This might involve greater emphasis on interactive learning methods, the development of local information champions, and the creation of feedback mechanisms to ensure message comprehension and applicability. Such approaches would recognize that in today's information-rich environments, the quality and delivery of health messages have become at least as important as their basic availability.

The multivariate analysis also revealed that attitude significantly influences family behavior in preventing TB transmission (p -value = 0.010). A total of 55.8% of families demonstrated positive attitudes, which correlated with good prevention practices, such as monitoring patients' nutritional intake (50%) and encouraging patients to cover their mouths while coughing or sneezing (65.4%). This finding supports previous studies which reported a significant relationship between positive attitudes and TB prevention behaviors (p -value = 0.000).^{11,16,17} However, findings by Muzakir et al. (2021) differ, showing no significant relationship between attitude and TB prevention behavior (p = 0.301). This discrepancy may be due to variations in methodology or population characteristics.¹⁸ Another study by Zhang et al. (2024) revealed that while positive attitudes had a significant relationship with TB prevention practices (OR = 7.03), factors such as knowledge,

education, and disease duration also influenced practice scores.¹⁹

Access to information emerged as another significant variable influencing TB prevention behavior. Respondents with limited access to TB-related information were 1.75 times more likely to exhibit poor prevention behaviors compared to those with better access. This study aligns with previous research indicating that information accessibility is associated with TB prevention efforts.^{10,20} In this study, 44.6% of respondents reported never receiving TB-related information via social media, while 35.7% had not read TB prevention guidelines at health facilities. These findings indicate critical gaps in information dissemination, particularly in rural or underserved areas.

Previous studies emphasize the transformative potential of accessible health information.^{21,22} Other research noted that access to comprehensive TB information significantly enhances preventive behaviors,^{22–24} while Gunawan et al. (2022) highlighted the need for culturally sensitive educational strategies to reach families with low literacy levels.¹⁴ However, Eibich and Goldzahl (2020) cautioned that while health information improves knowledge, its direct impact on behavior change remains limited without complementary interventions, such as community engagement and support systems.²⁵

The study found that healthcare worker support did not significantly influence family TB prevention behaviors (p -value = 0.545). While 51.9% of respondents perceived this support as adequate, it did not reveal into measurable differences in prevention practices. This contrasts with some previous studies that reported strong associations between healthcare worker support and improved TB prevention behaviors (e.g., Amallia et al., OR = 13.472). However, our findings align with other research showing no significant relationship (p -value = 0.116), suggesting contextual factors may modify this association.

The apparent lack of influence from healthcare workers in our study may reflect changing patterns of health information

access rather than ineffective support. In the digital era, families increasingly obtain health information through multiple channels (social media, online platforms, community networks) beyond formal healthcare worker interactions. This democratization of information access could diminish the relative impact of healthcare worker support, as even families with limited direct support may acquire sufficient TB prevention knowledge through alternative sources. Additionally, the standardized nature of TB education in this region may have created a "ceiling effect," where both supported and unsupported families received similar baseline information through community campaigns or peer networks.^{19,26,27}

This interpretation is supported by several observations from our data: (1) overall knowledge levels were moderately high (mean score = 7.2/10) regardless of healthcare worker support status; (2) respondents frequently cited non-clinical sources (WhatsApp groups, village announcements) as primary TB information channels; and (3) no significant differences emerged in specific knowledge items between those with and without healthcare worker support. These findings suggest that in settings with robust alternative information ecosystems, the traditional role of healthcare workers as primary behavior-change agents may need re-evaluation. The study highlights the need to reconceptualize healthcare worker support in TB prevention programs. Rather than focusing solely on direct education, future interventions could leverage healthcare workers as facilitators of community-based learning networks or digital information verification systems. This approach may better align with contemporary health information-seeking behaviors while maintaining the credibility and trust associated with professional healthcare providers.

Strengths and Limitations of the Study

This study offers several notable strengths that enhance the validity and applicability of its findings. By focusing specifically on the Baturraden II Health Center area - a documented high-burden TB region in Central Java - the research

provides targeted insights that can directly inform local TB control programs. The development of a standardized, behavior-based categorization system for TB prevention practices represents a particular strength, as it moves beyond simple knowledge assessment to evaluate actual implementation of prevention measures in household settings. This operational framework, grounded in national PHBS guidelines and validated through expert consultation, offers a replicable model for similar community-based TB studies. Methodologically, the study benefits from its comprehensive approach combining total sampling of eligible caregivers (achieving 93% coverage of the target population) with mixed data collection methods, thereby enhancing the reliability of its findings. The extended four-month data collection period further strengthened the research by allowing for thorough household engagement and iterative refinement of measurement tools based on pilot testing.

However, several limitations must be acknowledged when interpreting these results. The relatively small sample size ($n=52$), while representative of the specific high-risk population under study, may constrain the generalizability of findings to broader or differently resourced settings. The cross-sectional design, while efficient for identifying associations, inherently limits our ability to establish causal relationships between identified determinants and prevention behaviors. Potential measurement biases, particularly the reliance on self-reported behaviors without systematic observational validation, may have influenced the accuracy of behavior categorization. Additionally, the study did not fully capture certain contextual factors such as economic constraints or social stigma that may significantly influence prevention practices. These limitations highlight important opportunities for future research, including longitudinal designs to track behavior change over time, incorporation of objective behavior measurement methods, and expansion to include diverse geographic and socioeconomic settings to enhance the generalizability of findings.

Despite these limitations, the study makes valuable contributions to understanding family-level TB prevention behaviors in high-burden community settings. The carefully developed behavior assessment framework and the contextual insights from this focused investigation provide a foundation for developing more effective, locally tailored TB prevention interventions. The findings particularly underscore the need to bridge the gap between TB prevention knowledge and actual practice in household environments, a challenge that remains under-addressed in many TB control programs. Future research building on this work could productively explore the specific barriers to behavior adoption identified in this study while employing more robust designs to establish causal pathways and test intervention strategies.

Conclusion

This study found the factors associated to family behavior on TB preventions were knowledge, attitude, and access to health information, with knowledge emerging as the strongest predictor. Families with lower knowledge on TB were 10 times more likely to adopt poor preventive behaviors compared to those with adequate understanding. This finding underscored the critical role of targeted TB education programs. Additionally, attitude was a key determinant, with positive attitudes correlating with better practices such as nutritional support for TB patients and adherence to health protocols. Access to health information further reinforced prevention efforts by improving awareness of transmission risks and mitigation strategies.

Ethics approval

Ethical approval for this study was granted by the Health Research Ethics Committee of the Faculty of Health Sciences, Universitas Jenderal Soedirman (Approval No. 1274/EC/KEPK/XI/2023).

Availability of data and materials

The datasets generated and/or analyzed during the current study are not

publicly available due to the sensitive nature of the information related to tuberculosis patients and to protect the privacy and confidentiality of the respondents. However, they are available from the corresponding author upon reasonable request.

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Author Contribution

WL was responsible for study design, data collection, statistical analysis, and interpretation of results. LN drafted the manuscript and was responsible for literature review. All authors contributed to the critical revision of the manuscript and approved the final version

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