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Local Culture and The Risk of Pulmonary Tuberculosis: A Case Study in Teminabuan Community Health Center, Indonesia

Budaya Lokal dan Risiko Tuberkulosis Paru: Studi Kasus di Puskesmas Teminabuan, Indonesia

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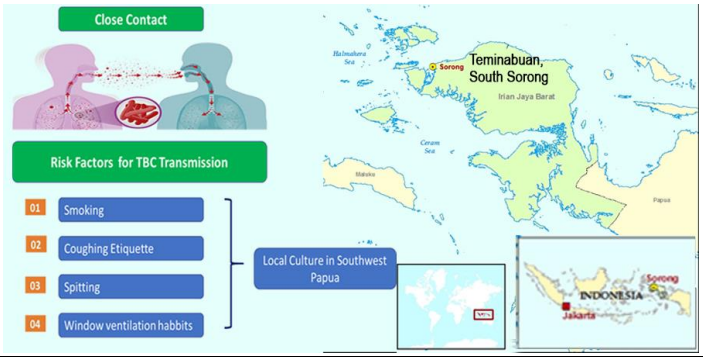
Abstract
Pulmonary tuberculosis (TB) remains a persistent public health challenge globally, with Indonesia ranking among the highest burden countries. In regions such as Southwest Papua, the incidence of TB is strongly influenced by cultural practices and daily behavioral patterns, yet limited studies have explored this dimension. This study aimed to analyze behavioral factors related to pulmonary TB incidence in Teminabuan, Indonesia, focusing on ventilation practices, cough etiquette, sputum disposal, smoking, and betel nut chewing. A cross-sectional design was conducted from May to June 2024 involving 97 respondents, consisting of families and neighbors of TB patients, selected through purposive sampling. The majority of participants were indigenous Papuans (76.29%), with 44.33% consuming betel nut and 43.33% spitting indiscriminately. Bivariate analysis showed that poor ventilation, inadequate cough etiquette, and indiscriminate spitting were significantly associated with TB incidence ($p < 0.05$). Among these, indiscriminate spitting was the most influential factor (PR = 0.421; 95% CI: 0.194–0.648). Smoking showed no significant association, while betel nut chewing, often accompanied by spitting, was found to increase TB transmission risk. These findings underscore the urgent need for culturally sensitive interventions that address traditional practices, while promoting the principle of cleanliness as part of faith in Islam, thereby strengthening family health protection and TB control efforts.

Abstrak
Tuberkulosis paru (TB) tetap menjadi tantangan kesehatan masyarakat global, dengan Indonesia termasuk dalam negara dengan beban kasus tertinggi. Di wilayah seperti Papua Barat Daya, kejadian TB sangat dipengaruhi oleh praktik budaya dan perilaku sehari-hari, namun penelitian yang membahas aspek ini masih terbatas. Penelitian ini bertujuan menganalisis faktor perilaku yang berhubungan dengan kejadian TB paru di Teminabuan, Indonesia, dengan fokus pada praktik ventilasi, etika batuk, pembuangan dahak, merokok, dan mengunyah pinang. Desain penelitian menggunakan potong lintang yang dilaksanakan pada Mei–Juni 2024 dengan melibatkan 97 responden yang merupakan keluarga dan tetangga pasien TB, dipilih melalui purposive sampling. Mayoritas responden adalah masyarakat asli Papua (76,29%), dengan 44,33% mengonsumsi pinang dan 43,33% meludah sembarangan. Analisis bivariat menunjukkan bahwa ventilasi yang buruk, etika batuk yang tidak tepat, dan kebiasaan meludah sembarangan berhubungan signifikan dengan kejadian TB ($p < 0,05$). Di antara faktor tersebut, meludah sembarangan merupakan faktor paling berpengaruh (PR = 0,421; 95% CI: 0,194–0,648). Kebiasaan merokok tidak berhubungan signifikan, sementara mengunyah pinang yang sering disertai meludah meningkatkan risiko penularan TB. Temuan ini menegaskan pentingnya intervensi sensitif budaya yang memperhatikan kebiasaan lokal serta menekankan prinsip kebersihan sebagai bagian dari iman dalam Islam, sehingga memperkuat perlindungan kesehatan keluarga dan upaya pengendalian TB.

Graphical Abstract



Keyword
cough; mastication; pulmonary; smoking; tuberculosis

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INTRODUCTION

Pulmonary tuberculosis (TB) is one of the most serious infectious diseases and remains a major threat to global public health, particularly in low- and middle-income countries (Kumawat et al., 2023). Within the framework of the Sustainable Development Goals (SDGs), TB is a priority of Goal 3: Good Health and Well-being, which aims to end the global epidemic of AIDS, tuberculosis, malaria, and neglected tropical diseases by 2030. Despite global efforts, TB continues to represent one of the leading causes of preventable mortality worldwide. The World Health Organization reported 10.6 million new cases and 1.6 million deaths in 2021, including 187,000 deaths among individuals co-infected with TB and HIV (Noora et al., 2020; World Health Organization, 2022; Yablonskii et al., 2019). These statistics demonstrate the urgent need for more effective interventions, especially in regions with persistent transmission.

In Indonesia, TB remains a significant burden, with the country ranked second globally after India, reporting an incidence rate of 312 cases per 100,000 population (Tamara et al., 2022; Balasubramnian et al., 2022). Despite the national End TB 2030 strategy, multiple challenges persist, including sociocultural barriers, stigma, poor health-seeking behavior, multidrug-resistant TB (MDR-TB), and comorbidities such as HIV, diabetes mellitus, malnutrition, and anemia. In Southwest Papua, the incidence of TB is particularly high, with Teminabuan Primary Health Center reporting the highest number of pulmonary TB cases (28.65%). Local practices such as betel nut chewing, indiscriminate spitting, poor household ventilation, and inadequate cough etiquette exacerbate transmission risk (Iskandar et al., 2023; Trajman et al., 2025). Socioeconomic constraints, including unemployment and malnutrition, further contribute to the vulnerability of this population (Esmail et al., 2022).

Despite existing TB control programs, transmission remains high in regions such as Southwest Papua due to cultural practices and unhygienic behaviors that facilitate disease spread. Previous studies have shown that inadequate case detection, delays in diagnosis, and failure to incorporate cultural sensitivity into health interventions hinder TB elimination efforts (Lestari et al., 2020; Pradipta et al., 2022; Shah et al., 2022). Therefore, the central research problem is the persistence of TB transmission despite ongoing interventions, largely due to sociocultural determinants. A potential solution lies in strengthening culturally adaptive, community-based strategies that integrate health education, behavioral modification, and faith-based values to reduce stigma and promote healthier practices.

Evidence suggests that integrating cultural and behavioral considerations into TB prevention programs enhances their effectiveness. Studies in Bangladesh and the Philippines have shown that community-based health education, combined with improved sanitation, can reduce TB incidence by up to 40% within five years (Galvin et al., 2022; Kak et al., 2020). Furthermore, interventions emphasizing household ventilation and proper sputum disposal have been associated with a measurable decline in TB prevalence in high-risk populations (Gebeyehu et al., 2025; Trajman et al., 2025). These findings highlight the importance of addressing environmental and behavioral determinants alongside biomedical approaches to TB control.

In Indonesia, previous surveys indicate that the prevalence of bacteriologically confirmed TB remains high, particularly due to undiagnosed and untreated cases (Balasubramnian et al., 2022; Tamara et al., 2022). Delays in seeking medical care, stigma, and reliance on traditional practices contribute significantly to this problem (Adeoye et al., 2024; Marahatta et al., 2020). Research shows that culturally sensitive health promotion, which acknowledges and modifies risky practices such as betel nut chewing and spitting, can improve prevention outcomes (Malik et al., 2020; Manghani et al., 2024; Pele et al., 2021). These insights underscore the necessity of interventions tailored to the sociocultural dynamics of communities such as Teminabuan.

While numerous studies have investigated biomedical and epidemiological aspects of TB, limited research has examined the intersection of local cultural practices and TB transmission risk in Indonesia, particularly in remote regions such as Southwest Papua. Studies often emphasize structural health system challenges but underexplore behavioral and sociocultural determinants (Kumawat et al., 2023; Esmail et al., 2022). Existing evidence points to the significant influence of betel nut chewing, indiscriminate spitting, and poor cough etiquette on TB transmission, yet these factors remain inadequately addressed in public health strategies. This gap underscores the necessity of localized research that captures the lived realities of high-burden communities.

The novelty of this study lies in its focus on the behavioral risk factors shaped by local culture and their direct relationship to pulmonary TB incidence in Teminabuan, Indonesia. Unlike prior research, this study integrates epidemiological evidence with cultural context while aligning with Islamic values that emphasize cleanliness as part of faith. The study aims to provide evidence-based recommendations for culturally sensitive TB control interventions that can strengthen family health resilience and support the national End TB 2030 strategy.

METHODS

This study employed a quantitative cross-sectional design conducted in the catchment area of Teminabuan Primary Health Center, South Sorong Regency, Southwest Papua Province, Indonesia. The research was carried out over a two-month period, from May to June 2024. This design was chosen to allow for the simultaneous assessment of behavioral factors and their relationship with pulmonary tuberculosis (TB) incidence within the community.

Table 1
Characteristics of Respondents

Characteristic	Frequency	Percentage
Age		
Productive (19-59 years)	78	80.41
Unproductive (<19 and >59 years)	19	19.59
Gender		
Male	50	51.55
Female	47	48.45
Working Status		
Work	41	42.27
Doesn't work	56	57.73
Ethnic		
Native Papua	74	76.29
No Papua	23	23.71
Window Ventilation Habits		
Not eligible	39	40.21
Qualify	58	59.79
Coughing Etiquette		
Any cough	63	64.59
Practice cough etiquette	34	35.05
TB Patient contacts without a mask		
Yes	61	62.89
No	36	37.11
Sputum Disposal Practices		
Get ride of any phlegm	78	80.41
Get rid of phlegm properly	19	19.59
Smoking habit		
Active smoker	50	51.55
Not a smoker	47	48.45
Number of cigarettes comsumed		
None	47	48.45
1-2 cigarattes	3	3.09
2-8 cugarattes	18	18.56
>8 cigarattes	28	28.87
Betel Nut Chewing		
Yes	23	23.71
Occasionally	20	20.62
No	54	55.67
Spriting betel nut residue anywhere		
Yes	25	25.77
Occasionally	17	17.53
No	55	56.7
Distance of spit <1m		
Yes	43	44.33
No	54	55.67
Spit residue in the house		
Yes	59	60.82
No	38	39.18

The study population consisted of 2,621 households living in the Teminabuan Primary Health Center catchment area. The sample size of 97 families was determined using Slovin's formula with a margin of error of 10%. Respondents were selected using purposive sampling, focusing on families and neighbors of pulmonary TB patients who had been diagnosed and registered at the health center. Inclusion criteria included households with at least one adult member (aged ≥18 years), willingness to participate in the study, and residence within the designated area for a minimum of six months. Families with incomplete data or unwillingness to provide informed consent were excluded.

Data collection was conducted through structured questionnaires and direct home visits. The questionnaire was designed to capture demographic characteristics, household ventilation, cough etiquette, sputum disposal practices, smoking behavior, and betel nut chewing habits. In addition, environmental observations were carried out by trained health professionals to verify household ventilation and sanitation conditions. Prior to data collection, enumerators received intensive training to ensure standardized data gathering procedures.

The research procedures included (1) identification and verification of pulmonary TB patients based on health center records; (2) recruitment of eligible household respondents; (3) administration of the structured questionnaire during home visits; (4) environmental assessments of ventilation and sanitation conditions; (5) data recording and monitoring; and (6) supervision by field coordinators to maintain data accuracy and reliability. To ensure ethical compliance, all participants were informed of the study objectives and procedures, and written informed consent was obtained prior to participation.

Data processing followed several stages, including editing, coding, data entry, and cleaning. Statistical

Specifically, individuals who did not routinely open

Table 2
Bivariate Analysis of Behavioral Determinants of Pulmonary Tuberculosis

Variable	PR	95% CI	P-Value
Window Ventilation Habits			
Not eligible	4.156	1.414 – 12.215	0.007
Qualify			
Coughning Etiquette			
Any cough	5.3	2.043 – 13.748	0.0001*
Practice cough etiquette			
Sputum disposal practices			
Get rid of any phlegm	9.905	3.209 – 30.570	0.0001*
Get rid of phlegm properly			
Smoking habit			
Active smoker	0.95	0.358 – 2.519	0.918
Not a smoker			

Note: *p < 0.05 indicates statistical significance

analysis was performed using SPSS software. Univariate analysis was applied to describe demographic and behavioral characteristics. Bivariate analysis using chi-square tests or Fisher's exact test was conducted to assess associations between behavioral factors and pulmonary TB incidence. Multivariate analysis with logistic regression was applied to identify the most influential risk factors while controlling for potential confounders. Study findings were presented in tables and narrative form to provide a comprehensive overview. Ethical approval for this study was obtained from the relevant institutional review board, and all procedures adhered to the ethical standards of research involving human participants.

RESULTS

Based on Table 1, the majority of respondents in this study (78 individuals or 80.41%) were in the productive age range of 19 to 59 years. Although not statistically significant, male participants (51.55%) slightly outnumbered female participants. A notable proportion of respondents (56 individuals or 57.73%) were unemployed. Most respondents were indigenous Papuans, accounting for 76.29% of the total sample.

In the behavior-related categories, more than half of the respondents (59.79%) reported regularly opening and closing windows. A large proportion (64.95%) exhibited poor coughing etiquette. Additionally, 62.89% of respondents reported engaging in face-to-face interactions without wearing masks. Only 19.59% of the respondents disposed of sputum properly, while 51.55% were identified as heavy smokers.

As presented in Table 2, bivariate analysis revealed that several behavioral factors were significantly associated with pulmonary tuberculosis (TB) transmission (p-value < 0.05). These factors included window ventilation habits, coughing behavior, sputum disposal practices, and smoking. Conversely, no statistically significant associations were observed between TB transmission and other environmental factors such as lighting levels, housing density, room ventilation area, and temperature.

and close windows had a 4.2 times higher risk of pulmonary TB transmission compared to those who did (Prevalence Ratio [PR] = 4.156; 95% Confidence Interval [CI]: 1.414–12.215). Participants with poor coughing etiquette had a 5.3 times greater risk of TB transmission (PR = 5.300; 95% CI: 2.043–13.748). Improper sputum disposal was associated with a substantially increased risk, with those exhibiting this behavior being 9.9 times more likely to transmit TB (PR = 9.905; 95% CI: 3.209–30.570).

Multivariate analysis (See Table 3) was conducted to identify dominant risk factors while adjusting for confounding variables. The analysis demonstrated that sputum disposal habits remained significantly associated with pulmonary TB incidence. Respondents who did not dispose of sputum properly had a 7.6-fold increased risk of developing TB (Odds Ratio [OR] = 7.630; 95% CI: 1.991–29.242; p = 0.003). In contrast, window ventilation habits (OR = 1.979; 95% CI: 0.536–7.303; p = 0.305) and coughing etiquette (OR = 0.962; 95% CI: 0.252–3.681; p = 0.955) were not statistically significant in the multivariate model. These findings suggest that local habits, particularly sputum disposal practices, play a critical role in the transmission of pulmonary TB in the studied population.

DISCUSSION

The findings of this study provide a comprehensive understanding of the behavioral and cultural factors contributing to the incidence of pulmonary tuberculosis (TB) in the working area of the Teminabuan Health Centre, Southwest Papua. Considering that 80.41% of respondents were within the productive age category (19–59 years), and a significant majority (76.29%) were indigenous Papuans, this demographic profile underscores the necessity of taking cultural context into account when addressing health challenges. The dominance of indigenous communities observed in this study underscores the importance of culturally tailored health interventions that align with local practices and beliefs.

The habit of opening and closing windows emerged as a significant factor related to TB transmission. The

Table 3
Multivariate Analysis of Behavioral Factors Associated with Pulmonary Tuberculosis Incidence

Variable	OR	95% CI	P-Value
Window Ventilation Habits			
Not eligible	1.979	0.536 – 7.303	0.305
Qualify			
Coughning Etiquette			
Any cough	0.962	0.252 – 3.681	0.955
Practice cough etiquette			
Sputum disposal practices			
Get rid of any phlegm	7.63	1.991 – 29.242	0.003*
Get rid of phlegm properly			

Note: *p < 0.05 indicates statistical significance

finding that individuals who do not practice this habit have a 4.2 times higher risk of contracting TB highlights the importance of adequate ventilation in reducing the spread of airborne infectious diseases (Felgueiras et al., 2022). Home environmental conditions were associated with the risk of TB transmission, namely house ventilation (p < 0.001; OR = 3.811) (Sulidah et al., 2024). In densely populated areas, where the risk of TB transmission is elevated, promoting proper ventilation practices can be a simple yet effective public health strategy. Public health initiatives should encourage improvements in living conditions to ensure better air circulation (Rai et al., 2021). Community workshops can educate residents about the importance of ventilation in preventing TB and other respiratory infections. In addition, collaboration with local governments to enhance housing infrastructure can improve living conditions and reduce the risk of TB transmission (Onmek et al., 2020). From an Islamic perspective, efforts to preserve air quality and protect the environment represent the implementation of *maqāṣid al-sharīʿah*, particularly the principle of *ḥifẓ al-nafs* (protection of life).

This study identified health behavior trends that substantially contribute to the transmission of tuberculosis. Specifically, the habit of indiscriminate coughing was reported by 64.95% of respondents, while 62.89% reported engaging in contact without wearing masks. These findings are very concerning, considering that TB is a highly contagious disease transmitted through respiratory droplets. The significant relationship between cough etiquette and TB transmission (PR 5.300) indicates a serious gap in public awareness regarding respiratory hygiene. Studies in humans have shown that patient use of surgical masks reduced infection by 14.8%, while tuberculosis incidence declined between 0.5% and 28.9% (Fox et al., 2021). Improper cough etiquette not only increases the risk of TB transmission but also reflects broader issues related to health literacy in society. Effective health education campaigns need to focus on promoting proper coughing techniques and emphasising the importance of covering the mouth and nose when coughing and wearing masks, especially in crowded places (Quan et al., 2024). In addition, community leaders and healthcare workers can play an important role in setting an example and reinforcing the importance of this behaviour (Alipanah et al., 2018). Based on the above studies, improper cough etiquette and lack of mask use are common and significantly associated with TB transmission. This underscores the need for health education regarding respiratory hygiene and mask use. From an Islamic perspective, careless coughing and failure to wear masks can be regarded as a form of dharar (causing harm) to oneself and others, since Mycobacterium tuberculosis is transmitted through the air.

The study findings regarding sputum disposal practices are striking. Only 19.59% of respondents disposed of their sputum correctly, indicating a significant public health risk. Respondents who disposed of their sputum improperly had a 9.9-fold higher risk of tuberculosis transmission, making this behavior the most critical risk factor identified in the study. This behavior is often associated with the habit of chewing betel nut, as the study observed a considerable presence of betel nut spit in respondents' homes. Nearly half of the respondents who consumed betel nut spat within less than 1 meter of others, highlighting the potential for rapid bacterial transmission, where droplets from TB patients could easily be inhaled by nearby individuals. This underscores the need for targeted interventions to improve safe sputum disposal practices. According to Paleckyte et al. (2021), health education initiatives should focus on raising public awareness about the risks of improper sputum disposal and provide clear guidelines on safe disposal methods. Community-based programs involving local leaders and healthcare workers can facilitate discussions on TB transmission and the importance of good hygiene practices (Shafique et al., 2024). Additionally, providing accessible disposal facilities and encouraging their use can help reduce TB transmission risks.

The study revealed that 51.55% of respondents were smokers. However, smoking behaviour did not show a significant association with the incidence of tuberculosis in the studied population. These findings contradict the existing literature, which generally identifies smoking as a risk factor for TB due to its immunosuppressive effects and potential damage to lung tissue (Apatzidou, 2022). Other

studies have demonstrated associations between the number of cigarettes, duration of smoking, cigarette type, and knowledge, while finding no association between income and pulmonary TB incidence (Obore et al., 2020; Tewatia et al., 2020). The absence of a significant relationship in this context may reflect unique local dynamics, such as interactions between smoking and other risk factors, or differences in smoking patterns compared with other regions (Corrales et al., 2020).

The cultural context of the indigenous Papuan community is crucial in understanding health behaviors related to TB transmission. This study highlights the need for culturally sensitive health interventions that consider local customs and practices. For example, the common practice of chewing betel nut in the region can affect behaviors related to sputum disposal and respiratory hygiene. In line with what was conveyed by Dickerson et al. (2020) that health education programs need to be designed to engage the community in discussions on how cultural practices influence health outcomes. The involvement of community leaders and influential figures can improve the acceptance and effectiveness of health interventions. The formulation of health messages tailored to local beliefs and practices can encourage greater community involvement and improve adherence to recommended health behaviors (Cao et al., 2023).

From an Islamic perspective, careless spitting that endangers others contradicts the prophetic principle found in Hadith Ibn Mājah No. 2340, which states:

> "*There should be neither harming nor reciprocating harm*."

This hadith underlines the prohibition of any behavior that causes direct or indirect harm to oneself or others. Accordingly, proper sputum disposal is not merely a medical obligation but also a moral and spiritual responsibility for every Muslim. It reflects obedience to Islamic teachings that emphasize the protection of health, the preservation of communal well-being, and the maintenance of public cleanliness as acts of faith (Mohidem & Hashim 2023). The Qur'an emphasizes the importance of cleanliness and purification in daily life, as stated in Q.S. Al-Baqarah/2:222:

> *"... Indeed, Allah loves those who are constantly repentant and loves those who purify themselves."*

This verse highlights that maintaining cleanliness is an act of devotion, and behaviors that pollute the environment or contribute to the spread of disease stand in clear opposition to the values of purity upheld in Islamic teachings. Moreover, Islam underscores the significance of social responsibility in protecting the community from contagious diseases (Irfan et al., 2025). This aligns with the command of Allah in Q.S An-Nisa/4:29, which states:

> *"... And do not kill yourselves (or one another). Indeed, Allah is to you ever Merciful."*

This verse reminds believers that any act that threatens personal health or the health of others, including indiscriminate spitting that can transmit tuberculosis, must be avoided. In addition, health ethics in Islam relate to the principle of *fard kifayah* (collective duty), which obligates the community to safeguard public health, beginning with the family as the primary unit of care (Piwko, 2021). Thus, practicing proper cough etiquette and disposing of sputum responsibly are not only medical practices but also manifestations of Islamic values in preserving human dignity, protecting family well-being, and fulfilling communal responsibility. Comparative literature also affirms that integrating religious and cultural frameworks into health education enhances community acceptance and effectiveness of interventions (Abu-Ras et al., 2024; McLaren et al., 2021). Thus, aligning TB control measures with Islamic values and indigenous cultural practices can provide a holistic and more effective strategy to reduce transmission.

The implications of this study for family health are significant. Given that TB primarily affects individuals in their productive years, its impact extends beyond individual morbidity to the economic stability and psychosocial well-being of entire households. Unsafe sputum disposal, poor cough etiquette, and inadequate ventilation not only endanger immediate family members but also perpetuate transmission across generations. Promoting culturally sensitive, family-centered interventions, such as household-level health education, improved sanitation practices, and advocacy for better ventilation, can therefore serve as vital preventive strategies (Islam et al., 2021). Furthermore, embedding Islamic values of cleanliness and protection of life within these programs may strengthen compliance and community ownership, fostering healthier family environments (Mohidem & Hashim 2023).

This study offers the strength of highlighting the intersection between cultural practices and TB risk, providing novel insights into behavioral determinants within indigenous Papuan communities. However, certain limitations must be acknowledged. The cross-sectional design restricts causal inference, while the relatively small sample size may limit generalizability. Additionally, self-reported data on health behaviors may be subject to recall and social desirability biases. Despite these limitations, the study contributes important evidence for public health planning, particularly in culturally diverse and high-prevalence settings such as Southwest Papua. Future research employing longitudinal designs and larger samples is recommended to further validate these findings and explore deeper sociocultural dynamics influencing TB transmission.

CONCLUSIONS

This study identifies key behavioral and environmental factors contributing to the transmission of pulmonary tuberculosis (TB) in the Teminabuan Health Centre area, Southwest Papua. The findings highlight that

chewing betel nut, improper sputum disposal, and inadequate ventilation significantly increase the risk of TB transmission. Specifically, improper sputum disposal emerged as the most critical risk factor, with individuals engaging in careless practices facing a 9.9 times higher risk of infection. In addition, the cultural practice of betel nut chewing indirectly contributes to TB spread through associated spitting behaviors, while poor ventilation in households exacerbates airborne transmission.

The implications for family health are significant, as TB mainly affects individuals in their productive years, threatening household stability and intergenerational well-being. An integrated public health strategy is needed, combining education on sputum disposal, promotion of ventilation, and culturally sensitive engagement on betel nut practices. Collaboration with community leaders can improve acceptance and sustainability. Future research should use longitudinal designs with larger samples to strengthen evidence. This study enhances understanding of culturally specific determinants of TB and offers practical recommendations for family and community-centered interventions, supporting efforts to reduce TB incidence and progress toward ending TB by 2030.

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AUTHORS' CONTRIBUTIONS
Ishaq Iskandar conceptualized the study, supervised the research process, critically revised the manuscript, and approved the final version for submission. Imelda Naolin coordinated data collection in the field, contributed to data acquisition, and participated in drafting and revising the manuscript. Arlin Adam provided academic guidance, validated the methodological framework, reviewed the manuscript critically, and approved the final draft. Harun Iskandar contributed expertise in pulmonology, guided the interpretation of clinical aspects, and revised the manuscript. Syamsuri Syakri contributed to the methodological design, data analysis, and interpretation, and reviewed the manuscript. All authors jointly designed the study, contributed to field work, and ensured the overall integrity of the study.

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COMPETING INTERESTS
The author(s) declare no potential conflict of interest with respect to the research, authorship, and/or publication of this article.

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