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Comprehensive Approach to Accelerate Tuberculosis Case Finding among Women and Children Under Five in Rural Indonesia

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ABSTRACT

Tuberculosis (TB) continues to be a major worldwide health concern, with some regions in Indonesia facing challenges in achieving case detection objectives. This initiative sought to enhance tuberculosis case detection using mobile X-ray screening, the provision of preventative medication, and the identification of latent tuberculosis infections among household contacts and high-risk groups, especially stunting children. The results indicated that just 6.03% of participants had a history of tuberculosis contact, but 67.84% presented risk factors including malnutrition, exposure to smoking, previous tuberculosis diagnosis, and diabetes. Chest radiography revealed anomalies in 6.03% of individuals, requiring further diagnostic verification. Furthermore, stunting was widespread, with 48% categorized as moderately stunted and 27% as severely stunted. Post-intervention evaluations indicated an enhanced mother's understanding of tuberculosis. Initiatives to enhance tuberculosis case finding among women and children under five in rural regions must be expanded and strengthened to decrease transmission, enhance detection rates, bridge information gaps, mitigate stigma, and increase treatment coverage, ultimately leading to reduced tuberculosis transmission.

INTRODUCTION

Tuberculosis (TB) continues to pose a significant health risk globally, particularly in Indonesia (Kemenkes RI, 2024a). The World Health Organization (WHO) indicates that TB is the second leading cause of mortality among infectious illnesses, surpassed only by COVID-19 (WHO, 2024). The global incidence of tuberculosis rose by 4.5%, from 10.1 million cases in 2020 to 10.6 million in 2021, resulting in 1.6 million fatalities (WHO, 2024; Word Health Organization, 2024). Indonesia now ranks as the nation with the second-greatest tuberculosis burden globally, behind India (Global TB Report, WHO, 2022). In 2022, there were 1,060,000 cases, or 385 per 100,000 people, and 141,000 deaths, or 51 per 100,000 people, the highest figures since 1995(Kemenkes

RI, 2020). While, in 2024, the tuberculosis incidence rate in Indonesia is sustained at 354 per 100,000 people. This statistic remains well behind the national objective established in the National Medium-Term Development Plan 2020-2024, which aspires to achieve 190 per 100,000 people by 2024(Kemenkes RI, 2023).

This significant gap indicates that Indonesia has not yet achieved its target for case detection, which affects the number of TB patients who have not received treatment and contributes to high transmission rates. To date, many indicators of the TB control program have not been met and are even far from the national targets. In 2022, the Case Detection Rate (CDR) was only 52% of the 90% target, the Treatment Success Rate (TSR) was 82% of the 90% target, the Treatment Coverage was 57% of the 90% target, the Case Investigation was 89% of the 100% target, the Enrollment Rate for Drug-Resistant TB (DR-TB) was 57% of the 93% target, and the TSR for DR-TB was only 50% of the 80% target (Kemenkes RI, 2023).

Recent data indicated that Nusa Tenggara Timur (NTT) Province has one of the highest tuberculosis prevalences in Indonesia (Kemenkes RI, 2024a). NTT Province continues to have significant obstacles in managing tuberculosis (Susilawati & Therik, 2022). The tuberculosis control program in NTT Province has been implemented via numerous initiatives. Nonetheless, the success rate remains behind the national objective. In 2023, the tuberculosis case detection aim in NTT will achieve just 46%, remaining below the national target of 90%. The success rate for tuberculosis therapy in NTT province is 89.7%. This figure remains below the national objective of 90% (Mulya, 2023). In the TTS Regency, the case detection rate (CDR) was 25.5% in 2018, 58.3% in 2019, and 27.39% in 2020. This statistic has not attained the national minimum aim of 70% (Jepapu et al., 2023).

Active case-finding (ACF) for TB in NTT encounters considerable obstacles, such as restricted healthcare access and insufficient public knowledge (Kemenkes RI, 2023). Timely identification by sputum analysis and radiographic evaluation is essential for minimizing diagnostic delays, treatment interruptions, and the socioeconomic impact on patients and their families (Kemenkes RI, 2024b). Nevertheless, diagnostic resources are limited in rural regions, and misunderstandings about TB transmission and treatment compliance continue to exist.

Timor Tengah Selatan Regency in NTT has a high and rising incidence of tuberculosis, with many cases remaining undetected or unreported (Dinas Kesehatan NTT, 2024). In the TTS Regency, stigma, and misinformation hinder patients from seeking treatment, hence perpetuating transmission throughout the community. Geographic, socio-economic, and infrastructure challenges contribute to delayed diagnosis and poor treatment adherence (Maulana et al., 2024). Many patients discontinue treatment due to drug side effects, lack of awareness, and difficulty accessing healthcare facilities (Mayopu et al., 2022; Susilawati et al., 2023). These barriers exacerbate transmission and hinder tuberculosis control efforts in the region.

Therefore, a Comprehensive Approach to Accelerate Tuberculosis Case Finding among vulnerable populations is crucial to achieve tuberculosis eradication in Indonesia by 2030, the goal incidence rate is established at 65 per 100,000 people (Kemenkes RI, 2024a). Tuberculosis management involves a comprehensive and coordinated approach, including early detection, appropriate treatment, and community-level education and prevention (Kemenkes RI, 2023). Community empowerment is a key strategy in TB management, especially in resource-limited areas. By actively involving the community in case detection, prevention, and treatment support, this approach helps identify symptoms early, reduce stigma, and improve treatment adherence. This initiative in Timor Tengah Selatan Regency aimed to

increase TB awareness, reduce transmission, and enhance patient compliance, ultimately lowering TB-related deaths. By fostering active participation, the community not only benefits but also contributes to creating a TB-free environment. This model can be replicated in other regions, ensuring sustainable and effective TB control while improving overall quality of life.

METHODS

The initiatives to expedite TB case identification among vulnerable populations, including mothers and children under five, in the Timur Tengah District were components of the community service program financed by Poltekkes Kemenkes Kupang. This community services program was conducted over three months, from November 2024 to January 2025. The initiative started with the identification of the area exhibiting the greatest incidence of TB and the formulation of a cross-sectoral action plan in collaboration with stakeholders.

The initial study revealed inadequate knowledge among women and children on TB screening, a limited understanding of tuberculosis as a communicable disease, and an increase in malnutrition, which may be attributable to latent tuberculosis. Furthermore, the accessibility of portable X-ray technology remains constrained, perhaps resulting in a reduced rate of tuberculosis case identification.

Implementing TB screening, diagnosis, and latent tuberculosis infection evaluation to provide tuberculosis preventive therapy (TPT) for household and close contacts of TB index cases, as well as high-risk groups (including individuals with diabetes, HIV, malnourished children, and the elderly), utilizing TB screening methods (symptoms and/or X-ray) to improve TB case detection rates and the administration of tuberculosis preventive therapy.

Therefore, the implementation of Active Case Finding through a concurrent screening methodology using a 5-table system is regarded as a holistic strategy to accelerate tuberculosis finding and diminish TB transmission.

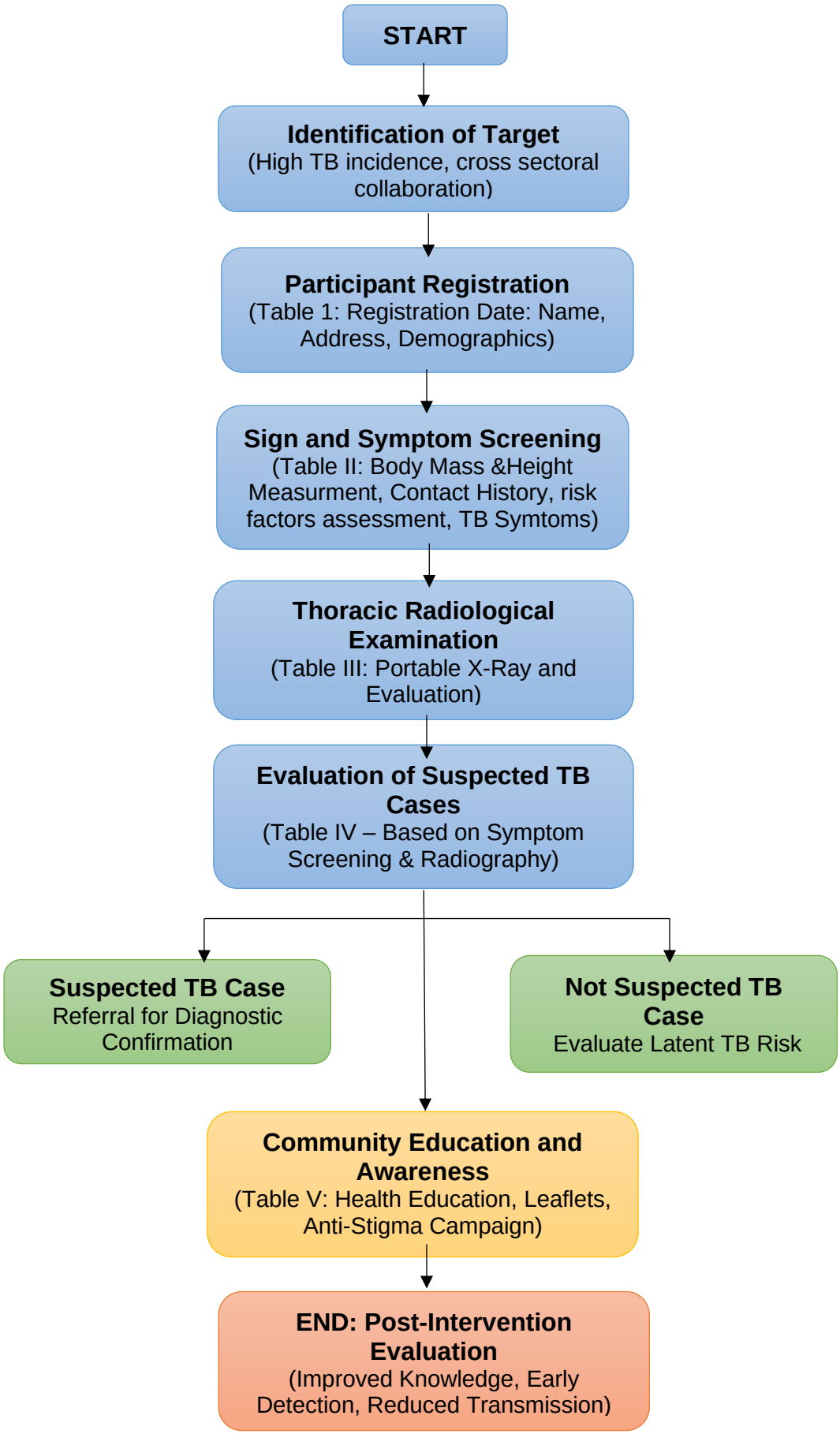

Figure 1. Flow diagram of Activity stages

Table I: Registration:

The registration table is utilized to gather information including the screening date and location, name, address as per the Identity Card, domicile address, National Identification Number, occupation, date of birth, gender, and contact details such as phone number or email.

Figure 2. Registration of participants

Table II: Sign and Symptoms Screening

This session included the assessment of body mass and height, review of contact history, evaluation of risk factors, and screening for TB symptoms.

Evaluation of Body Mass and Height

Evaluating nutritional status by the measurement of body mass and height in relation to age groups. The nutritional status of children under 15 years is adjusted according to age categories. Children under 2 years use weight-for-length calculations derived from the Z-score table, while children aged 2-5 years' employ weight-for-height calculations based on the Z-score table. The nutritional condition of individuals aged 18 and older is evaluated by their Body Mass Index (BMI).

Figure 3. Measurement of body mass and height

Assessment of Contact History

All women and children were questioned on any prior contact with a tuberculosis (TB) patient. If contact had transpired, further questions were conducted about the nature of the encounter, particularly if it constituted close

contact or household contact. Close contact refers to persons who, although not living in the same home, often interact with a diagnosed TB patient over a prolonged period. Household contact denotes persons who have lived in the same household as a diagnosed TB patient for at least one night or have consistently inhabited the dwelling during daytime hours in the last three months.

Subsequent to the confirmation of contact, further investigations were undertaken into the specific types of tuberculosis shown by the index case (bacteriologically confirmed pulmonary TB, clinical TB, extrapulmonary TB, or unspecified TB type). Bacteriologically verified pulmonary tuberculosis denotes tuberculosis cases validated by bacteriological examination of sputum specimens. This test is used to detect Mycobacterium tuberculosis, the bacterium responsible for TB. Clinical TB is a tuberculosis diagnosis made by a physician, regardless of whether the patient fulfills the criteria for a bacteriological diagnosis. Extrapulmonary tuberculosis is an infection that manifests beyond the pulmonary system. It is caused by Mycobacterium tuberculosis, which disseminates to organs beyond the lungs.

Assessment of Risk Factors

During the risk factor evaluation, all participants were questioned whether they had ever had a diagnosis or treatment for TB. Inquiries included prior partial TB treatment, experiences of starvation, smoking habits, and exposure to secondhand smoke. Additionally, participants were questioned on their diabetes history, HIV status, age above 65 years, pregnancy status, incarceration status, and residency in a slum area.

Screening for Tuberculosis Symptoms

Each participant was questioned for several symptoms, including a cough accompanied by intermittent fever of indeterminate cause, unexplained weight loss, difficulties in gaining weight, reduced appetite, and night sweats without significant exercise. Furthermore, healthcare practitioners must examine to assess lymphadenopathy. Healthcare professionals would thereafter assess the results of the tuberculosis symptom screening. An individual is considered positive in the TB symptom screening if they meet one of the following criteria: A cough lasting for about two weeks. Any cough, regardless of associated symptoms or signs, will be classified as a positive TB symptom screening in persons living with HIV if at least one symptom is present.

Figure 4. Screening for Tuberculosis symptoms

Table III: Thoracic Radiological Examination

The thoracic radiographic evaluation was performed by the X-ray Team at Poltekkes Kemenkes Kupang, including radiographers and administrative staff for portable X-ray procedures. At this step, all participants received a thoracic radiographic evaluation with a Portable X-ray thorax. The AI evaluation score for the thoracic radiographic examination results was examined. The results of the thoracic radiographic examination are classified as normal, abnormal indicating TB, and abnormal not indicating tuberculosis.

Figure 5. Thoracic Radiological Examination

Table IV: Evaluation of Suspected Tuberculosis by Symptom Screening and Chest Radiographic Assessment

Subsequently, it was determined if the individual was suspected of having TB. An individual is classified as a suspected TB case if the TB symptom screening produces a positive outcome and/or the thoracic radiographic examination shows abnormalities suggestive of TB.

An individual is considered not suspected of having TB if the TB symptom screening result is negative and/or the thoracic radiographic test result is normal or abnormal but does not indicate TB. A latent TB examination is conducted if an individual has had household contact with a bacteriologically confirmed tuberculosis patient but is not classified as a suspected tuberculosis case or part of a high-risk group not suspected of having tuberculosis. Latent TB testing is not conducted for those classified as suspected TB cases or those living with HIV, since they would get Tuberculosis prophylactic treatment.

Table V: Enhancing Community Education and Awareness

A significant obstacle in tuberculosis management is the limited public understanding of the illness. Consequently, excellent education may enhance comprehension of tuberculosis symptoms, transmission, and the significance of adhering to treatment. In Table V, all mothers were provided with fundamental information on TB. The session aimed to provide critical information on TB and mitigate stigma. Anti-stigma initiatives must underscore that tuberculosis is a treatable condition while promoting familial support for sufferers. Furthermore, including local values in educational resources guarantees that health messages are more successfully acknowledged and valued within the community. They were provided with a clear leaflet to take home, with instructions on preventing TB spread and administering treatment at home.

Figure 6. Educational session on Tuberculosis (TB): Providing participants with knowledge on transmission, symptoms, prevention strategies, and treatment adherence.

RESULTS AND DISCUSSION

Table 1 highlights the characteristics of the individuals. The participants included two groups: women over 18 years old (mothers) and one of their children under five years of age. The bulk of the children (99%) were aged 0-5 years, with 55.92% being male. All the moms or women were above 18 years old, with the majority being housewives who cared for their children at home.

Table 1. Sociodemographic Characteristics of Subject

Variables	n	%
Children under 15 years old		
Gender		
Male	55	53.92
Female	47	46.08
Age group		
0-5 years	101	99.02
5-18 years	1	0.98
Women > 18 Years Old		
Age group		
>18 years	97	100%
Occupation		
Self-employed	3	33.33
Housewife	91	93.81
Teacher	2	2.06

Table 2 indicates the nutritional condition of children under five years of age; the majority were well-nourished (86.27%), 7.84% were classified as moderately malnourished, and 5.88% exhibited severe malnutrition. In terms of stunting, the majority were classed as moderately stunted, with a height-for-age z score (HAZ) between -2 SD and -3 SD, accounting for around 48%. Severely stunted individuals,

with HAZ < -3 SD, comprised about 27%. Merely 25% exhibited normalcy. The majority of moms were of normal weight (61.86%). However, 2.055% and 9.28% represented thinness and underweight, respectively.

Table 2 Characteristics of Respondents based on the Nutritional Status

Variables	n	%
Children under 5 years old		
Severe malnutrition	6	5.88
Moderate malnutrition / Undernutrition	8	7.84
Good nutrition / Well-nourished	88	86.27
Children age 15-18 years old.		
Good nutrition / Well-nourished		100%
Stunting Category for children < 5 years		
Normal: Height-for-Age Z-score (HAZ) **≥ -2 SD**	25	25
Stunted: HAZ **between -2 SD and -3 SD** (Moderate Stunting)	48	48
Severely Stunted: HAZ **< -3 SD** (Severe Stunting)	27	27
Women > 18 Years Old		
BMI <17.0: thinness	2	2.06
BMI <18.5: underweight	9	9.28
BMI 18.5-24.9: normal weight	60	61.86
BMI ≥25.0: overweight	15	15.46
BMI ≥30.0: obesity.	11	11.34

Table 3 indicated that only 6.03% of the subjects had a history of contact with TB, whereas 67.84% exhibited risk factors for contracting tuberculosis, including malnutrition, exposure to a smoker at home, a prior diagnosis of tuberculosis, and a history of diabetes. The examination revealed that 3.02% of individuals had TB symptoms, including cough and unexplained weight loss. Furthermore, the thoracic radiographic evaluation performed by the X-ray Team of Poltekkes Kemenkes Kupang revealed that 12 individuals (6.03%) had chest abnormalities potentially indicative of tuberculosis, necessitating confirmation by rapid molecular diagnostic assays and the TB skin test. Furthermore, those who had engaged with historical and abnormal AI analysis of X-rays were referred to Public Health Centers for further examination.

Tabel 3. Tuberculosis screening among Housewife and underfive childeren in Siso Public Health centres

Variables	n	%
Contact History with Tuberculosis		
Yes	12	6.03
No	187	93.97
Having risk Factors		
Yes	135	67.84
No	64	32.16
Screening for Tuberculosis Symptoms		
Yes	6	3.02
No	193	96.98
Score AI Tuberculosis		
Normal	187	93.97
Abnormality	12	6.03

Figure 7. Radiological signs of TB

Table 4 demonstrated that after receiving knowledge on Tuberculosis, most mothers exhibited an improved understanding of diabetes, as shown by their responses to specific questions. All respondents said that Tuberculosis is airborne and that it may be cured with daily treatment for a minimum of six months. The majority (98.97%) recognized that fever followed by weight loss might indicate TB, while 97.94% said that tuberculosis is not hereditary. Furthermore, the majority agreed that chest X-rays are a method for diagnosing tuberculosis.

Table 4. Mothers' knowledge about Tuberculosis after the health education session

No	Questions	Your response			
		Correct		Wrong	
		n	%	n	%
1	Tuberculosis (TB) can occur anywhere in the human body	90	92.78	7	7.22
2	TB is inherited from parents, so if parents are infected with TB, then their child will get TB	95	97.94	2	2.06
3	TB bacteria are spread in the air	97	100.00	0	0.00
4	There are no specific symptoms that appear in the early stages of TB infection	88	90.72	9	9.28
5	When infected with TB, a person will experience a mild fever in the afternoon	97	100.00	0	0.00
6	If mild fever persists and is accompanied by weight loss, it may be TB	96	98.97	1	1.03
7	Chest X-rays are one way to diagnose TB	95	97.94	2	2.06
8	TB can only be treated if there are obvious symptoms	85	87.63	12	12.37
9	TB is treated by taking medication every day for at least six months	97	100.00	0	0.00
10	TB treatment is difficult, and if anti-TB drugs are not taken regularly, it can lead to drug resistance	92	94.85	5	5.15

A comprehensive approach to accelerating TB case finding among women and

children under five is crucial to improving early detection, timely treatment, and reducing transmission. Women and young children are particularly vulnerable to TB due to biological and social factors, including limited healthcare access and higher exposure in household settings. By integrating active case-finding strategies, such as community-based screening, mobile diagnostic units, and symptom-based screening at maternal and child health services, more TB cases can be identified at an earlier stage. In addition, utilizing radiographic AI-assisted screening and molecular diagnostic tests ensures more accurate and rapid detection, leading to faster initiation of treatment and better health outcomes.

The findings indicate that 6.03% of the participants have a history of contact with tuberculosis (TB) patients. This proportion, while relatively low, highlights a potential risk of disease transmission. Previous studies have shown that individuals with close contact history have a significantly higher risk of developing TB, with research suggesting that household contacts of TB patients have a 30–50% increased risk of infection (Faiz & Hadi, 2024; Wolde et al., 2024). Given the infectious nature of TB, identifying and monitoring individuals with a contact history is crucial for early detection and intervention (Fox et al., 2017). These results emphasize the need for targeted public health strategies, including contact tracing, preventive treatment, and health education, to minimize TB transmission.

Furthermore, the study revealed that six individuals (3.2%) reported TB-related symptoms, such as persistent cough, fever, and weight loss. The presence of these symptoms is clinically significant, as symptomatic individuals are more likely to be in the active phase of TB, potentially contributing to further transmission (Fox et al., 2017; Zaidi et al., 2023). Studies suggest that individuals with prolonged TB symptoms have a higher likelihood of developing active TB and spreading the infection within their communities (WHO, 2021).

Additionally, 12 respondents (12.06%) showed abnormal AI-based chest X-ray scores, which may indicate potential TB-related lung abnormalities. Chest radiography remains a crucial screening tool for TB, particularly in asymptomatic individuals or those with subclinical infections (Marais & Graham, 2022). AI-assisted radiographic analysis has been increasingly utilized to enhance early TB detection, as previous studies have demonstrated that abnormal chest X-ray findings are associated with a 20–50% increased risk of active TB, particularly in high-burden settings (Qin et al., 2022; Zhang et al., 2023).

This study also highlighted that stunting, a condition characterized by chronic undernutrition during the critical periods of early childhood, affects approximately 75% of children under five in the given population. This high prevalence of stunting presents significant public health concerns, particularly in relation to the increased susceptibility of these children to infectious diseases, such as tuberculosis (Millward, 2017; Morales et al., 2024). A study conducted in Bandung revealed that among 169 under-five children with stunting and severe stunting, 59.76% were diagnosed with pulmonary tuberculosis (Nataprawira et al., 2024). Previous studies have shown that undernutrition can increase the risk of developing TB by 2 to 4 times compared to well-nourished individuals (Wagnew et al., 2024). Malnutrition weakens the immune system, reducing the body’s ability to mount an effective immune response against infections (Morales et al., 2024). Undernourished children often experience deficiencies in essential micronutrients, such as vitamin A, zinc, and iron, which play crucial roles in immune function (Roberts et al., 2022). Consequently, these deficiencies make stunted children more vulnerable to infectious agents, including Mycobacterium tuberculosis, the causative agent of TB

(Nataprawira et al., 2024; Roberts et al., 2022). Malnourished children, especially those experiencing stunting, have weakened immune responses, making them more vulnerable to TB infection and progression to active disease.

Knowledge about tuberculosis enhanced after the intervention in the designated communities, accompanied by better educational initiatives. Health-seeking behavior and comprehension of tuberculosis are essential, since they may either mitigate or exacerbate disease spread (Dewi et al., 2016). The research indicated that most moms provided accurate responses about TB. It is posited that the augmentation of knowledge leads to a heightened comprehension of a particular condition or behavior, enhanced behavior-specific self-efficacy (confidence in one's capacity to effectively perform recommended behaviors), and outcome expectancy (the belief that engaging in a behavior will yield desired results) (Ryan, 2009). A prior research indicated that organized counseling enhanced patient awareness and rectified prevalent misconceptions about tuberculosis, leading to better patient outcomes (Sajjad et al., 2020).

CONCLUSION AND SUGGESTIONS

A comprehensive approach is essential to accelerating TB case finding among women and children under five in Rural Indonesia. Regular screening for high-risk populations, improved access to diagnostic tools, and community-based treatment strategies are critical components in reducing TB incidence. The high prevalence of stunting observed in this study underscores the need for integrated TB control and nutritional intervention programs. Addressing childhood malnutrition through enhanced food intake, maternal health initiatives, and community-based nutritional support can significantly lower TB risk. Additionally, early detection of latent tuberculosis infection and providing preventive treatment play a crucial role in breaking the transmission chain, particularly among vulnerable groups such as children and household contacts of TB patients. Strengthening contact tracing, ensuring preventive treatment delivery, and conducting awareness campaigns will enhance early intervention efforts. A multi-sectoral, gender-sensitive, and child-focused TB control strategy can improve TB case detection rates, expand access to tuberculosis preventive treatment, and ultimately contribute to reducing the global TB burden. Strengthening healthcare systems and fostering community engagement will be key to achieving sustainable TB control and prevention efforts in NTT Province.

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