Pediatric Tuberculosis Screening through Parent Involvement

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KEYWORDS

Tuberculosis self-screening; education, structured training, simulation, maternal empowerment.

ABSTRACT

Introduction: Tuberculosis (TB) remains a significant public health concern, particularly in developing countries. Pediatric TB poses a unique challenge due to the difficulty in diagnosing the disease in young children. Early detection and treatment of TB are crucial to prevent transmission and improve outcomes. Parent involvement in pediatric TB screening can be vital in increasing case detection and reducing morbidity and mortality.

Objectives: This study aims to investigate the effectiveness of pediatric TB screening through parent involvement in a community setting in Indonesia. The study will assess this approach's feasibility, acceptability, and impact on identifying TB cases among children. The findings will contribute to developing effective strategies for pediatric TB screening in resource-limited settings.

Methods: The research used a pre-and post-test design with a control group design involving 177 mothers with children aged 0-14 years in the Seberang Health Center Working Area, Padang City. Three interventions were applied: self-screening education, structured training, and self-screening simulation.

Results: The intervention group showed notable improvements in knowledge, understanding, confidence, and skills across all stages, with statistically significant results ($p < 0.05$). In contrast, the control group experienced either minimal improvements or decreases in these areas. These findings suggest that the comprehensive approach of education, training, and simulation-based interventions is highly effective in enhancing parents' capacity for early detection of childhood tuberculosis, offering a promising solution for preventing and managing the disease.

Conclusions: The results showed significant improvements in mothers' knowledge, understanding, and skills, with each approach contributing differently. The implications are substantial, providing practical guidance for the implementation of TB self-screening in communities and changing the paradigm of TB detection in children nationally and globally.

1. Introduction

TB is still one of the ten diseases that kill children in the world [1]. Every year, 12% of the global TB burden is in the child age range, shown by data that 1.1 million children in the world suffer from TB and 7.5 million children are infected. [2]. The incidence of TB will continue to increase until they become teenagers and turn into an adult type of disease [3]. The problem of TB detection is still a global problem; only two-thirds of cases are detected, while one-third are missed. As many as 1 million children aged less than 16 years are infected with TB, 225,000 of whom are estimated to die from TB and its complications [4]. Children with TB experience gaps in diagnosis, as only one-third of cases are reported and diagnosed. The majority of children who die from TB have never been diagnosed [5].

The estimated Indonesian TB incidence in 2021 is 969,000 or 354 per 100,000 population; TB-HIV is 22,000 cases per year or 8.1 per 100,000 population. Deaths due to TB are estimated at 144,000 or 52 per 100,000 population, and TB-HIV deaths at 6,500 or 2.4 per 100,000 population. Based on the incidence of tuberculosis in 2000-2020, there was a decrease in TB, and the TB death rate, although not too sharp, increased in 2020-2021. TB incidents in 2021 there was increased by 18% (absolute in 2020; 819,000 in 2021; 969,000 and rate per 100,000 population of 2020; 301 in 2021; 354), and TB mortality rates increased by 55% for absolute (2020; 93,000 2021; 144,000), 52% for rate per 100,000 population (2020; 34, 2021; 52). Based on the TB incidence of 969,000 cases per year, there are notifications of TB cases in 2022, 724,309 patients (75%), or there are still 25% that have not been notified; either unreached, undetected or unreported. The estimated MDR/RR TB cases in 2021 are 28,000 or 10 per 100,000; when compared with 2020, there is an increase of 17% from 24,000, and the rate per 100,000 population is 15%; TB RO case discovery was 12,531 with 51% coverage [6]. West Sumatra Province has a history of Indonesia's second-largest TB incidence. Padang City is the district with the highest TB rate in West Sumatra, with a total of 1650 cases out of a total of 7262. Padang City

is also a city with a high rate of childhood TB, with 238 cases or 14% of the total TB cases [7].

Children with TB have high mortality [8]. TB is an infectious disease associated with malnutrition [9]. One reason for the high number of TB cases in children is the delay in identifying new cases [10], [11]. A study in Peru found that most of the causes of delays in TB diagnosis were ignorance of their children's or their own TB symptoms [12], so people will only seek treatment after the disease occurs [13]. In addition, traditional TB investigations do not achieve satisfactory coverage due to the limited number of health workers [14]. This situation is often made worse by the difficulty of family access to health service providers due to their rural location and ignorance of the risk of transmission from TB sufferers [15]. However, a lack of public knowledge largely determines the incidence of late TB diagnosis [16]. Kranzer et al. (2013), in their review, found that door-to-door TB investigations supported longer delays in diagnosis and treatment (57 days) compared to people who received information about TB through pamphlets (53 days). These findings at least indicate that people who receive education about TB symptoms, even in minimal ways, still have a positive impact. Furthermore, based on the results of their study, they believe that independent screening management must be implemented to prevent delays and break the chain of TB transmission at the family and community levels [18]. Several studies have recommended involving families is the most effective way to reduce transmission and discover new cases. [19], [20], [21].

This research responds to recommendations from previous research to develop a TB screening approach model in the form of educational interventions and empowering the community [12]. A study conducted an intervention in their study in Flores, Indonesia, involving 50 community representatives from six villages. The intervention is asset-based education, which aims to change public knowledge and stigma about TB and change TB prevention behaviour. As a result, after two months post-intervention, it was found that there was an increase in knowledge about TB [22]. Stigmatization also improved, and clean and healthy living behaviour as a TB prevention measure was seen in the intervention village group. This study's focus on the family as the primary agent of change has not been highlighted, so recommendations for continuing education for families are stated. Next, a study in Indonesia carried out an intervention in the form of comprehensive education for households as the closest contacts of TB. The intervention involves increasing knowledge about TB and providing social support to increase self-confidence. The study found that comprehensive education could increase household contact participation by 1.83 times and case findings by 3.13 times. However, the study's evaluation was only carried out once, so progress data was not obtained at each stage of education [21].

In contrast to previous methods, the new approach in this study empowers parents with in-depth knowledge and concrete skills to identify TB symptoms independently. This approach explores parents' potential as effective early detection agents by providing gradual guidance, from increasing knowledge and structured guidance to ensuring independence. In this process, parents are not just passive recipients of knowledge but become active participants in preventing and detecting TB in children. This approach provides increased understanding and active parental involvement in monitoring their children's health, establishing a solid foundation for early detection and treatment of TB at the community level. In addition, this approach can reduce delays in the diagnosis process and help overcome the problem of detection gaps that still exist in the treatment of childhood TB.

Objectives

The main aim of this research is to prove the effectiveness of the TB self-screening approach through structured education and training that involves parents in detecting TB in children early. This research focuses on increasing detection rates and empowering parents as the primary agents in preventing tuberculosis. By actively involving parents, this research aims to create an approach model that can be applied widely and sustainably in society. The implications of this research are very significant. The results will provide practical guidance for implementing TB self-screening approaches in communities and change the TB disease detection paradigm in children nationally and globally. Thus, this research not only provides immediate benefits to children affected by TB but also has a long-term positive

impact on the health of society as a whole.

2. Methodology

Research design

This study used a pre-and post-test design with a control group design involving mothers with children aged 0-14 years as research respondents. The total number of respondents was 177 people selected through accidental sampling with the research location in the Seberang Health Center Working Area, Padang City. We divided respondents into two groups: the intervention group of 90 people and the control group of 87 people. To prevent biased research results, researchers set two exclusion criteria: (1) parents are health workers or have relatives who are health workers; (2) children or families who have been diagnosed with TB and are on treatment.

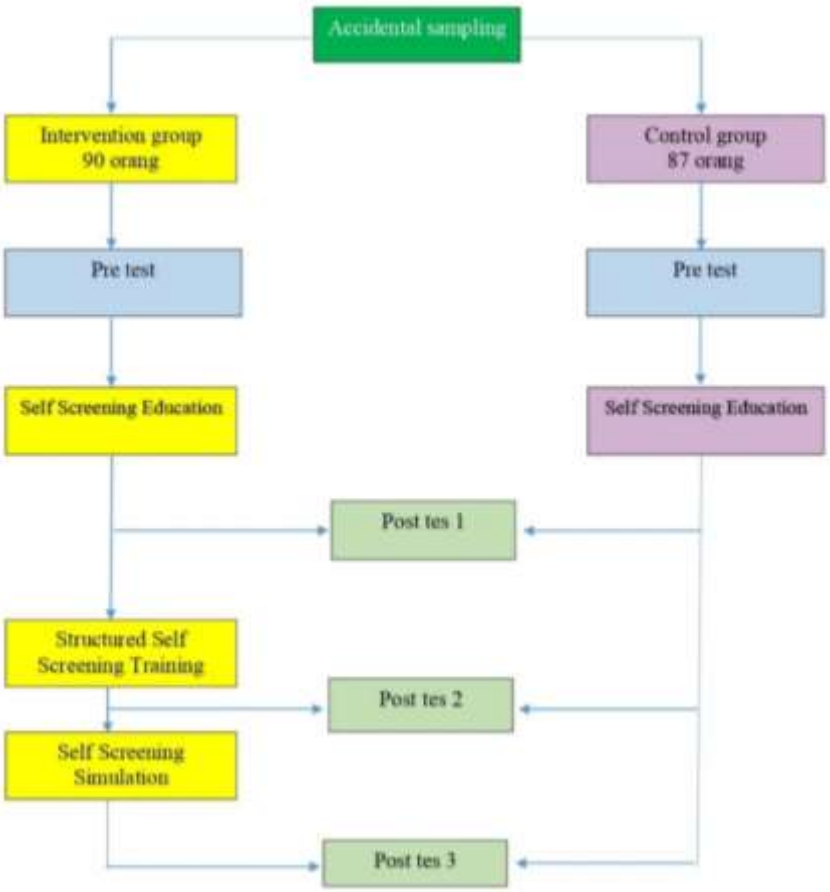

Figure 1 Research procedure

This study emphasizes interventions that refer to processes or actions to increase family strength, independence, and capacity in decision-making and improve access to health resources. The empowerment design for the intervention group included (1) self-screening education using audio-visual media and booklets, (2) structured self-screening training, and (3) structured simulation. Meanwhile, for the control group, families were only given an educational intervention. Researchers collected data through pre-tests and post-tests to determine the improvement/success in each intervention session using a questionnaire as a measuring tool with indicators.

Table 1. TB self-screening education intervention approach for parents

	Self-screening education	**Structured Self-Screening Training**	**Self Screening Simulation**
Objective	• Increase respondents' knowledge and	• Increase participants' ability to carry out self-screening steps.	• Increase understanding of the concept of self-

	understanding of the self-screening process. • Increase respondent satisfaction with educational materials and media.	• Increase participants' confidence in carrying out self-screening. • Increase participant participation and engagement in training sessions.	screening through simulations. • Improve critical thinking skills. • Readiness to implement self-screening
Location	village hall of Seberang Palinggam, Padang	village hall of Seberang Palinggam, Padang	village hall of Seberang Palinggam, Padang
Method	Classical use of audio-visual media (video and booklet), Duration 100 minutes	Demonstrations, roleplays, case studies. Duration 3x120 minutes	Simulation, interactive scenarios Duration: 3x120 minutes
Technical	• The trainer explains why self-screening is essential for early detection and prevention of tuberculosis in children. • The trainer uses multimedia to present material and videos about tuberculosis, symptoms, and follow-up if signs are positive. • The trainer demonstrates the steps for self-screening for TB in children and how to carry out interpretation. • The trainer guides the interactive discussion.	• The trainer explains the importance of structured self-screening steps. • The trainer provides an interactive module that includes detailed self-screening steps. • The trainers guide interactive demonstrations to show correct implementation. • Participants joined small groups (9-10 people per group) for practical training on self-screening steps. • The facilitator provides guidance and feedback.	• The facilitator carries out a self-screening simulation using a mannequin or simulation tool. • Participants participate in the self-screening simulation while the facilitator provides guidance and feedback. Use of interactive scenarios to simulate self-screening implementation situations. • Group discussions on how to deal with various scenarios.
Evaluation Object	Knowledge and understanding	Confidence and participation	Critical thinking skills and implementation readiness
Participant	Intervention and control group	Intervention group	

Data analysis

Data collection on pre-test and post-test results of each intervention were analyzed using the chi-square test with SPSS application to determine the significant difference between the two groups. Meanwhile, the author used the Wilcoxon sign test to determine the difference in overall effect in each intervention in each group. Previously, respondents were also analyzed univariately to display the frequency distribution of their characteristics regarding age, education, previous health program participation, and access to health information.

Ethical Considerations

This research was declared ethically appropriate by following WHO 2011 standards. This feasibility was determined by the Ethics Committee of the Faculty of Nursing, Andalas University, with number 168.laiketik /KEPKFKEPUNAND. The research process considers the principles of benefit and respect by maintaining confidentiality of identity and protecting safety and comfort.

3. Results and Discussion

Table 2 below shows the characteristics of the respondents in this study. Most respondents were 20-30 (56.5%), indicating that this age group constituted a significant portion of the research sample. These findings suggest that productive age has positive prospects in TB self-screening interventions. Most respondents had a medium level of education (53.7%). This educational dominance can influence understanding and participation in self-screening programs.

Regarding participation in previous health programs such as education or similar training, the majority of respondents (67.8%) participated, which may reflect the level of health awareness and interest in participating in prevention efforts, including TB self-screening. Regarding access to information, most respondents stated that they often access health information (50.8%). This condition can facilitate the dissemination of information related to TB self-screening through media or educational materials.

The overall distribution of respondent characteristics in the intervention and control groups was similar, as evidenced by the chi-square test results ($p > 0.05$). The similarity in the distribution of these characteristics indicates a more solid or accurate initial basis for the research results due to the intervention carried out by the researcher. In addition, the similarity of distributions can help reduce potential bias that may arise due to differences in baseline characteristics between groups

Table 2: Respondent Characteristics

Characteristics	**Intervention Group (n = 90)**	**Control Group (n = 87)**	**Total (n = 177)**	**p-value**
	n	**%**	**n**	**%**
Age (years)				**0.325**
20-30	48	53.3%	52	59.8%
31-40	25	27.8%	25	28.7%
41-50	17	18.9%	10	11.5%
Education				**0.388**
Low	29	32.2%	18	20.7%
Middle	47	52.2%	48	55.1%
High	14	15.6%	21	24.2%
Previous health program participation				**0.415**
Ever been	27	30.0%	30	34.5%
Never	63	70.0%	57	65.5%
Access to information				**0.270**
Never	45	50.0%	45	51.7%
Seldom	40	44.4%	30	34.5%
Often	5	5.6%	12	13.8%

This study highlighted significant differences between the intervention and control groups in parents' ability to screen children for tuberculosis through three stages of intervention: self-screening education, structured self-screening training, and self-screening simulation. Intervention and control groups experienced significant improvements in knowledge and understanding at the self-screening education stage with sig of 0.009 and 0.000, respectively. Furthermore, at the structured self-screening training stage, the intervention group experienced a significant mean increase in confidence and skills with a sig of 0.000. Meanwhile, the control group tended to experience a decrease, as evidenced by a statistical sig of 0.197. Finally, at the self-screening simulation stage, the intervention group experienced a more significant increase in understanding of the screening concept and readiness to implement screening (sig of 0.000).

In contrast, the control group tended to experience a more significant decrease with a sig of 0.205. Overall, the two groups had a substantial difference, as indicated by a p-value of 0.000 for all stages (Table 3). The findings highlight that the combination of education, training, and structured simulation-based interventions significantly improved parents' ability to screen children for tuberculosis compared to the control group that received only classical self-screening education. This result indicates that the approach can be an effective solution for early detection and prevention of childhood tuberculosis-related diseases.

Table 3: Differences in parents' ability to self-screen children for tuberculosis according to intervention stages

Interventions and indicators	**Intervention group**		**Control group**		**P value**
	Mean	Sig	Mean	Sig	

Pre-test	2.8		3.0		
Post-test 1 Self-screening education					
Increased knowledge of respondents	4.2	0.009	4.4	0.000	0.000
Increased understanding of the self-screening process	3.8		3.9		
Participant satisfaction with educational materials and media	4.0		4.3		
Post-test 2 Structured Self-Screening Training					
Ability to carry out self-screening steps	4.2	0.000	2.9	0.197	0.000
Confidence in performing self-screening	4.4		2.8		
Participation and engagement in training sessions	4.4		2.9		
Post-test 3 Self Screening Simulation					
Understanding the concept of self-screening through simulation	4.6	0.000	2.7	0.205	0.000
Critical thinking skills.	4.4		2.7		
Readiness to implement self-screening	4.8		2.7		

Discussion

All respondents were in the most dominant age group in the 20-30 year range. This condition follows the finding that the productive age group has positive prospects in self-screening interventions and indicates that this age group tends to be more responsive to health programs. Secondary education level and history of participation in health programs also appear to be highly influential in understanding and participation in TB screening. This data is consistent with previous research, which shows that the level of education is a factor that plays a role in the success of community empowerment [23]. Most respondents often access health information about TB screening through various channels [24]. In addition, the success of TB self-screening interventions can be further increased by utilizing online platforms or health applications that can provide information quickly and easily accessed [25]. The result is that people have independent healthcare skills faster than before.

The results of this study show that the three types of intervention—self-screening education, structured self-screening training, and self-screening simulation—significantly positively impacted participants' knowledge, understanding, and skills in the context of TB screening. The results of this study align with previous research highlighting the effectiveness of education in public health interventions. A study found that mothers who received early complementary feeding counseling were more likely to introduce complementary foods at the appropriate time and in a safe manner. This finding suggests that education can play a crucial role in improving maternal knowledge and practices [26].

The data showed consistent changes in participants' scores before and after the intervention, confirming the effectiveness of each approach. The significant increase in participants' knowledge after the self-screening education intervention follows the study findings, emphasizing the importance of public education to prevent delays in TB diagnosis [27]. These results align with previous research showing that conveying information about TB symptoms can positively influence people's understanding of this disease [28]. Increasing knowledge of the self-screening process also contributes to the literature, given that such information can empower individuals to engage in self-screening efforts actively. In addition,

improvements in participants' understanding of the self-screening process after the intervention also had a significant positive impact. Knowledge of self-screening measures remains limited, hindering individual empowerment in early disease detection [29]. This study goes beyond existing research by delving into the nuances of self-screening through parent involvement. By elucidating the effectiveness of this intervention, we can potentially equip parents with a robust self-screening approach, ultimately accelerating pediatric TB identification.

Unlike passive training methods, structured self-screening training demonstrably boosted participants' confidence in self-screening. This finding transcends mere alignment with prior research [30] and strengthens the argument for structured training as a key driver of confidence and competence. Notably, the observed confidence increase wasn't an isolated phenomenon; it was demonstrably linked to a heightened ability to perform self-screening and active participation, signifying a deeper understanding fostered by the structured approach.

However, we should note that this increase in confidence does not only have a psychological impact. These findings were also accompanied by a marked improvement in participants' ability to carry out self-screening steps. Thus, structured training focuses on building self-confidence and provides a real foundation for improving participants' skills in conducting self-screening. This improvement is consistent with previous research showing that implementation skills can be improved through a structured training approach [31]. Thus, structured self-screening training increases participants' confidence and impacts their capacity to carry out self-screening steps effectively.

The observed surge in participant engagement within the training sessions shouldn't be relegated to a mere side note. Numerous studies suggest that active participation directly translates to enhanced training effectiveness and improved knowledge transfer to real-world applications [32]. Structured training orchestrates a powerful synergy: burgeoning confidence intertwines with active engagement, a testament to its ability to craft an optimal learning environment. This environment transcends mere information transfer; it empowers participants and actively solicits their voices. Our findings illuminate this phenomenon: structured training acts as a catalyst, cultivating a cadre of confident, skilled individuals who thrive within a supportive ecosystem that fosters active learning.

Finally, self-screening simulation stands out as the intervention with the most significant impact, especially in increasing understanding of the concept of self-screening through simulation and critical thinking skills. This result is in line with a previous study, that obtained the results from their study that before the training was carried out, parents did not know how to use the Self Screening instrument to prevent tuberculosis transmission [33]. After the training, all parents learned how to use the self-screening tool to prevent tuberculosis transmission. The advantage of this method, which uses a practice-based approach, is also seen in participants' increased readiness to implement self-screening, which supports previous findings that emphasize the importance of community readiness in adopting disease prevention practices [34].

4. Conclusion and future scope

This study showed that three types of interventions, namely self-screening education, structured self-screening training, and simulation, significantly improved participants' knowledge, understanding, and skills related to TB screening. The results also indicated the effectiveness of each indicator, such as increased knowledge in self-screening education, increased confidence and skills in structured self-screening training, and a significant impact on understanding and readiness for self-screening implementation through self-screening simulation. These findings are essential to the literature, confirming that a combination of education, structured training, and simulation approaches can holistically strengthen community capacity in the early detection and prevention of diseases, particularly TB.

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