



Effect of Life Skills Education on Preventing Household Tuberculosis Transmission in North Sumatra



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ABSTRACT

Aims Pulmonary tuberculosis disproportionately affects the productive age group and has a tendency to spread to household contacts, especially vulnerable populations like children from low socioeconomic backgrounds. This study aimed to develop a life skills education model for tuberculosis patients, employing an effective life skills education strategy to prevent tuberculosis transmission, particularly among household contacts.

Materials & Methods This quantitative quasi-experimental study used a two-group pre-test and post-test design. The study population comprised all tuberculosis patients in the North Sumatra region. The sample included 127 patients from urban areas and 126 patients from rural areas assigned to the intervention and control groups. The non-parametric Friedman test was used to examine changes in knowledge, attitudes, and practices regarding the prevention of tuberculosis transmission among household contacts. Concurrently, the Mann-Whitney test was applied to compare scores between the groups.

Findings Post-intervention analysis revealed significant changes in attitudes for both urban and rural groups ($p=0.0001$), with no significant difference in the magnitude of these changes between the two areas ($p>0.05$). While practice scores improved significantly following the intervention ($p<0.05$), no significant difference in changes in practice scores was found between rural and urban areas when comparing the first and third tests ($p>0.05$).

Conclusion Health education delivered via the lecture method, incorporating the life skills education module, effectively improves knowledge, attitudes, and actions in both urban and rural settings.

Keywords Interpersonal Skills; Pulmonary Tuberculosis; Household Contacts

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Introduction

Indonesia has set a target within the 2030 Sustainable Development Goals (SDGs) Program in the health sector, focusing on improving the quality of life for individuals affected by infectious diseases and strengthening prevention efforts [1]. Achieving the SDGs requires immediate initiation through coordinated, cross-sectoral endeavors. Globally, the management of tuberculosis (TB)-related challenges has progressed slowly over the past two decades, attributable to numerous factors, including non-compliance with government-programmed medication. The treatment rate for TB sufferers has stagnated, showing a mere annual decrease of 0.6% since 1999 [2].

Preventing and mitigating the spread of infectious diseases among humans is a crucial function of community health. Over the last four to five decades, extending into the late 20th century, infectious diseases were generally not considered a primary cause of mortality in developed countries. While deaths from acute infections are limited in these nations, infections continue to be a significant cause of costly morbidity in affluent countries [3]. TB ranks among the top 10 leading causes of death globally and is the foremost cause of death from infectious diseases [4]. Worldwide, an estimated 10.6 million people (ranging from 9.8 to 11.3 million) suffer from TB. This includes 1.4 million (ranging from 1.3 to 1.5 million) TB deaths among those who are HIV-negative and 187,000 deaths (ranging from 158,000 to 218,000) among those who are HIV-positive [5]. Global targets and milestones to reduce TB incidence and mortality have been set as part of the SDGs and the End TB Strategy, with completion targets by 2030. Specifically, these goals include a 90% reduction in deaths and an 80% reduction in incidence (defined as new and relapse cases per 100,000 population per year) between 2015 and 2030 [6].

The global commitment to eradicating TB is outlined in the End TB Strategy, which aims to achieve an 80% reduction in incidence and a 90% reduction in deaths by 2030 [7]. In alignment with this, the Indonesian Ministry of Health has developed an Elimination Roadmap that also targets 2030. This roadmap seeks to decrease TB incidence by 80% to 65 cases per 100,000 population and deaths to 6 per 100,000 population. Key strategies include expanding TB detection and treatment coverage to at least 90%. Furthermore, the targets for successful TB treatment are set at a minimum of 90%, and for tuberculosis preventive therapy (TPT), at a minimum of 80% [8].

The Indonesian government's initiatives to eliminate TB by 2030 are articulated in the 2020-2024 RPJM (National Medium-Term Development Plan), the 2020-2024 National Tuberculosis Control Strategy, and the 2025-2026 Interim Plan. These strategies prioritize implementing the elimination agenda by

augmenting the involvement of communities, partners, and diverse multisectoral stakeholders, and by reinforcing program management through enhancements to the health system.

Individuals with pulmonary TB can transmit the disease by expelling germ-laden droplet nuclei into the air through coughing or sneezing; a single cough can generate approximately 3,000 phlegm droplets. These droplets, containing infectious agents, can remain airborne at room temperature for several hours. Infection can occur when these droplets are inhaled into the respiratory tract [9]. A single patient with sputum smear-positive pulmonary TB (BTA +) has the potential to infect 10-15 people annually, suggesting a significant possibility of infection for every contact with the sufferer. Approximately 10-15% of infected individuals develop active TB, with a yearly rate of up to 10% [10]. A survey conducted in Indonesia indicated that the incidence of TB remains high, and a considerable number of patients undergoing treatment through the Directly Observed Treatment, Short-course (DOTS) program do not achieve recovery. One primary reason for this is patients' failure to complete their treatment for the duration prescribed by the program [11].

A significant challenge persists: despite extensive TB treatment through the DOTS strategy, which is widely considered effective, the prevalence of the disease remains high [8]. This issue is compounded by the fact that the core program for patients is not yet sufficient to break the chain of transmission from infected individuals to those at risk of continuing the cycle, specifically household contacts [12-17]. Studies by Tostmann *et al.* [18] and Soepandi [19] on multidrug-resistant TB (MDR TB) therapy indicate a favorable conversion rate of approximately 80% by the second and third months. This finding offers optimism for the effectiveness of incidence reduction by interrupting transmission chains or minimizing the duration of *Mycobacterium tuberculosis* (BTA) transfer from infected individuals to their household contacts [13, 14].

According to the Global TB Report 2022, Indonesia ranks second globally in TB burden, following India. The World Health Organization (WHO) estimates 969,000 TB cases in Indonesia, with the current reported notification figure standing at 717,941 cases [10].

Data from the North Sumatra Health Service Profile in 2024 reveals that 10,568 TB cases were recorded in the province. Medan City reports the highest number of cases, with 3,775, followed by Deli Serdang Regency with 1,051. Other regions with significant case numbers include Simalungun Regency (517 cases), Langkat Regency (447 cases), and Binjai City (431 cases). The notification figure for 2023 was 49,999 cases, underscoring that the number of TB sufferers in North Sumatra remains substantial [20-29].

This study aimed to develop a life skills education (LSE) model for TB patients to prevent transmission among household contacts.

Materials and Methods

This study employed a quantitative, quasi-experimental method utilizing a two-group pre-test and post-test design. The target population comprised all individuals with TB in the areas of North Sumatra experiencing the highest case burdens. The sample consisted of 127 patients from urban areas and 126 patients from rural areas.

The LSE intervention was developed by the researchers, drawing on existing life skills education frameworks, and adapted to the context of tuberculosis prevention among household contacts. It consisted of a structured educational program delivered through lectures and guided discussions using a specifically designed module. The module covered key topics, including prevention of tuberculosis transmission, treatment adherence, cough etiquette, and personal hygiene practices. The intervention was delivered by trained health workers in several sessions over a defined period. To assess the outcomes, a structured questionnaire was used to measure knowledge, attitudes, and practices (KAP). The instrument consisted of multiple items using ordinal scales (including Likert-type responses for attitudes and practices).

The questionnaire was developed based on previous literature and public health guidelines, and was tested for validity and reliability prior to data collection. Data collection was conducted in several stages, including a baseline (pre-test) and post-intervention assessments at one week (T1), one month (T2), and three months (T3).

Statistical analysis was conducted using SPSS 25. Due to non-normal data distribution, non-parametric tests, including the Friedman test (to analyze repeated measurements of respondents' knowledge, attitudes, and practices (KAP) across different time

intervals) and the Mann-Whitney U test (to compare differences between the intervention and control groups), were used.

Findings

The 26-35-year age group constituted 67.6% of the sample, while the 36-45-year age group represented 27.6%. These figures indicate a higher likelihood of TB occurrence within the productive age range (Table 1).

There was no statistically significant difference in the mean knowledge score between the intervention and control groups before the intervention. For questions 6, 7, 8, and 9, the frequency distribution between rural and urban areas showed no significant difference ($p > 0.05$; Table 2).

Table 1. The frequency of rural (n=126) and urban (n=127) samples' demographic characteristics

Parameter	Rural	Urban	Total
Age (year)			
≤25	6.7	4.7	3.7
26-35	66.7	63.8	67.6
36-45	26.2	31.5	27.6
≥46	0.8	0	1.1
Education			
Elementary school	72.8	30.8	48.5
Junior high school	12.6	20.2	15.0
Senior high school	13.6	41.3	29.3
Bachelor degree	1.0	7.7	7.2
Occupation			
Farmer	71.8	12.5	34.3
Trader	10.7	38.5	27.6
Laborer	10.7	24	13.5
Civil servant	1.9	6.7	7.2
Others	4.9	18.3	17.4

Prior to the intervention, significant differences in attitude scores between the rural and urban groups were observed for most questions ($p < 0.05$), except for question 8 ($p = 0.071$; Table 3).

A statistically significant difference in practice scores between the rural and urban groups was observed before the intervention for most questions ($p < 0.05$), except for question 10 ($p = 0.526$; Table 4).

Table 2. Respondents' mean knowledge score based on the area before the intervention

Item	Rural			Urban			p-Value
	Intervention	Control	Total	Intervention	Control	Total	
1- What causes pulmonary TB?	0.22±0.41	0.69±0.46	0.45±0.49	0.48±0.50	0.70±0.45	0.58±0.49	0.002
2- Where can TB bacteria be found?	0.83±0.36	0.74±0.43	0.79±0.40	0.71±0.45	0.68±0.46	0.07±0.40	0.004
3- Which organs are affected by TB?	0.34±0.47	0.37±0.48	0.35±0.40	0.20±0.40	0.25±0.44	0.23±0.42	0.002
4- What are the correct symptoms of TB?	0.11±0.31	0.19±0.39	0.14±0.35	0.50±0.50	0.37±0.48	0.44±0.49	0.0001
5- How is TB transmitted?	0.24±0.43	0.37±0.48	0.30±0.46	0.64±0.48	0.31±0.46	0.49±0.50	0.0001
6- What type of cough do TB patients have?	0.19±0.40	0.24±0.43	0.21±0.41	0.16±0.37	0.18±0.38	0.17±0.37	0.222
7- What are the correct ways to prevent TB?	0.17±0.38	0.18±0.38	0.17±0.38	0.18±0.38	0.12±0.33	0.15±0.36	0.506
8- How long is TB treatment (OAT)?	0.22±0.41	0.23±0.42	0.22±0.41	0.21±0.41	0.20±0.40	0.20±0.40	0.617
9- What are nutritious foods for TB patients?	0.07±0.25	0.10±0.31	0.08±0.28	0.13±0.34	0.05±0.23	0.09±0.30	0.653
10- What are the factors leading to treatment failure in TB?	0.35±0.48	0.34±0.47	0.35±0.47	0.64±0.48	0.48±0.50	0.57±0.49	0.0001

A statistically significant difference in knowledge scores was found between urban and rural areas ($p = 0.0001$). Furthermore, when examining the differences within rural and urban areas across all groups following interventions (the first and third

tests: T3-T1), the urban area showed no significant difference ($p > 0.05$). In contrast, the rural area exhibited a significant difference between the intervention and control groups ($p = 0.0001$; Table 5). The changes in respondents' attitudes in both urban

and rural areas from the pre-test to the post-test, conducted three months after the intervention, were statistically significant ($p=0.0001$). However, no significant difference was found in the magnitude of these attitude changes between the urban and rural areas across all groups ($p>0.05$; Table 6).

There was a significant improvement in respondents' practice score following the intervention ($p<0.05$). Conversely, when comparing the first and third tests (T3-T1), no significant difference in practice score was observed between the rural and urban areas ($p>0.05$; Table 7).

Table 3. Respondents' attitude score based on area before the intervention

Item	Rural			Urban			p-Value
	Intervention	Control	Total	Intervention	Control	Total	
1- TB patients must prevent transmission to others	1.83±0.70	1.79±0.69	1.81±0.69	1.99±0.72	1.97±0.81	1.98±0.76	0.020
2- Cover your mouth when coughing or sneezing	1.83±0.70	1.79±0.69	1.81±0.69	1.99±0.72	1.97±0.81	1.98±0.76	0.020
3- Do not spit indiscriminately	1.71±0.73	1.85±0.77	2.17±0.80	1.59±0.77	1.91±0.77	1.73±0.78	0.0001
4- Take medication according to the prescribed dose	1.71±0.79	1.45±0.71	1.59±0.76	2.71±0.60	2.15±0.76	2.46±0.73	0.0001
5- Provide a container for sputum	2.79±0.52	2.82±0.45	2.80±0.49	2.76±0.56	2.20±0.72	2.51±0.70	0.0001
6- Stay away from infants and toddlers	2.66±0.58	2.55±0.76	2.80±0.50	2.63±0.62	2.09±0.85	2.38±0.78	0.0001
7- Take medication regularly for 6 months	2.00±0.72	1.89±0.72	1.55±0.72	1.70±0.70	1.75±0.74	1.73±0.72	0.001
8- Sun-dry bedding	1.61±0.65	1.46±0.50	1.55±0.59	1.43±0.49	1.96±0.73	1.67±0.66	0.071
9- Housing density	2.46±0.73	2.37±0.80	2.42±0.76	2.77±0.57	2.45±0.65	2.62±0.63	0.004
10- Alcohol consumption among TB patients	1.47±0.61	1.27±0.50	1.36±0.57	2.48±0.73	1.96±0.82	2.25±0.81	0.0001

Table 4. Comparison of respondents' practice score based on the area before the intervention

Item	Rural			Urban			p-Value
	Intervention	Control	Total	Intervention	Control	Total	
1- Covering the mouth when coughing	1.53±0.64	1.67±0.59	1.60±0.62	2.15±0.76	1.74±0.72	1.96±0.77	0.0001
2- Wearing a mask	2.28±0.73	2.23±0.68	2.36±0.72	2.07±0.75	1.72±0.76	1.91±0.77	0.0001
3- Adherence to medication	2.73±0.45	2.73±0.50	2.73±0.47	2.87±0.45	2.79±0.40	2.83±0.43	0.004
4- Sputum disposal	2.46±0.74	2.67±0.54	2.74±0.51	1.44±0.74	1.86±0.62	2.16±0.93	0.0001
5- Environmental hygiene	2.17±0.81	2.22±0.74	2.19±0.77	1.62±0.67	1.75±0.61	1.68±0.65	0.0001
6- Home ventilation	2.58±0.72	2.65±0.63	2.61±0.68	2.87±0.41	2.70±0.45	2.87±0.39	0.0001
7- Diet	1.64±0.70	2.41±0.83	1.74±0.91	2.39±0.68	2.70±0.48	2.53±0.61	0.0001
8- Routine checkups	2.25±0.91	2.46±0.72	2.32±0.87	2.77±0.43	2.68±0.46	2.66±0.53	0.0001
9- Adherence to treatment schedules	2.16±0.71	2.58±0.58	2.35±0.68	2.33±0.70	2.25±0.73	2.18±0.70	0.009
10- Other preventive behaviors	2.12±0.65	2.20±0.64	2.20±0.71	2.22±0.74	1.18±0.70	2.25±0.68	0.526

Table 5. Comparison of respondents' knowledge mean score before and after the intervention

Region	Before intervention				After intervention				p-Value	Δ (T3-T1)	p-Value
	T0	T1	T2	T3	T0	T1	T2	T3			
Urban											
Intervention	6.07±2.29	11.77±2.30	10.92±2.43	11.06±2.61	0.0001	4.98	0.738				
Control	5.25±2.26	10.41±2.45	9.68±2.66	10.96±2.76	0.0001	5.71					
Rural											
Intervention	4.36±1.94	12.96±2.40	11.45±1.94	13.26±2.38	0.0001	8.90	0.0001				
Control	5.45±2.10	9.96±2.97	8.97±3.51	10.55±2.35	0.0001	5.98					

T0=Test before the intervention, T1=Test given one week after the intervention, T2=Test given one month after the intervention, T3=Test given three months after the intervention

Table 6. Comparison of respondents' attitude score before and after the intervention

Region	Before intervention				After intervention				p-Value	Δ (T3-T1)	p-Value
	T0	T1	T2	T3	T0	T1	T2	T3			
Urban											
Intervention	31.22±1.84	38.37±2.18	36.97±2.45	37.06±2.62	0.0001	5.74	0.886				
Control	30.57±3.40	39.66±2.03	38.35±2.64	37.05±2.43	0.0001	6.48					
Rural											
Intervention	28.92±2.76	39.34±1.71	38.45±1.94	37.53±2.52	0.0001	8.61	0.162				
Control	30.87±2.39	36.96±2.52	36.62±2.87	36.76±3.40	0.0001	5.89					

T0=Test before the intervention, T1=Test given one week after the intervention, T2=Test given one month after the intervention, T3=Test given three months after the intervention

Table 7. Respondents' practice mean score before and after the intervention

Region and group	Before intervention				After intervention				p-Value	Δ (T3-T1)	p-Value
	T0	T1	T2	T3	T0	T1	T2	T3			
Urban											
Intervention	28.44±2.33	30.66±2.21	29.39±0.94	30.80±2.35	0.0001	2.25	0.144				
Control	28.68±2.03	30.57±1.34	29.62±1.48	31.38±1.42	0.0001	1.63					
Rural											
Intervention	27.46±1.98	30.70±1.74	29.53±1.97	30.73±1.75	0.0001	3.26	0.602				
Control	28.44±2.42	32.52±2.10	30.62±2.66	30.88±2.13	0.0001	2.43					

T0=Test before the intervention, T1=Test given one week after the intervention, T2=Test given one month after the intervention, T3=Test given three months after the intervention

Discussion

This study aimed to develop an LSE model for TB patients to prevent transmission among household contacts. The use of nonparametric statistical tests, specifically the Friedman and Mann-Whitney U tests, enhanced the credibility of the findings regarding changes in KAP among pulmonary TB patients. The significant improvement observed following the implementation of the LSE intervention indicated that a structured educational approach can effectively alter health-related behaviors, even when the data do not conform to a normal distribution. Similar findings were also reported by Alipour *et al.* [30] and Ghosh *et al.* [31], who found that behavioral interventions centered on self-management and problem-solving lead to significant improvements in adherence to TB treatment and a reduction in the risk of transmission within households.

The non-normal distribution of the data suggested heterogeneity in the participants' baseline knowledge levels and behavioral patterns. This heterogeneity is frequently encountered in public health research involving diverse populations, particularly when comparing urban and rural areas. The LSE module's capacity to elicit significant behavioral improvements in both urban and rural settings demonstrates its adaptability across diverse sociocultural contexts [32]. Drawing upon Bandura's Social Cognitive Theory [33], these results reflect the synergistic impact of individual self-efficacy, environmental support, and observational learning in shaping health-related actions.

Accurate knowledge or information about a subject is a critical factor in forming a concept, ensuring that the process of sequential behavioral change can be optimally developed. Knowledge can be acquired through an individual's own experiences and those of others, including influences from teachers, family, friends, officials, and the media.

An individual's mental attitude is essentially a psychological state encompassing feelings and desires that influence daily actions or behavior. This mental attitude develops alongside the individual's inner growth, shaped by experience, education, or social interactions. Attitude is described as a latent reaction or response from an individual to a stimulus or object. It can also be defined as an individual's response to an object, which can fundamentally change according to the stimulus and the information obtained.

Furthermore, attitudes possess motivational and emotional aspects, natural characteristics that distinguish them from an individual's skills or knowledge.

Knowledge, thoughts, beliefs, and emotions play a significant role in the formation of a complete attitude. This is further supported by factors that can influence attitude formation, including personal experience, the influence of other individuals

considered important, and the impact of culture, education, religion, and mass media.

Prior to the intervention, the respondents' actions regarding TB disease were sufficient, as evidenced by their answers in the pre-test. However, after the intervention was administered to all groups, a statistically significant increase was observed. This suggests that the LSE method could enhance respondents' knowledge and attitudes toward preventing TB transmission among household contacts of sufferers. Based on the changes in respondents' actions, no significant difference was found between urban and rural areas. This suggests that actions are influenced by behavior, which is shaped by factors beyond education. To effectively change behavior, it is crucial to strengthen other elements, such as social norms, local government policies, and, most importantly, the intention to change, which serves as the strongest predictor of actions. Additionally, individuals exhibit varying willingness to change even when faced with identical conditions.

Behavior occurs when an individual has progressed through the stages of knowledge and developed strong attitudes, leading to the adoption of new actions or ideas. Environmental factors also significantly support the emergence of new changes. Life skills are the abilities required to address the challenges faced by individuals with infectious or other diseases. The fundamental principle of LSE is to foster learning outcomes that are closely linked to real-life situations, the surrounding environment, and personal experiences within family and social contexts.

These skills are particularly focused on enhancing interactions with others in the community. Personal skills include self-awareness and thinking. More specifically, self-awareness encompasses skills related to responding to pulmonary TB, including adherence to treatment and care to support healing. Additionally, thinking skills are essential, which involve the ability to explore and find information, process and make decisions, and solve problems that may arise if not handled properly.

Furthermore, our results highlight the importance of integrating psychosocial and behavioral dimensions into TB control programs. While medical treatment remains a key component, the sustainability of TB elimination efforts also heavily relies on patient behavioral adherence, awareness, and self-regulation skills. Pefura-Yone *et al.* [34] and Kigozi *et al.* [35] demonstrate that patient education, when combined with community support, can improve treatment success rates and reduce relapses.

The choice of non-parametric analysis not only aligns with the characteristics of the data but also reflects the realistic complexity of community-based public health interventions, where strict statistical assumptions are rarely met. By applying appropriate

analytical methods, this study provides reliable evidence that the LSE approach can enhance individual capacity and behavior towards TB prevention. This supports Indonesia's national TB elimination roadmap by 2030 [36].

Overall, our findings underscore that statistical rigor and contextual relevance are equally important in health research. Methodological consistency—through the use of non-parametric tests for ordinal data—and the effectiveness of the LSE method collectively strengthen this study's contribution to behavioral health promotion and TB control strategies in resource-limited settings.

Our findings offer a significant contribution to understanding the effectiveness of a life skills-based educational approach in TB control. Through the application of participatory and contextual learning methods, TB patients demonstrated improvement in their cognitive, affective, and psychomotor skills related to preventing transmission within the household. However, this study is subject to several limitations, including the absence of an analysis of contextual factors such as family support, socioeconomic conditions, and the quality of health services, all of which may influence intervention outcomes.

To enhance the life skills of individuals with TB, it is essential to implement the LSE strategy as a guideline and to engage in self-training to improve individual coping mechanisms when dealing with the disease. This includes complying with recommended treatment therapy, both in interactions with others and with household contacts, to prevent TB transmission. Therefore, further research is recommended to adopt a mixed-methods approach to explore the social and cultural factors influencing the effectiveness of LSE strategies. It is thus hoped that the research findings can serve as a foundation for developing more comprehensive policies and interventions in national TB elimination efforts.

Conclusion

The health education strategy using the LSE method enhances the knowledge, attitudes, and practices of individuals with TB.

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Authors' Contribution: Amirah A (First Author), Methodologist/Main Researcher (20%); Suharto T (Second Author), Methodologist/Assistant Researcher (15%); Nur'aini N (Third Author), Assistant Researcher/Statistical Analyst (15%); Ekowati N (Fourth Author), Assistant Researcher/Statistical Analyst (10%); Desy RJ (Fifth Author), Assistant Researcher (10%); Sembiring KDB (Sixth Author), Introduction Writer/Discussion Writer (10%); Syam A (Seventh Author), Assistant Researcher (10%); Malik M (Eighth Author), Introduction Writer/Assistant Researcher/Discussion Writer (10%)

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