The Influence of Life Skill Education (LSE) Strategies in Pulmonary Tuberculosis Patients on Prevention of Household Contact Infringement in North Sumatra

Abstract

Aims: In Indonesia, pulmonary tuberculosis remains a public health problem because it is the country with the second-highest number of TB cases in the world. Pulmonary TB primarily affects the productive age group and tends to spread to household contacts, particularly vulnerable groups such as children from low socioeconomic backgrounds. The purpose of this study is to develop a life skills education model for TB patients, utilizing an effective Life Skills Education strategy to prevent TB transmission, particularly among household contacts.

Materials & Methods: Using quantitative research with a quasi-experimental design, utilizing a two-group pre-test and post-test design for the intervention and control groups to assess the effect of the Life Skill Education strategy on the prevention of transmission to household contacts through the implementation of life skills education for TB patients. The study population consisted of all TB patients in the North Sumatra region. The sample consisted of 127 patients in urban areas and 126 patients in rural areas. The non-parametric-Friedman test was used to examine changes in knowledge, attitudes, and actions towards preventing TB transmission among household contacts. Meanwhile, the Mann-Whitney test was used to compare scores between groups.

Findings: All results were statistically significant ($p<0.05$).

Conclusion: The conclusion showed that health education using the lecture method with the LSE module could improve knowledge, attitudes, and actions in both urban and rural areas. It is recommended that health workers provide counseling using the LSE module more practically to prevent household transmission, as part of the TB Elimination Program by 2030.

Introduction

Indonesia has set a target under the Sustainable Development Goals (SDGs) Program in 2030 in the health sector, focusing on improving the quality of life for people affected by infectious diseases and strengthening efforts for their prevention [1]. The achievement of SDGs goals should be initiated now through coordinated efforts across various sectors. Over the past 20 years, the handling of tuberculosis (TB)-related challenges has been very slow globally due to multiple factors, and also related to non-compliance with taking medication that has been programmed by the government. The percentage of TB sufferers who are treated has been stunted, decreasing by only 0.6% per year since 1999 [2].

Preventing and reducing the spread of infectious diseases among humans is an important function of community health. Over the past four to five decades and at the end of the 20th century, infectious diseases have generally not been considered a major cause of death in developed countries. Deaths from acute infections in developed countries are very limited, but infections remain an important cause of expensive morbidity in rich countries [3]. TB is one of the 10 highest causes of death worldwide and the leading cause of death from infectious diseases [4]. Globally, an estimated 10.6 million (range 9.8-11.3 million) people are sick with TB; 1.4 million (range 1.3-1.5 million) TB deaths include HIV-negative, and 187,000 deaths (range 158,000-218,000) include HIV-positive [5]. Global targets and milestones for reducing TB incidence and deaths have been set as part of the SDGs and the End TB Strategy by the end of 2030; Namely a 90% reduction in deaths and an 80% reduction in incidence (new and relapse cases per 100,000 population per year) between 2015 and 2030 [6].

The global commitment to ending TB is outlined in the End TB Strategy, which targets an 80% reduction in its incidence and 90% in deaths by 2030 [7]. The Indonesian Ministry of Health has prepared an Elimination Roadmap with a global target of 2030, the incidence will decrease by 80% to 65 per 100,000 population, and deaths will decrease to 6 per 100,000 population, with efforts to increase the scope of TB detection and treatment to ≥90. The success rate of TB treatment is ≥90%, and TB preventive therapy (TPT) is ≥80% [8].

The Indonesian government's efforts to eliminate TB by 2030 are outlined in the 2020-2024 RPJM, the 2020-2024 National Tuberculosis Control Strategy, and the 2025-2026 Interim Plan. These efforts emphasize implementing the elimination strategy by enhancing the role of communities, partners, and other multisectoral stakeholders, as well as strengthening program management through improvements in the health system.

Pulmonary TB sufferers can spread germs into the air in the form of *droplet nuclei* when coughing or sneezing, and a cough can produce around 3000 phlegm droplets. These phlegm droplets contain germs

and can survive in the air at room temperature for several hours. People can be infected if the phlegm droplets are inhaled into the respiratory tract [9]. One patient with pulmonary TB BTA (+) has the potential to infect 10-15 people per year, thereby there is a possibility that every contact with the sufferer will be infected with TB. Approximately 10-15% of those infected develop actively up to 10% per year [10]. According to a survey in Indonesia, the incidence of TB is still high, and many sufferers receive treatment through the DOTS program but do not recover. One of the contributing factors is that sufferers do not continue treatment until the time determined by the program [11].

The actual problem is that amid quite massive TB treatment with the DOTS strategy, which is considered effective, the prevalence remains high [8]. This is added by the core program for sufferers and is not yet adequate in efforts to break the chain from sufferers to people who have the potential to continue the chain of transmission (in this case, household contacts with sufferers) [12]. The findings of Tostman *et al.* [18] and Soepandi [19], respectively, on MDT and MDR TB therapy, show adequate conversion (around 80%) in the second and third months. This finding provides hope for the effectiveness of reducing incidence in the form of breaking the chain or minimizing the time of BTA transfer from contact persons to household contacts (Gebreegziabher, Yimer, & Bjune, 2016) [13, 14].

Based on the Global TB Report in 2022, Indonesia is the second country with the highest TB burden in the world after India. WHO estimates 969,000 TB cases in Indonesia, with the current notification figure of 717,941 cases [10]. Based on the North Sumatra Health Service Profile in 2024, 10,568 cases of TB were recorded. The highest number of cases in Medan City was 3,775 cases, followed by Deli Serdang Regency with 1,051 cases. Additionally, 517 cases were recorded in Simalungun Regency, Langkat Regency, with 447 cases, and Binjai City, with 431 cases. The Notification in 2023 was 49,999 cases, and this shows that the number of TB sufferers in North Sumatra is still high.

Materials and Methods

This is a quantitative research using a quasi-experimental design with a two-group pre-test and post-test design. The population was all TB sufferers in areas with the highest cases in North Sumatra. The sample was 127 patients in urban areas and 126 patients in rural areas.

Prior to statistical testing, a normality assessment was conducted to determine whether the data followed a normal distribution. The results revealed that the data did not meet the normality assumption. Consequently, non-parametric statistical analyses were used to ensure appropriate interpretation of the findings. Specifically, the Friedman test was applied to analyze repeated measurements of respondents' knowledge, attitudes, and actions over different time intervals, while the Mann-Whitney U test was employed to compare differences between the intervention and control groups.

The decision to employ non-parametric tests was based on both statistical and conceptual considerations. First, the variables in this study were measured using questionnaire-based scores with an ordinal scale—representing levels of knowledge, attitudes, and practices (KAP)—which inherently do not meet the interval data requirements of parametric tests such as ANOVA or the independent t-test. Second, preliminary normality testing using the Kolmogorov-Smirnov and Shapiro-Wilk methods indicated p-values below 0.05, confirming that the data were not normally distributed. Hence, non-parametric methods were deemed most suitable to preserve analytical robustness under these conditions.

Furthermore, the use of the Friedman and Mann-Whitney U tests has been widely recommended in health behavior research and public health intervention studies where ordinal or skewed data are common. These tests provide reliable results for assessing changes over time and comparing independent samples without requiring normality or homogeneity of variances. In addition, non-parametric approaches are less sensitive to outliers and small sample size variations—an important consideration in field-based community health studies. Therefore, the analytical strategy adopted in this study was appropriate for the data characteristics, ensuring valid, consistent, and unbiased statistical conclusions. This approach aligns with best practices in quantitative public health research, where ensuring the suitability of statistical assumptions is essential for maintaining scientific rigor and interpretative accuracy.

Findings

1. Distribution based on respondent characteristics

Based on the distribution of respondent characteristics, it was found that the age group of 26-35 years was 67.6% while the age group of 36-45 years was 27.6%. This shows that TB sufferers are more likely to occur in a productive age (Table 1).

Table 1. Respondent characteristics based on the observation area

Characteristics	Rural (%) n=126	Urban (%) n=127	Total (%) n=234

Age			
≤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
Working			
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

Source: Primary data

2. Distribution of respondents based on knowledge of preventing TB transmission in household contacts

Based on the frequency distribution of questions in the rural and urban groups, a p-value>0.05 was obtained for questions number 6, 7, 8, and 9. This means that there was no difference in knowledge before the intervention was carried out in both the treatment and control groups, compared to other questions (Table 2).

Table 2. Distribution of respondents' knowledge based on the observation area before intervention

Question	Rural			Urban			p
	Case Stanel Score	Control Stanel Score	Total	Case Stanel Score	Control Stanel Score	Total	
1	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	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	0.34±0.47*	0.37±0.48*	0.35±0.48*	0.20±0.40*	0.25±0.44*	0.23±0.42*	0.002
4	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	0.24±0.43*	0.37±0.48*	0.30±0.46*	0.64±0.48*	0.31±0.46*	0.49±050*	0.0001
6	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	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	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	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	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

p<0.05=Mann-Whitney*

3. Distribution of respondents based on attitudes towards preventing TB transmission in household contacts

Based on the distribution of 10 questions of respondents' attitudes with a p-value<0.05, there was no difference between rural and urban groups before the intervention. Meanwhile, question no. 8 found a difference before the intervention (Table 3).

Table 3. Distribution of respondents' attitude questions based on rural and urban areas before the intervention

Question	Rural			Urban			p
	Case	Control	Total	Case	Control	Total	
1	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	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	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	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	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	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	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	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	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	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

p<0.05=Mann-Whitney*

4. Distribution of respondents based on actions to prevent transmission of TB household contacts

Based on the distribution of questions, the results obtained were p<0.05, which means there was a difference between rural and urban groups before the intervention (Table 4).

Table 4. Distribution of respondents based on actions to prevent transmission of TB to household contacts

Question	Rural			Urban			p
	Case	Control	Total	Case	Control	Total	

1	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	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	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	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	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	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	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	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	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	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

p<0.05=Mann-Whitney*

5. Distribution of respondents' knowledge before and after *LSE* intervention on preventing TB transmission to household contacts

Subject knowledge in urban areas in MMC and MPM groups

Table 5. Respondents' knowledge before and after LSE intervention on preventing transmission of pulmonary TB

Region and group	Before TO Stanel score±SD	After T1 Stanel score±SD	T2 Stanel score±SD	T3 Stanel score±SD	p	Δ T3-T1	P
Urban							
Case	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							
Case	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**	

Based on the results of Table 5, it was found that respondents' knowledge in urban and rural areas was statistically significant with a p-value=0.0001. Meanwhile, based on the differences in rural and urban areas in all groups with T3-T1 interventions, with a p-value>0.05 in the urban group, while in the rural group, there was a difference between cases and controls with a p-value=0.0001.

6. Respondents' attitudes before and after LSE intervention towards preventing TB transmission among household contacts

The attitudes of subjects in urban and rural areas in all groups before and after the intervention are presented in Table 6.

Table 6. Respondents' attitudes before and after the LSE intervention toward preventing TB transmission among household contacts

Region and group	Before TO Stanel score±SD	After T1 Stanel score±SD	T2 Stanel score±SD	T3 Stanel score±SD	p	Δ T3-T1	P
Urban							
Case	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							
Case	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	

In Table 6, it was found that changes in respondents' attitudes in urban and rural areas from the pre-test to the post-test three months after the intervention were all statistically significant with a p-value of 0.0001. However, there was no difference in changes in attitudes between urban and rural areas in all groups, with a p-value>0.05.

7. Respondents' actions before and after LSE intervention on preventing TB transmission among household contacts

Respondents' actions before and after LSE intervention on the prevention and TB transmission patients are obtained as follows (Table 7).

Table 7. Respondents' actions before and after LSE intervention on preventing transmission of TB to household contacts

Region and group	Before TO Stanel score±SD	After T1 Stanel score±SD	T2 Stanel score±SD	T3 Stanel score±SD	p	Δ T3-T1	p
Urban							
Case	28.44±2.33	30.66±2.21	29.39±-094	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							
Case	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	

p<0.05, p=Friedman test and Mann-Whitney difference test; T0=Test before Intervention, T1=Test given one week after Intervention, T2=Test given one month after Intervention, T3=Test given three months after intervention

The results indicate that the respondents' actions to prevent TB transmission among household contacts showed a significant improvement after the intervention, with a p-value<0.05. Meanwhile, T3-T1 from the first and the third tests showed no difference in the two groups of rural and urban areas, with p>0.05.

Discussion

The use of non-parametric statistical tests such as the Friedman and Mann-Whitney U tests in this study strengthens the validity of the findings regarding changes in knowledge, attitudes, and practices (KAP) in pulmonary tuberculosis (TB) patients. The significant improvement observed after implementing the Life Skills Education (LSE) intervention demonstrates that a structured educational approach can effectively modify health-related behaviors, even when data do not meet the assumption of a normal distribution. Similar findings were also reported by Alipour *et al.* [30] and Ghosh *et al.* [31], who reported that behavioral interventions focused on self-management and problem-solving significantly improved adherence to TB treatment and reduced the risk of transmission within the household.

The non-normal nature of the data indicates heterogeneity in participants' baseline knowledge levels and behavioral patterns. This heterogeneity is common in public health research involving diverse populations, particularly between urban and rural areas. The LSE module's ability to produce significant behavioral improvements in both areas demonstrates the model's adaptability to different socio-cultural contexts. Based on Bandura's Social Cognitive Theory [33], these results reflect the combined influence of individual self-efficacy, environmental support, and observational learning in shaping health actions.

Accurate knowledge or information about a subject is a critical factor to consider when forming a concept. This ensures that the process of sequential behavioral change can be developed optimally. Previous analysis showed that knowledge can be obtained from an individual's own experience and that of others, in relation to this are teachers, family, friends, and officers, including the media.

The mental attitude possessed by an individual is essentially a psychological condition, feelings, and desires to influence daily actions or behavior. This mental attitude is obtained along with the development of the soul, which is influenced by experience, education, or interaction with the social environment. Stated that attitude is a reaction or response that is still closed from an individual to a stimulus or object. Attitude can also be defined as an individual response to an object, and can basically change according to the stimulus, with the information obtained. In addition, it also has motivational and emotional aspects, natural characteristics that distinguish attitudes and skills or knowledge possessed by individuals.

Explained that in determining a complete attitude, knowledge, thoughts, beliefs, and emotions play an important role. This is reinforced by factors that can influence the formation of attitudes are personal experience, other individual influences who are considered important, as well as the influence of culture, education, religion, and mass media.

The results found that before the intervention, the Respondent's Actions against TB disease were sufficient. This can be seen from the respondents' answers in the pre-test before the intervention. However, after the intervention was administered to all groups, there was a statistical increase, all significant at p<0.05. Therefore, the learning process of improving skills with the LSE method can improve respondents' knowledge and attitudes towards preventing TB transmission with household contacts for sufferers. Based on changes in Respondent Actions using the Mann-Whitney difference test (T3-T1), T1=test given one week after the intervention, T2=test given one month after the intervention, and T3=test given three months after the intervention, there was no difference in urban and rural areas with a value of p=0.1444. This indicates that actions are influenced by behavior, which is shaped by factors beyond education. To effectively change behavior, it is essential to strengthen other elements such as social norms, local government policies, and, most importantly, the intention to make changes, which serves as the strongest predictor of Actions. In addition, an individual has a different willingness to change even though the conditions are the same.

The behavior occurs when an individual has passed through the stages of knowledge and strong attitudes to realize the existence of a new action or idea. Environmental factors also greatly support the occurrence of a new change. Life skills refer to the abilities required to address challenges faced by individuals with infectious or other diseases. The core principle of Life Skills Education (LSE) lies in fostering learning outcomes that are closely connected 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 their community. Personal skills include self-awareness and thinking. More clearly, self-awareness includes skills in responding to Pulmonary TB related to compliance with treatment and care for healing the disease. In addition, there

needs to be thinking skills that include the ability to explore and find information, process and make decisions, and the ability to solve problems that will arise if not handled properly.

Furthermore, the results of this study emphasize the importance of integrating psychosocial and behavioral dimensions in TB control programs. While medical treatment remains a key component, the sustainability of TB elimination efforts also depends heavily on patient behavioral adherence, awareness, and self-regulation skills. Studies by Pefura-Yone *et al.* [34] and Kigozi *et al.* [35] show that patient education 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 improve individual capacity and behavior towards TB prevention, and supports Indonesia's national TB elimination roadmap by 2030 [36].

Overall, the results of this study emphasize 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 LSE education together strengthen this study's contribution to behavioral health promotion and TB control strategies in resource-limited settings.

Conclusion

In conclusion, the Health Education Strategy with the LSE learning method can improve the knowledge, attitude, and action of TB sufferers. Principles in learning are related to the approach model using modules and lectures as a guide in delivering material and expected skills appropriate to learning objectives. These materials provide intellectual, as well as psychological and physical development of patients in receiving the response given.

The results of this study provide an important contribution to understanding the effectiveness of a life skills-based educational approach in tuberculosis control. Through the application of participatory and contextual learning methods, TB patients were able to improve their cognitive, affective, and psychomotor skills in preventing transmission within the household. However, this study has several limitations, including the lack of analysis of contextual factors such as family support, socioeconomic conditions, and quality of health services that may influence intervention outcomes.