

Impact of a Simple Educational Intervention Against Tuberculosis Among High School Children in Lahore, Pakistan

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Abstract

Background: Tuberculosis (TB) remains a significant public health challenge in Pakistan despite the availability of effective treatment. Raising awareness among students can contribute to early detection and disease prevention. This quasi-experimental study assessed the impact of a targeted educational intervention on TB-related knowledge among schoolchildren.

Methodology: A quasi-experimental study was conducted from December 2023 to September 2024 among 71 school students aged 10–14 years in grades 6–8 in an outskirt area of Lahore, Pakistan. Students were assigned to teacher-led (n=36) or expert-led (n=35) tuberculosis awareness sessions. A WHO-adapted, reliable KAP questionnaire assessed knowledge at baseline and six months post-intervention. Both groups received six monthly sessions, and changes in knowledge scores were analyzed and compared using SPSS-26.

Results: Out of 118 students, 11 did not provide consent, 16 missed one or more intervention sessions, and 20 did not completely answer the questionnaire and were therefore excluded from the final analysis. A total of 71 students gave complete answers to the pre-test questionnaire. The mean age of the students for group A was 12.85 ± 2.11 SD (in years), and for group B, it was 12.67 ± 1.23 SD (in years). In total, there were 38% boys and 62% girls. The mean percentage of all pre-test participants (71 students) involved was 55.9%, which improved to 80.1% in Group A (36 students) and 92.6% in Group B (35 students) after intervention. Both groups showed substantial improvement, but the increase was greater in the expert-led group.

Conclusion: Both educational approaches significantly influenced TB knowledge, with expert-led sessions yielding superior outcomes. These findings suggest that integrating expert-guided TB awareness programs into school curricula could enhance long-term public health impact.

Keywords: Tuberculosis; educational intervention; school children; knowledge; Lahore

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Introduction

Tuberculosis (TB) remains a leading cause of morbidity and mortality worldwide, particularly in low- and middle-income countries like Pakistan, with an estimated incidence of 259 cases per 100,000 population (1). TB is caused by *Mycobacterium tuberculosis* and is transmitted through respiratory droplets; however, most infections are preventable and curable with proper awareness and timely treatment (2). It usually affects the lungs in 80% of cases, with warning signs of cough, hemoptysis, chest pain, shortness of breath, fever, weight loss, and drenching night sweats (3) but can also involve other organs, leading to extrapulmonary TB. It is spread mainly through the air in the form of droplets. Droplets containing *Mycobacterium tuberculosis* are sprayed into the air when infectious people cough, sneeze, talk, laugh, or spit. People nearby may inhale the bacteria and become infected. *Mycobacterium tuberculosis* can remain viable as air-borne droplets suspended in the air for a long time or as part of house dust for weeks. However, transmission usually occurs only after substantial exposure to someone with active TB (3,4).

According to the WHO Global TB Report 2024, Pakistan ranks among the top 30 high-burden countries and accounts for 61% of TB cases in the WHO Eastern Mediterranean Region (8). The country faces a significant challenge, with an estimated prevalence of 348 cases, an incidence of 276 cases, and a mortality rate of 34 cases per 100,000 population annually (9). Despite the



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availability of effective treatment and the adoption of the Directly Observed Treatment, Short-course (DOTS) strategy by Pakistan's National TB Program (NTP) in 1995, 10 delays in diagnosis and treatment persist due to low awareness, stigma, limited access to care, and socio-cultural barriers (5). The National Strategic Plan (NSP) 2020–2023, (6) aligned with the WHO “End TB Strategy”, aims to eliminate TB-related fatalities and reduce disease burden, with a long-term goal of ending the TB epidemic in Pakistan by 2035 (6). Additional challenges include low health-seeking behaviour, complex diagnostic procedures, long waiting times, and perceptions of poor healthcare quality and cost, all of which contribute to underutilization of TB services (11, 12). Limited evidence exists regarding the comparative effectiveness of different educational strategies—such as expert-led versus teacher-led interventions—in improving TB awareness, particularly among school-aged populations.

Therefore, this study aimed to evaluate the effectiveness of two educational interventions—one led by experts and the other led by teachers—in improving TB knowledge among school students in Lahore. The findings are expected to guide health-education strategies that can be integrated into school curricula to strengthen community-based TB control.

The objective of this research was to evaluate and compare the effectiveness of two educational approaches – teacher-led sessions and expert-led sessions – on students' knowledge about tuberculosis.

Methodology

A quasi-experimental study was conducted among school students of an outskirt area of Lahore, Pakistan, from December 2023 to September 2024 (9 months). The study protocol was reviewed and approved by the Ethical Review Board of Central Park Medical College, Lahore (Approval No: CPMC/IRB-No/1308). Out of 118 students, 11 did not provide consent, 16 missed one or more intervention sessions due to absenteeism, illness, or examination schedules, and 20 did not completely answer the questionnaire and were therefore excluded from the final analysis. A total of 71 students gave complete answers to the pre-test questionnaire. The participants aged between 10 and 14 years, constituting the entire population of students in grades 6 to 8 of the school. These 71 students are divided into two groups—36 students in group A and 35 in group B. Due to the logistical constraints of conducting the intervention within a school setting, random allocation of students was not feasible. Therefore, participants were grouped based on existing class divisions and friendship networks to maintain classroom integrity and encourage peer engagement. While this non-random grouping may introduce selection bias, efforts were made to ensure comparability between groups in terms of age, gender distribution, and baseline knowledge scores. This approach aligns with the practical realities of school-based

interventions and enhances ecological validity.

Group A received teacher-led sessions, and Group B received expert-led sessions. A structured questionnaire adapted from the WHO Knowledge, Attitude, and Practices (KAP) tool on TB was used to assess students' awareness (13). The questionnaire consisted of sections on general knowledge, transmission, symptoms, prevention, and treatment. The questionnaire was pretested among 10 students and reviewed by public health experts to ensure clarity and relevance. The Cronbach's alpha for the knowledge section was calculated to be 0.78, indicating acceptable reliability.

A pre-test was conducted to assess baseline knowledge. Educational sessions were then delivered as follows:

Group A (Teacher-led): Trained peers conducted interactive sessions using the same material.

Group B (Expert-led): Sessions were conducted by public health experts using audiovisual presentations.

Both groups received six sessions (once a month for six months).

Post-test assessments were carried out six months after the interventions to evaluate improvement in knowledge scores.

The principal investigator created the educational material for Group B, including audio-visual health education, role-play, posters, and bilingual (Urdu and English) pamphlets, whereas Group A received routine education from their class teachers. The educational package included audio-visual health education, role-play, posters, and bilingual (Urdu and English) pamphlets. The same pre-test was given to the participants as a post-test after six months. The same questionnaire was administered before and after six months. The paired t-test (within-group) and independent t-test (between-group) were used for mean score comparisons. A p -value < 0.05 was considered statistically significant with a 95% confidence interval. The score for the knowledge variables was recorded on an interval scale with “Yes” or “No” answers for each variable question. A score of “1” was awarded for each correct answer. The total score was adjusted to be out of 100. Data was entered, cleaned, and analyzed in SPSS-26. The effect of the awareness program was observed by comparing both groups.

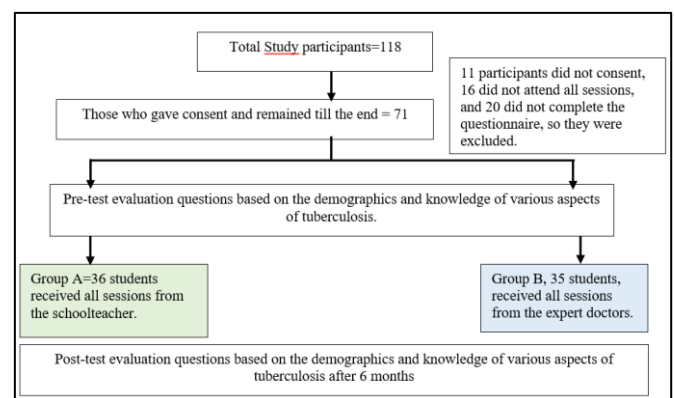


Figure 1: The flow of the quasi-experimental study

Results

The pre-test questionnaire was administered to 118 students, but only 71 participants gave consent as well as filled the form properly. The mean age of the students for group A was 12.85 ± 2.11 SD (in years), and for group B, it was 12.67 ± 1.23 SD (in

years). In total, there were 38% boys and 62% girls.

The participants were tested on their knowledge of various aspects of TB, along with its prevention and control. After the educational intervention as planned by teachers and experts, the scores for all the variables improved, and the differences were all statistically significant.

Table 1: Pre-Evaluation and Post-Evaluation of Various Factors Regarding Awareness of TB

Factor	Categories	Pre-Evaluation (n=71)	Post-Evaluation of Group A (n=36)	Post Evaluation of Group B with intervention (n=35)
TB is caused by germs called bacteria.	Yes	54 (76.1%)	29 (81.7%)	32 (91.4%)
	No	17 (23.9%)	07 (18.3%)	03 (8.6%)
Is TB a contagious disease?	Yes	42 (59.2%)	32 (88.8%)	34 (97.1%)
	No	29 (40.8%)	04 (11.2%)	01 (2.9%)
TB is spread from one person to another through the air.	Yes	55 (77.5%)	30 (83.4%)	34 (97.1%)
	No	16 (22.5%)	06 (16.6%)	01 (2.9%)
Everyone should get tested for TB.	Yes	33 (46.5%)	24 (66.6%)	34 (97.1%)
	No	38 (53.5%)	12 (33.4%)	01 (2.9%)
Everyone who gets infected with TB bacteria will get sick.	Yes	57 (80.3%)	30 (83.4%)	33 (94.3%)
	No	14 (19.7%)	06 (16.6%)	02 (5.7%)
Some people can get TB disease easier than others.	Yes	46 (64.8%)	30 (83.4%)	31 (88.6%)
	No	25 (35.2%)	06 (16.6%)	04 (11.4%)
TB disease can be cured.	Yes	49 (69.0%)	35 (98.6%)	35 (100%)
	No	22 (31.0%)	01 (1.4%)	---
TB can affect other parts of the body besides lungs.	Yes	21 (29.6%)	23 (64.8%)	30 (85.7%)
	No	50 (70.4%)	13 (35.2%)	05 (14.3%)
Coughing for more than 3-weeks indicate TB testing.	Yes	36 (50.7%)	24 (66.6%)	29 (82.8%)
	No	35 (49.3%)	12 (33.4%)	06 (17.2%)
If you have TB infection, you may have to take medicine, even if you don't feel sick.	Yes	32 (45.1%)	34 (94.4%)	34 (97.1%)
	No	39 (54.9%)	02 (5.6%)	01 (2.9%)
Use of mask is necessary in Pulmonary TB infection.	Yes	48 (67.6%)	36 (100%)	35 (100%)
	No	23 (32.4%)	---	---
Do you know that BCG vaccination gives a permanent mark on your right upper arm?	Yes	39 (54.9%)	27 (76.1%)	32 (91.4%)
	No	32 (45.1%)	09 (23.9%)	03 (8.6%)
Do you know that government of Pakistan is providing free treatment for tuberculosis?	Yes	21 (29.6%)	24 (66.6%)	28 (80.0%)
	No	50 (70.4%)	12 (33.4%)	07 (20.0%)
Do you know that TB treatment is for 9-months?	Yes	23 (32.4%)	26 (71.8%)	33 (94.3%)
	No	48 (67.6%)	10 (28.2%)	02 (5.7%)
Total Yes responses		556	404	454
Mean of 'Yes' response as per participant:		556/71= 7.83	404/36=11.22	454/35=12.97
Mean % = (mean/number of items x100)		55.9%	80.1%	92.6%

Correct information improved the knowledge in both groups. Before the educational intervention by expert doctors with role play, only 59.2% of the participants knew that TB is a contagious disease. This rose to 97% post-intervention. Similarly, the knowledge that everyone should get tested for TB if there are any symptoms increased from 47% to 97%. Before our educational intervention, only 69% knew that the disease could be cured. This rose to 100% post-intervention.

Similarly, the use of masks gets 100% post-intervention from 68%. Whereas the knowledge about free treatment from the government improved post-intervention from 30% to 80%, but still there are doubts among participants about its free availability for 9 months. (Table 1)

Table 2: Comparison between pre-test and post-test knowledge scores of PTST and PTSE with absolute change

Variables	n	Pre-test	Post-test	Absolute change
Group A PTST	36	7.83	11.22	+ 3.39
Group B PTSE	35	7.83	12.97	+ 5.14

from the pre-test to the post-test in both groups, which can be attributed to simple educational intervention by the expert method of teaching in group B regularly by using different modalities of audio-visual health education, role-play, posters, and pamphlets displaying tuberculosis in both Urdu and English for better understanding and in group A by teachers once a month.

Therefore, it can be interpreted that the knowledge score of participants in each group was significantly improved due to the respective interventions. (Table 2)

Table 3: Comparison of Improvements PTPT and PTPE

Measure	PTPT (A)	PTPE (B)	Difference (B-A)
Absolute improvement	+ 3.39	+ 5.14	+ 1.75
Percentage improvement	+24.2%	+36.7%	+12.5

In order to determine which method was more effective, the effect size was calculated.

Table no. 3 shows that the absolute improvement in knowledge score in the PTPT group was 3.39, and in the PTPE group was 5.14. The difference in the gain in knowledge score between group A and B was found to be +1.75. Hence, it can be interpreted that the gain in knowledge in the PTPE was higher than that of the PTPT group.

Discussion

The present study evaluated and compared the effectiveness of two educational approaches—expert-led and peer-led—in improving knowledge about tuberculosis among school students in Lahore. Both interventions led to significant improvement in post-test scores, demonstrating that structured health-education sessions are effective tools for enhancing TB awareness among adolescents.

However, the improvement was greater in the expert-led group, indicating that professional facilitation and the use of audiovisual material may enhance comprehension and retention of knowledge. The results revealed a mean percentage of 80.1% in group A and 92.6% in group B post-intervention. This aligns with findings from a study in Sudan, where school-based health education interventions similarly increased TB awareness after the intervention (14). Similarly, a study from Gambia has reported substantial knowledge gains following targeted TB educational campaigns, underscoring the effectiveness of school-based interventions globally (15). These studies highlight that focused educational efforts can substantially improve disease knowledge even in resource-constrained settings.

The improvement in knowledge about TB transmission in this study (from 77.5% to 83.1% in group A and 98.6% in group B) was significant, and this finding is consistent with an international study conducted in Ethiopia that found similar results, where student awareness regarding airborne transmission of TB increased significantly after health education sessions (16). However, a study from Rawalpindi, Pakistan, reported lower baseline knowledge with only 65.5% of participants compared to this study (17).

The improvement in recognizing TB symptoms, particularly the significance of a cough lasting more than three weeks (from 50.7% to 83% in group B), highlights the effectiveness of the intervention. This is consistent with findings from a study conducted in India (18). Similarly, the increase in awareness that TB treatment lasts for nine months (from 32.4% to 93%) is encouraging, and it mirrors improvements seen in other educational interventions. A study in Jordan reported somewhat low awareness about treatment duration, i.e., 27.4%, among all the students who participated in the study (19). However, many participants are still unaware of the need for prolonged treatment.

The significant improvement in students' knowledge about the BCG vaccination (from 54.9% to 91.4%) underscores the intervention's success in promoting TB prevention strategies. This is comparable to studies in China, where educational interventions similarly increased awareness of TB

prevention (20). However, in contrast, a study from the slums of Nairobi reported that only 43% of teenage mothers were aware of the BCG vaccine (21). The increase in knowledge that the government provides free TB treatment (from 29.6% to 80%) is particularly relevant to Pakistan's public health efforts. Other studies conducted in Pakistan recognize the leading factors contributing to the TB cost (22).

Knowledge regarding the necessity of mask use in pulmonary TB increased markedly in both groups, rising from approximately 68% at baseline to 100% post-intervention. This represents a complete attainment of correct knowledge in both groups, reflecting a robust improvement in awareness across the study population. These results are consistent with similar studies conducted in India and Jordan (23,19). In the intervention group, knowledge regarding tuberculosis cure is increased from 69.0% at baseline to 100% post-intervention (group B), demonstrating complete uptake of this treatment-related concept. This result is also consistent with a study conducted in 2021 in which there is a significant increase in knowledge post-interventionally.¹¹ The intervention clearly improved knowledge in both groups, but the expert-led, multi-modal approach had a greater effect. The knowledge about the duration of TB treatment of 9 months was 32.4%, which rose to 94.3% after intervention. The results are consistent with a study conducted in Pune, India, where only 43% of students in the pre-test and 97% of students in the post-test knew about the duration of treatment under DOTS. The percentage rise in knowledge for this response was maximum, i.e., more than 50% (24). But at the same time, a study conducted in Nigeria showed an unsatisfactory level of awareness of tuberculosis (25).

The high dropout rate observed in this study (39%) may have affected the final results and is recognized as a limitation. Absenteeism during the study period was primarily due to examination schedules and student relocation. Another limitation was the non-random grouping of participants, which might have introduced selection bias. However, grouping by friendship networks was chosen intentionally to minimize attrition and promote engagement. Furthermore, the reliability of the questionnaire was not statistically tested using Cronbach's alpha. Although the instrument was adapted from the WHO TB-KAP tool and pretested for clarity, future studies should include psychometric validation to ensure consistency.

As the data were collected through self-reported questionnaires, participants may have provided responses they perceived as socially acceptable rather than their true beliefs or knowledge. This could have led to an overestimation of the intervention's impact.

Despite these limitations, the study provides valuable insight into practical school-based health-education strategies in low-resource settings. It demonstrates that even short, structured interventions can significantly improve disease awareness among adolescents, a group often overlooked in TB control programs.

Conclusion

Overall, this study demonstrates the potential for school-based educational interventions in TB awareness among adolescents, a key demographic in TB control efforts. A marked difference in knowledge is observed about various aspects of tuberculosis. Both expert-led and peer-led educational interventions significantly improved students' knowledge about tuberculosis, confirming that structured awareness sessions are effective in school settings. However, the expert-led approach resulted in a slightly greater improvement, possibly due to the facilitators' medical background and better communication of scientific information. The findings highlight that simple, low-cost educational interventions can meaningfully enhance disease awareness and contribute to TB prevention at the community level.

Recommendations

The findings emphasize the need to integrate TB education into the national school curriculum, supported by teacher-training modules which can ensure sustainability and scalability of awareness efforts, especially in resource limited settings. Public-private collaborations could help such initiatives nationwide. Implementing these recommendations can strengthen TB control efforts by empowering adolescents as informed health ambassadors within their communities.

To ensure sustainability, it is recommended that teachers be trained using similar audiovisual materials so that TB awareness can become a routine part of school health education.

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Ethical Approval:

Ethical Review Board of Central Park Medical College, Lahore Ref. No. CPMC/IRB-No/1308 Dated: 17-12-2023

Data Availability: Data supporting the findings are available upon reasonable request.

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Authors' Contribution:

SH: Concept and design of the study, data collection, interpretation of results, drafting of the manuscript.

NS: Data analysis and revision.

UH: Discussion writing

AH: Intervention material and questionnaire development

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