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A Pilot Project for School-Based Screening and Treatment of Latent TB Infection Among Freshman High School Students

Isis Cunningham
University of San Diego, icunningham@sandiego.edu

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Isis Y. Cunningham, BSN, RN, CPN

DNP Student

University of San Diego, Hahn School of Nursing

San Diego, CA

Mary Barger, PhD, MPH, BSN

Associate Professor of Nursing

Hahn School of Nursing

Faculty Advisor

University of San Diego

San Diego, CA

Susannah Graves, MD, MPH

Chief, Tuberculosis Control and Refugee Health

Clinical Mentor

Health and Human Services Agency

San Diego, CA

Marti Brentnall, M.P.H.

TB Outreach and Education Coordinator

Tuberculosis Control and Refugee Health

Health and Human Services Agency

San Diego, CA

Howard Taras, MD

District Physician Consultant

San Diego Unified School District

San Diego, CA

Abstract

Background: San Diego's tuberculosis (TB) incidence is 2.5 times higher than the national rate. Five cases of active TB in the county's public high schools during 2018 demonstrated the need for prevention interventions in this setting.

Objectives: This evidence-based project aimed to increase awareness, screening, and treatment of latent TB infection (LTBI) in the school setting.

Methods: A one-time TB educational presentation was given to high school freshman students with a pretest and posttest. A TB risk assessment and consent was sent home with the students. For at-risk students, a confidential package was sent to the parents recommending testing along with a letter to the child's provider offering the option of rifapentine and isoniazid (3HP) to be administered at school. Incentives were provided throughout the program.

Results: After the educational intervention, there was an average increase of 24.57% in posttest results (95% CI [21.14, 28.01]) and 87% of students agreed that the presentation improved their knowledge about TB. Of 294 Freshman students, 56 (19%) returned the TB risk assessment, 43% (n = 24) of those were found at risk for TB. A total of 7 students (29.2%) were tested for TB, all with negative results.

Conclusions: There was a low return of TB risk assessments but a high percentage of students at risk and who had not been tested. These results highlight the need to increase screening efforts in this setting. Future projects will be needed to assess the feasibility of offering 3HP via directly observed therapy at school.

Keywords: latent TB infection, school-based, tuberculosis, screening

Introduction

Tuberculosis (TB), a highly contagious airborne bacterium that primarily affects the respiratory system, remains in the top 10 causes of death globally (World Health Organization, 2017). San Diego's TB incidence in 2017 was 7.1 cases per 100,000 persons, 2.5 times higher than the national average of 2.8 (County of San Diego Health and Human Services, 2018). When a person is infected with TB, the bacteria can either multiply and cause illness (i.e., active TB disease) or remain dormant (i.e., latent) in the body for weeks to years. During this latent state, the person is neither symptomatic nor contagious, yet without prophylactic treatment, the person risks future activation of the bacillus. Overwhelmingly, 80% of active TB cases in California are due to the reactivation of latent TB infection (LTBI) rather than direct transmission. With an annual state expenditure of $78 million for the treatment and management of active TB, screening and prophylactic treatment of LTBI could reduce future costs by preventing TB's progression to active disease (California Department of Public Health, 2018).

Five exposures to active TB throughout the county's public high schools in 2018 warranted feasible interventions to address the screening and treatment of asymptomatic students with LTBI in the school setting. Due to a decrease in immunity during puberty, increased exposure, and the initiation of substance use and sexual activity, adolescents are at higher risk for TB disease progression and mortality (Seddon, Chiang, Esmail, & Coussens, 2018). In the United States, one-third of children and adolescents who have a positive TB test are symptomatic at initial evaluation and one-fifth are identified by incidental findings on X-ray. Additionally, foreign-born adolescents are diagnosed with active TB disease years after arrival in the United States, thus reflecting missed opportunities for LTBI screening and treatment (Winston & Menzies, 2012). Although children, adolescents, and contacts of TB patients are more likely to

start prophylactic treatment, the comprehensive management of LTBI remains a challenge. Patient barriers for completion of LTBI treatment identified in a systematic review included fear of side effects, treatment regimen and duration, lack of transportation, and lack of knowledge (Liu, Birch, Newbold, & Essue, 2018). Conversely, identified positive interventions to increase adherence to LTBI treatment included peer counseling, strong education initiatives with translated materials to meet the population culture, monetary and noncash incentives, close follow-up by phone, and shorter treatment duration (Liu et al, 2018).

The CDC approved a briefer, combination regimen of isoniazid plus rifapentine (3HP) given once weekly over 3 months via directly observed therapy (DOT) to treat LTBI in children older than 2-years of age (Borisov et al, 2018). A systematic review by Sharma, Sharma, Kadhiravan & Tharyan (2013) and a randomized clinical trial comparing the shorter combination treatment versus the recommended 9-month, daily self-administration of isoniazid (INH) for preventing TB in children and adolescents revealed decreased side effects and greater adherence to the shorter, supervised treatment (Villarino et al, 2015). In addition, the PREVENT TB Trial in the United States and Canada reported that non-compliance was statistically worse in the 9-month INH treatment group versus the 3HP via DOT; 28% and 18% respectively (Moro et al, 2016).

Prophylactic therapy administration through health departments has been associated with greater compliance in asymptomatic children treated for LTBI; however, the lack of infrastructure and cuts in funding have been perilously linked with increased drug-resistant TB disease cases (Cruz & Starke, 2012). One study at a Houston pediatric clinic comparing self-administration, enhanced self-administration with reminders, and DOT, concluded that DOT was

the only positively-associated factor in the completion of therapy (OR 7.2; 95% CI [3.8, 13.8]; Cruz & Starke, 2012).

School-based screening and treatment of LTBI has been utilized in the past to focus on this gap in care. Following the state's health services recommendations, a school-based TB screening and treatment program was implemented in two public high schools in Houston, TX to address the high prevalence of LTBI. A one-time education intervention was given to all 925 students; Of the 484 of students with at least one TB risk factor 86% (n = 415) agreed to be tested. The 16 students who tested positive for LTBI completed the 3HP regimen via DOT at their campus clinic without adverse side effects (Hatzenbuehler, Starke, Graviss, Smith, & Cruz, 2016).

Based on San Diego's recent TB exposure trends and guided by the above evidence, this pilot project was created to enrich awareness about TB, to increase screening and testing, and to offer shorter regimens of LTBI treatment for adolescents, ideally in the school setting. Due to the lack of financial resources, at-risk students for this project were referred to their providers for testing and prescribing of LTBI treatment as an alternative for providing these services in the school setting.

Methods

Participants and Setting

For this evidence-based project, 294 Freshman students taking English or English as a Second Language (ESL) in one public high school in San Diego County, CA were invited to participate. Prior to conducting this project, Institutional Review Board (IRB) approval was obtained from the school district, the University of San Diego, and the San Diego County Department of Health and Human Services.

Data Collection

Recruitment for this project occurred during the 3 days of school registration in Fall 2018. Freshman parents presented vaccination records to the school nurse, then were directed to the investigator for information about this program. A TB risk assessment and consent form was provided along with a CDC TB informational handout and letter explaining the project. All forms were provided in English and Spanish. Following the school's recommendation, Swahili translation of the forms was also available but ultimately not utilized. The TB risk questionnaire was formulated from both the County of San Diego's (2017) TB Risk Assessment and recommendations from the San Diego Pediatric TB Task Force (2017). Nominal prizes were offered to each student who received this packet during registration. A confidential envelope was included to protect personal information and completed forms were collected during this time. Students who returned the TB Risk Assessment and consent form entered a raffle for wireless headphones and movie tickets.

After the school year commenced, a TB education intervention was given to all freshman students taking English and ESL; a total of 10 presentations. A 3-minute video created by the County of San Diego (2018) was shown along with a 15-minute PowerPoint presentation explaining the program and promoting incentives to participate. The presentation was given in Spanish to the ESL students; one student in the ESL class did not speak Spanish. A pre- and post- test was administered to the students in 9 English classes. Questions to the pre- and post-test were based on those provided by Hatzenbuehler, Starke, Smith et al (2017).

A package was sent home including the TB risk assessment questionnaire, CDC informational handout, and a letter explaining the program and incentives. Parents were supplied with a confidential envelope to return the completed TB risk assessment and consent form to the

school nurse. The school sent two robocalls to all freshman parents reminding them of the deadline to return the questionnaires and incentives for participation. Classrooms were also visited frequently and the project manager interacted with students after the educational intervention to remind them to return the forms. Completed risk assessments and consents were also collected during these times to simplify the return process for the students.

After completing the TB risk assessment, a confidential package was sent home with the results. Students with one or more positive risk factors were given information on how to get tested, the prizes for returning test results to the school nurse, and how to begin treatment for LTBI. Included in this package was a letter from the San Diego County Department of Health and Human Services to be given to a provider explaining the reason for TB screening with attached copies of the self-administered questionnaire, the County's official TB risk assessment, and an official form from SDUSD for the administration of 3HP via DOT at school.

A protocol was created for the school nurse to administer 3HP via DOT. A dose and symptom log was also created for the nurse to monitor compliance, side effects, and incentives. WalMart gift cards were to be given to each student completing the LTBI treatment of their choice (i.e., self-administration, school administration) in three disbursements of $10 throughout the therapy and $20 at completion, for a total of $50 per student.

Two weeks after distribution of risk assessment results, a phone call was made to parents of at-risk students for follow up and to ask if the student was tested, where the testing was done, and the results of the testing. A $10 Target gift card was given to each student who turned in test results to the school nurse as well as receiving a raffle ticket for a pair of wireless headphones. Based on preliminary data and recommendations made to the County, the DHHS granted access to TB screening results under the San Diego Regional Immunization Record (SDIR), an

electronic database of all immunizations and TB testing given by participating providers in the county (San Diego Regional Immunization Registry, n.d.). The school nurse accessed SDIR after all follow up attempts were completed. Data received during phone interviews were compared to that on the SDIR database; the school nurse updated the SDIR records based on results.

Data Analysis

A paired T-test was used to analyze the mean difference of pre- and post-test results. Descriptive statistics were also obtained using Excel for the last three questions of the pre- and posttests and for the results of LTBI testing.

Results

TB Education Intervention

Of 294 students who received the education intervention, 81.4% (n = 236) returned a completed pre- and posttest for the first six knowledge questions. There was an average increase in post-test results of 24.57 percentage points (95% CI [21.14, 28.01]; Figure 1). Question 7 asked if the student would agree to TB testing after being told that (s)he was at risk for TB. Of 226 (76.9%) students who answered this question, there was a positive change above neutral of 14% and a negative change below neutral of 3.5% in post-test results (Figure 2). Question 8 asked if the student would agree to treatment if they had LTBI. Of 228 (77.5%) students who answered this question, there was a positive change above neutral of 15% and a negative change below neutral of 2% in post-test results (Figure 3). Finally, Question 9 asked if the presentation had improved their knowledge about TB. Of 234 (79.6%) students who answered this question, only 4% of respondents answered negatively (Figure 4).

Program Results

Of 294 students who received the education intervention, 56 (19%) of students returned the TB Risk Assessment and 24 (43%) of students were found at risk for TB with more than one positive risk factor (one student who had completed LTBI treatment before our program was excluded from this group). Out of the 25 students with positive risk factors, 10 (40%) had more than 2 risk factors; Table 1. During follow-up, 75% (n = 18) parents were contacted. One student transferred to another school after registration but parents were contacted and results of the TB risk assessment were mailed to them, including recommendation for testing. At the end of the program, 29.2% (n = 7) of the at-risk students were current with their TB testing (3 students had been recently tested for TB; 4 were tested after the program). All seven students tested negative for LTBI. From the 17 students who were at-risk but did not seek testing, 29.2% (n = 7) had a negative TB test result in SDIR dating back 8 years or more, but had risk factors that required re-testing; 41.7% (n = 10) had never been tested.

Discussion

A one-time TB education intervention was successful in increasing awareness and knowledge among students. There was also an increase in willingness to get tested and treated for LTBI after the educational session. One-on-one education was also provided to the parents during registration and follow-up that increased awareness among parents as well. Major areas of knowledge deficit were found in distinguishing LTBI from active disease and understanding a positive result for LTBI when the person had the bacilli Calmette-Guerin (BCG) vaccine as a child.

Overall, a small percentage of students returned the TB risk assessment questionnaire (19%), but of the 56 responders, a high percentage of them (n = 24 or 43%) were found at risk

for TB. Only 12.5% (n = 3) of at-risk students had current TB testing before the start of this program. These results highlight the need to increase awareness and screening efforts in the high school setting. Although the American Academy of Pediatrics recommends a yearly TB risk assessment (Bright Futures/American Academy of Pediatrics, 2019), adolescents who do not have a medical home could be overlooked unless TB screening can be incorporated into the school setting.

Practice Implications

Adding a brief educational session for parents during the registration process and for students as part of their health curriculum may increase knowledge and screening rates in this vulnerable population. Greater outreach strategies in this setting could lessen the spread of TB and offer better protection for the community.

Additionally, since 42% of the TB risk assessments were returned during the registration days, adding the completion of a risk assessment as part of the health requirements in the admissions process may be optimal in reaching otherwise busy parents. Currently, TB screening in San Diego is required to enter daycare but not for K-12 students (County of San Diego Tuberculosis Control Program, n.d.). Requiring TB screening for high school admission could ensure compliance and provide greater outreach to this population, thus preventing future cases of active TB exposure.

One major accomplishment of this project was that school nurses in this school district were granted access to the SDIR TB screening database. Previously, school nurses had access to vaccination records only in this database. This new access helped verify TB testing information provided by parents as well as allowed the school nurse to input test results missing from the database. Approximately 50% of test results reported in this project had not been entered into the

database, uncovering a need to increase awareness of this feature in SDIR among participating providers. Outcomes also demonstrated how school nurses can improve the health exchange data for the county. Accurate TB screening data in SDIR may prevent unnecessary testing and wasteful use of limited health care resources.

Limitations

Although TB risk assessments were distributed during registration days in the Fall, most of the students at registration came from outside the cluster of middle schools feeding into this high school (a very small percentage of the incoming Freshman class). Students from the cluster middle schools had already received their registration packages early Spring 2018 and registered for high school prior to IRB approval. Missing most of the incoming Freshmen during registration may explain the low return of risk assessments.

Additionally, the risk assessment questionnaire was revised after registration due to confusion in the wording when asking about birth in a "high risk country." The question was modified to say, "born outside the U.S." and asked the respondent to name the country. Changes were resubmitted for IRB revision and approval. Lack of a validated self-assessment questionnaire may have caused a misunderstanding about the TB risk among this population.

Finally, since all the tests results were negative for LTBI, it was not possible to assess the feasibility of administering 3HP in the school setting. Nevertheless, this option should be considered in future projects. Successful implementation of the school-based 3HP protocol offers the possibility of bringing more options to the LTBI treatment of adolescents.

Conclusion

San Diego has one of the highest rates of TB in the state of California and more than twice the national rate. Recent active TB exposures among high schoolers in the county

demonstrate the need for effective prevention interventions in the school setting. Results of this project revealed a consequential number of high school students at risk for TB and low screening rates in this population. Requiring the completion of a TB risk assessment as part of the high school admissions process could increase screening rates among students. Additionally, a one-time TB education intervention demonstrated an increase in TB awareness and improved knowledge among parents and students.

Conflicts of Interest

The authors have no conflicts of interest.

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Table 1

TB Risk Factors (n = 25)

	n (%)
1. Been around someone who had TB	0 (0%)
2. History of positive TB test (self/family)	7 (28%)
3. Born outside the US in a high-risk country	7 (28%)
4. Been to a high-risk country outside the US > 3 weeks	4 (16%)
5. Goes to Mexico frequently	8 (32%)
6. Ever eaten queso fresco or unpasteurized dairy	9 (36%)
7. Been around someone who is homeless, who used drugs, or was recently in jail	4 (16%)
8. Takes Prednisone or other medicines that lower the immune system	2 (8%)
9a. Ever taken medicine for positive TB test	1 (4%)
9b. Completed treatment	1 (4%)

Note: (a) 10 (40%) of students had > 2 risk factors; (b) student who completed LTBI treatment was excluded from at-risk group; (c) Questions 3 and 4 were changed after registration to include name of country; (d) questions adapted from San Diego County TB Risk Assessment and recommendations from the San Diego Pediatric TB Task Force

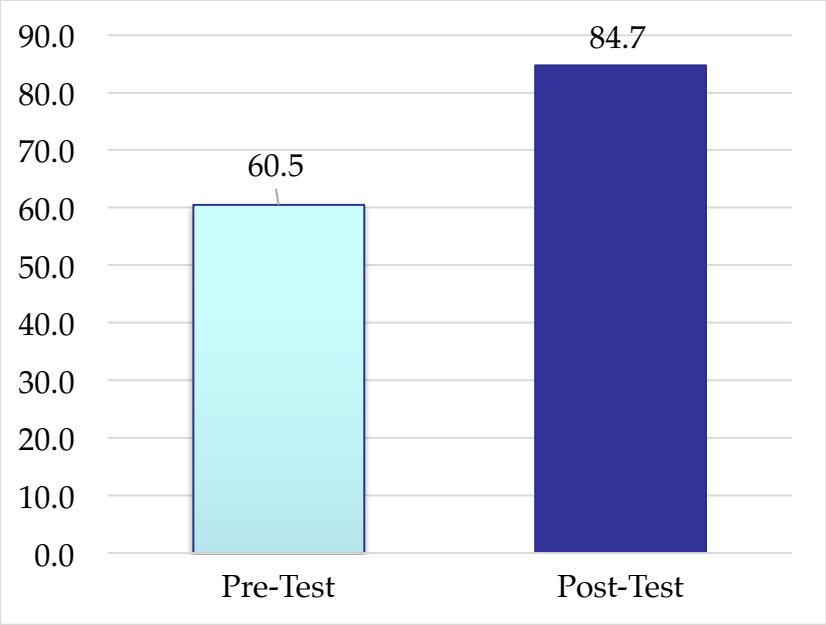

Figure 1. Average scores on TB knowledge (Mean Difference = 24.57; 95% CI [21.14, 28.01]).

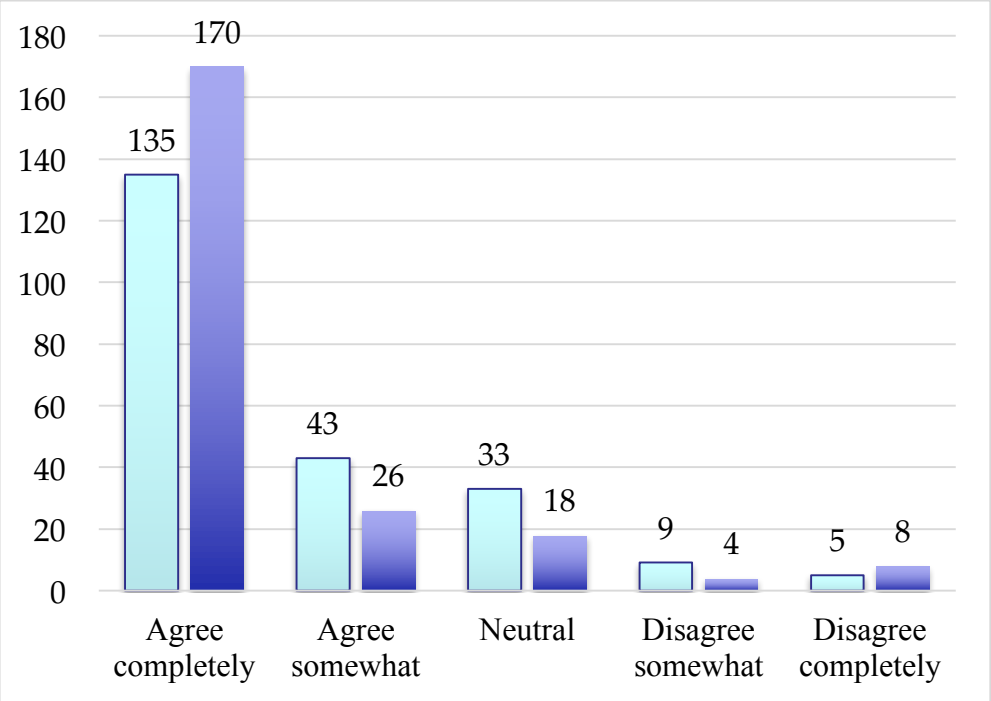

Figure 2. Question 7 asked if the student would agree to TB testing after being told they were at risk for TB. There was a positive change above neutral of 14% and a negative change below neutral of 3.5%.

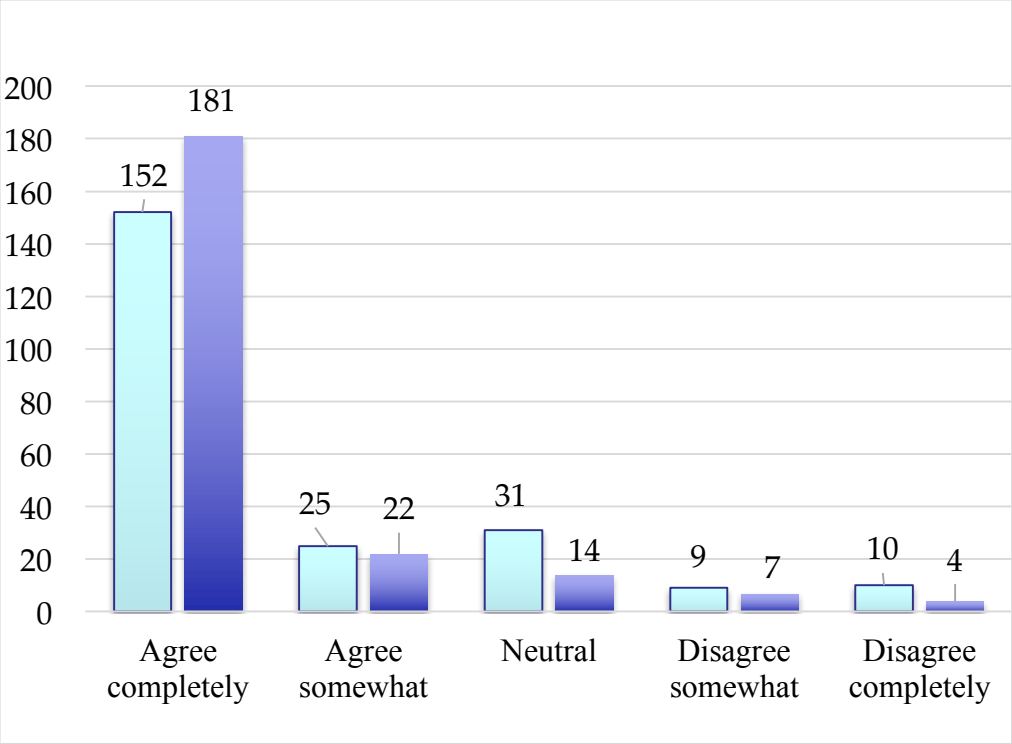

Figure 3. Question 8 asked if the student would agree to be treated for LTBI. There was a positive change above neutral of 15% and a negative change below neutral of 2%.

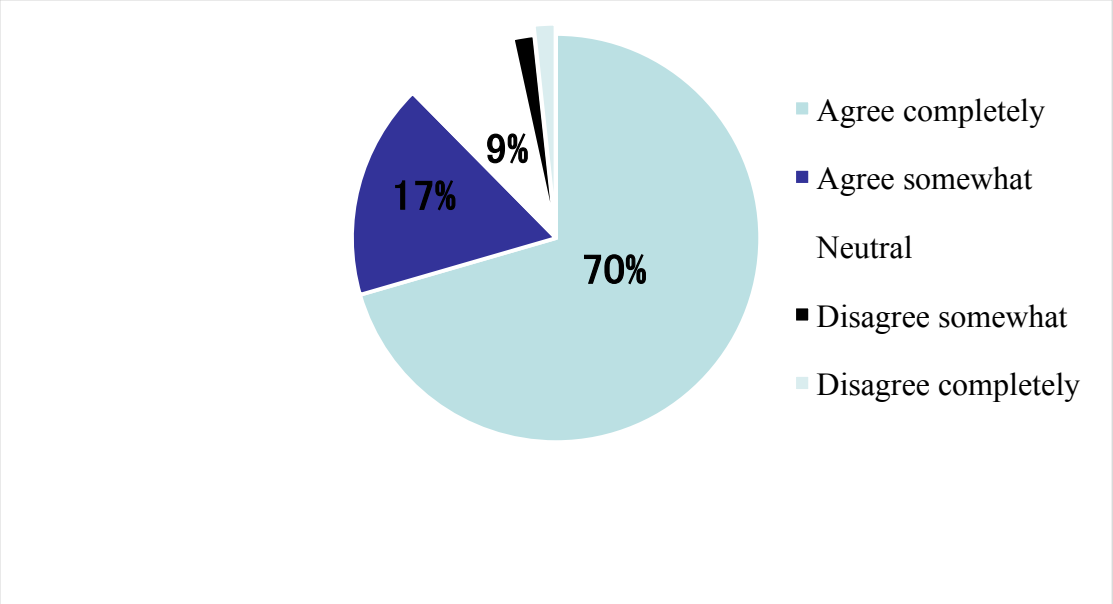

Figure 4. Question 9 in the post-test asked if the presentation had improved their knowledge of TB. 87% of students agreed.