

Knowledge, Attitudes, and Preventative Behavior Toward Tuberculosis in University Students in Indonesia

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Purpose: This study aimed to assess the knowledge, attitudes, and preventative behaviors of university students in Indonesia toward Tuberculosis (TB).

Patients and Methods: Participants included students from a university in West Java, Indonesia, who were aged ≥ 18 years, had access to electronic communication devices and the internet, and agreed to participate in this study. This cross-sectional study invited participants to fill an online questionnaire on Google Forms, and the study was conducted from February to March 2021. Descriptive statistics was used to describe the demographic characteristics of participants. Differences in participants' knowledge, attitudes, and preventative behavior were analyzed using *t*-test. Spearman correlation coefficient was used to determine the relationships between variables. Characteristics of participants that influenced preventative behavior toward TB were analyzed using linear multiple regression analysis.

Results: This study included 524 students. The average knowledge scores out of a possible 11 points of health and non-health students were 7.03 ± 2.36 (out of 11) and 4.98 ± 2.20 , respectively. The attitude was 45.40 ± 4.17 (out of 52), 43.75 ± 4.09 respectively, and their average scores out of 44 for preventative behaviors toward TB were 33.08 ± 4.49 and 33.16 ± 4.40 , respectively. Female students and students from health faculties demonstrated greater knowledge and better attitudes. Students with a postgraduate academic degree had better knowledge and attitudes and engaged in more preventative behavior. Students who did not smoke had greater knowledge than those who did, and students who had received information about TB engaged in more preventative behavior.

Conclusion: Faculty, knowledge of symptoms, preventative examinations, and attitudes toward preventative examinations, treatment, and preventative education, were found to affect TB prevention behavior. These variables should be emphasized in the development of university TB socialization and education programs. The internet and social media should be used in TB education for students.

Keywords: students, tuberculosis, symptoms, preventative education

Introduction

In 2019, it was estimated that Tuberculosis (TB) affects 10 million people worldwide and it caused 1.4 million deaths.¹ In a list of the 30 countries with the highest TB burden, Indonesia ranks as the third-highest in the world.¹ In 2020, the estimated number of TB cases in Indonesia was 845,000, of these, 7921 were with multi-drug resistant Tuberculosis (MDR-TB), 32,930 were children, and 7866 were with human immunodeficiency virus Tuberculosis (HIV-TB). The number of deaths due to TB was 13,947, and the therapeutic success rate was 83%.² West Java is among the provinces of Indonesia with the highest rate of MDR-TB. According to the data from the Ministry of Health, there were 1566 new cases in 2018 and 2073 in 2019 in this region.³

The handling of TB has been disrupted by the emergence of the COVID-19 pandemic. The priority of TB treatment, including diagnosis, procurement of drugs, and treatment monitoring, has been superseded by the global need to contain COVID-19.⁴ The incidence of TB in middle- and low-income countries is predicted to increase as a result.⁵

University students are at a high-risk group of TB.⁶ The crowded environment and high level of person-to-person contact in universities and schools increase the transmission of diseases, including TB.⁷ A recent study found a high prevalence of TB among students at an Ethiopian university, and the incidence was associated with a previous contact with patients with TB and behavioral factors.⁸ Knowledge, attitudes, and preventative practices are highly associated with the occurrence of many infectious diseases.⁹ A recent systematic review of knowledge, attitudes, and practices toward TB among university students found that these students had poor knowledge about TB in 8 out of 12 studies. In two of six studies, they had negative attitudes, and overall, 11.6% of students in a study did not engage in effective preventative practices.¹⁰

A positive correlation was found between knowledge and attitudes about the diagnosis, acceptance of diagnostic results, decisions to participate in TB treatment, adherence to drug treatment for TB, and engagement in community support for patients with TB.^{11,12} Establishing existing knowledge, attitudes, and preventative behaviors is necessary for the development of effective TB educational programs.¹³ Therefore, this study assessed knowledge, attitudes, and preventative behaviors of university students in West Java, Indonesia.

Materials and Methods

Study Design and Setting

This cross-sectional study measured knowledge, attitudes, and preventative behavior toward TB of students at a university in West Java, Indonesia. It was conducted between February and May 2021, and participants filled an online questionnaire on Google Forms. In 2021, the university had more than 33,000 students and 16 faculties. Participants were categorized as those from health and non-health faculties.

Sample Size and Participants

The sampling technique used was consecutive sampling. Based on a study by Charan and Biswas,¹⁴ the number of samples can be calculated using the standard normal variate at 5% type 1 error ($p < 0.05$), which was 1.96, with an absolute error of 5%, necessitating a minimum of 392 participants. The participants in this study were students enrolled at a public university in West Java, Indonesia, who were aged ≥ 18 years, had access to electronic communication devices and internet, and agreed to participate in the study. Students with a personal or family history of TB were excluded. Participation in this study was voluntary and all participant information was kept confidential.

Ethics

This study was conducted in accordance with the tenets of the Declaration of Helsinki 1964. Ethical approval was obtained from the Health Research Ethics Committee Universitas Padjadjaran (No.148/UN6.KEP/EC/2021). Written informed consent to participation and publication was obtained from all participants prior to participation. All data were recorded anonymously to ensure confidentiality.

Data Collection

Two research assistants were responsible for data collection. The data were collected from students of all faculties by a contact person at each faculty. Each contact person received a link to the Google Form questionnaire to be distributed to participants willing to participate in this study in person or through the chat groups. All responses were stored in an online database, which could be accessed and downloaded only by the authors.

Study Instruments

The questionnaire was adapted from a study by Choi and Jeong¹⁵ (copyrighted material permission was obtained from Osong Public Health and Research Perspectives) and translated into Bahasa Indonesia by a professional. The adapted

questionnaire consisted of 45 questions (see [Supplementary Questionnaire](#)). There were ten demographic questions and 35 questions about the three variables: knowledge, attitudes, and preventative behaviors toward TB. They were then tested for face and content validity by experts in clinical pharmacy and public health from the Universitas Padjadjaran, Indonesia. A pilot study with 60 participants was conducted to assess the reliability of the questionnaires. Cronbach's alpha values were obtained to assess the reliability and the results were in an acceptable range: 0.67, 0.85, and 0.84 for the knowledge, attitude, and preventative behavior variables, respectively. Thus, the questionnaire was found to be a valid and reliable measure.¹⁶ Slight modifications were made after the pilot study before data collection. Following these modifications, the questionnaire consisted of 11 knowledge questions, 13 attitude questions, and 11 questions about TB preventative behavior.

For the knowledge questions, participants were required to answer "Yes", "No", or "Don't know." Each correct answer had a score of 1, while the answer "Don't know" had a score of 0. The maximum score was 11. On the attitude and preventative behavior questions, participants answered on a Likert scale of 1–4, where 1 = strongly disagree, 2 = disagree, 3 = agree, and 4 = strongly agree. Scores for the attitude questions could range from 13–52, while for the preventative behavior questions, the score range was 11–44.

Statistical Analysis

Descriptive statistics, such as the number and percentage of students, were used to describe the demographic characteristics of participants. Differences in knowledge, attitudes, and preventative behaviors according to participant characteristics were analyzed using *t*-test. Spearman correlation coefficient was used to determine the relationships between variables. To determine factors affecting preventative behavior, a linear multiple regression analysis was used. Nominal scales were formed into dummy variables using the codes 0 and 1, including gender (male = 1, female = 0), age (<20 = 1, ≥20 = 0), faculty (health faculty = 1, non-health faculty = 0), degree level (undergraduate = 1, postgraduate = 0), residence (West Java = 1, outside West Java = 0), smoker (yes = 1, no = 0), been given information about TB (yes = 1, no = 0). A Durbin–Watson coefficient of 2 was used to indicate that there would not be autocorrelation. To confirm that there was no multicollinearity, we applied a tolerance level for all variables and a variance inflation factor of 0.54–0.95 and 1.05–1.86, respectively. In addition, we applied a regression test with the *p*-value set at <0.001, the mean of the residual standard at 0, and the range of the residual standard below 3. This indicated that there were no outliers. The regression model was assumed to be linear since the normality, residual, collinearity, regression test, and independent error met the required criteria. All data analysis was performed using SPSS v. 27 (IBM Corp., Armonk, NY, USA) software.

Results

Students' Characteristics

Of the 638 questionnaires returned, 114 were excluded because the respondents had a personal or family history of TB. This left a total number of participants of 524. [Table 1](#) shows the characteristics of the students who participated in this study. Of the participants, 264 (50.38%) were non-health faculty students, whereas 260 (49.62%) were health faculty students. The majority (*n* = 479, 91.41%) were undergraduate students and the rest (*n* = 45, 8.59%), postgraduate. Most (*n* = 438, 83.59%) had received information about TB, while the rest (*n* = 86, 16.41%) had never received information. Most had obtained information about TB on the internet (*n* = 351, 29.62%) or social media (*n* = 322, 27.17%).

Students' Knowledge About TB

[Table 2](#) shows the levels of students' knowledge about TB. As might be expected, knowledge about TB among health faculty students was better than that among non-health faculty students. The average knowledge score of health faculty students was 7.03 ± 2.36 out of 11, while the average score of non-health students was 4.98 ± 2.20 . Most students from both health (91.54%) and non-health (87.12%) faculties answered question number 7 correctly. This asked whether chest X-rays were one of the ways in which TB can be diagnosed. Question number 4 received the fewest correct responses among health faculty students, with only 39.62% providing the correct response. This question asked whether there were

Table 1 Student Characteristics

Characteristics		n (%)
Sex	Female	412 (78.63)
	Male	112 (21.37)
Age (Median: 20-years-old)	≥20 years old	364 (69.47)
	<20 years old	160 (30.53)
Faculty	Health faculties	260 (49.62)
	Non-health faculties	264 (50.38)
Academic degree	Postgraduate	45 (8.59)
	Undergraduate	479 (91.41)
Year began university	2016	10 (1.91)
	2017	146 (27.86)
	2018	100 (19.08)
	2019	177 (33.78)
	2020	83 (15.84)
	2021	8 (1.53)
Residence	West Java	393 (75.00)
	Outside West Java	131 (25.00)
Smoker	Yes	44 (8.40)
	No	480 (91.60)
Have obtained information about TB	Yes	438 (83.59)
	No	86 (16.41)
Source of information [#]	Social media	322 (27.17)
	Formal education	315 (26.58)
	Internet	351 (29.62)
	TV	110 (9.29)
	Healthcare providers	10 (0.84)
	Relatives	14 (1.18)
	Others	63 (5.32)

Note: [#]Multiple responses.

Abbreviations: n, number of students; %, percentage.

specific symptoms in the early stages of TB infection. Question number 9 asked whether TB can be treated only when there are obvious symptoms. This was only answered correctly by 20.83% of non-health faculty students.

Students' Attitude Toward TB

Table 3 shows the students' attitudes toward TB. The average score for the attitudes of health faculty students was 45.40 ± 4.17 out of a maximum score of 52, while the average score for non-health faculty students was 43.75 ± 4.09 . Question

Table 2 Students' Knowledge About TB

Question		Health Faculties					Non-Health Faculties				
		Yes n (%)	No n (%)	Correct Answer (%)	Mean (SD)	Rank	Yes n (%)	No n (%)	Correct Answer (%)	Mean (SD)	Rank
Route of infection	1.Tuberculosis (TB) can occur anywhere in the human body	119 (45.77)	121 (46.54)	45.77	0.46 (0.50)	8	56 (21.21)	144 (54.55)	21.21	0.21 (0.41)	10
	2.TB is inherited from parents, so if parents are infected with TB, then their child will definitely get TB ^R	25 (9.62)	209 (80.38)	80	0.80 (0.40)	3	46 (17.42)	161 (60.98)	60.98	0.61 (0.49)	3
	3.TB bacteria are spread in the air	190 (73.08)	50 (19.23)	72.69	0.73 (0.45)	5	168 (63.64)	51 (19.32)	63.64	0.64 (0.49)	2
Symptoms	4.There are no specific symptoms that appear in the early stages of TB infection	103 (39.62)	113 (43.46)	39.62	0.40 (0.49)	10	77 (29.17)	91 (34.47)	29.17	0.29 (0.48)	8
	5.When infected with TB, a person will experience a mild fever in the afternoon	139 (53.46)	28 (10.77)	53.46	0.53 (0.50)	7	105 (39.77)	11 (4.17)	39.77	0.40 (0.49)	7
	6.If mild fever persists and is accompanied by weight loss, it may be TB	172 (66.15)	22 (8.46)	66.15	0.66 (0.47)	6	126 (47.73)	20 (7.58)	47.73	0.48 (0.50)	5
Preventative examinations	7.Chest X-rays are one way to diagnose TB	237 (91.15)	7 (2.69)	91.54	0.92 (0.28)	1	230 (87.12)	2 (0.76)	87.12	0.87 (0.34)	1
	8.A single administration of the Bacillus Calmette–Guérin vaccine can protect against TB infection for a lifetime ^R	87 (33.46)	118 (45.38)	45.38	0.45 (0.50)	9	56 (21.21)	64 (24.24)	24.24	0.24 (0.43)	9
Treatment	9.TB can only be treated if there are obvious symptoms ^R	91 (35.00)	118 (45.38)	45.38	0.45 (0.50)	9	105 (39.77)	55 (20.83)	20.83	0.21 (0.41)	11
	10.TB is treated by taking medication every day for at least 6 months	203 (78.08)	7 (2.69)	78.08	0.78 (0.41)	4	122 (46.21)	4 (1.52)	46.21	0.46 (0.50)	6
	11.TB treatment is difficult, and if anti-TB drugs are not taken regularly, it can lead to drug resistance	220 (84.62)	0	84.62	0.85 (0.36)	2	150 (56.82)	5 (1.89)	56.82	0.57 (0.50)	4
				Total	7.03 (2.36)				Total	4.98 (2.20)	

Note: ^RReverse item.**Abbreviation:** SD, standard deviation; n, number of students; %, percentage.

Table 3 Students' Attitudes Toward TB

Questions		Health Faculties						Non-Health Faculties					
		SA n (%)	A n (%)	DA n (%)	SDA n (%)	Mean (SD)	Rank	SA n (%)	A n (%)	DA n (%)	SDA n (%)	Mean (SD)	Rank
Recognition of TB	1.If I got TB, I should immediately inform my family and/or my lecturers	207 (79.62)	51 (19.62)	2 (0.77)	0	3.79 (0.43)	1	194 (73.48)	67 (25.38)	3 (1.14)	0	3.72 (0.47)	1
	2.I think TB can be transmitted without even realizing it	158 (60.77)	92 (35.38)	10 (3.85)	0	3.57 (0.57)	7	118 (44.70)	126 (47.73)	20 (7.58)	0	3.37 (0.63)	8
	3.I may experience obstacles in my family and academic life if I were infected with TB	70 (26.92)	118 (45.38)	70 (26.92)	2 (0.77)	2.98 (0.76)	12	69 (26.14)	117 (44.32)	77 (29.17)	1 (0.38)	2.96 (0.76)	12
	4.I think that TB is a very serious disease	149 (57.31)	109 (41.92)	2 (0.77)	0	3.57 (0.51)	8	138 (52.27)	119 (45.08)	7 (2.65)	0	3.50 (0.55)	5
Preventative examinations	5.I think, regular medical examinations every year can prevent TB	95 (36.54)	141 (54.23)	24 (9.23)	0	3.27 (0.62)	11	106 (40.15)	139 (52.65)	19 (7.20)	0	3.33 (0.61)	9
	6.I think a person should be examined for TB if there is a TB patient among his family or friends	132 (50.77)	119 (45.77)	9 (3.46)	0	3.47 (0.57)	9	99 (37.5)	145 (54.92)	20 (7.58)	0	3.30 (0.60)	10
	7.TB screening can be easily accessed at health facilities, such as community health centers (Puskesmas)	59 (22.69)	124 (47.69)	75 (28.85)	2 (0.77)	2.92 (0.74)	13	41 (15.53)	155 (58.71)	65 (24.62)	3 (1.14)	2.89 (0.66)	13
Treatment	8.If I were diagnosed with TB I would take anti-TB drugs regularly for at least 6 months, as directed by the doctor	203 (78.08)	56 (21.54)	1 (0.38)	0	3.78 (0.43)	2	142 (53.79)	115 (43.56)	7 (2.65)	0	3.51 (0.55)	4
	9.If a friend discontinued taking anti-TB drugs, I would persuade him to continue regular TB treatment	194 (74.62)	64 (24.62)	2 (0.77)	0	3.74 (0.46)	3	132 (50)	125 (47.35)	7 (2.65)	0	3.47 (0.55)	6
	10.I would encourage those with TB around me to obtain treatment	190 (73.08)	70 (26.92)	0	0	3.73 (0.44)	4	138 (52.27)	126 (47.73)	0	0	3.52 (0.50)	3
	11.I think TB can be cured if it is detected and treated early	158 (60.77)	95 (36.54)	7 (2.69)	0	3.58 (0.55)	6	128 (48.48)	130 (49.24)	5 (1.89)	1 (0.38)	3.46 (0.56)	7
Preventative education	12.I am interested in finding out more about TB disease	95 (36.54)	143 (55.00)	21 (8.08)	1 (0.38)	3.28 (0.62)	10	55 (20.83)	184 (69.70)	24 (9.09)	1 (0.38)	3.11 (0.56)	11
	13.I think education about TB is very much needed	189 (72.69)	69 (26.54)	2 (0.77)	0	3.72 (0.47)	5	164 (62.12)	98 (37.12)	1 (0.38)	1 (0.38)	3.61 (0.52)	2
					Total	45.40 (4.17)					Total	43.75 (4.09)	

Abbreviations: SA, Strongly agree; A, Agree; DA, Disagree; SDA, Strongly disagree; SD, Standard deviation; n, number of students; %, percentage.

number 1 had the highest mean score, with a mean of 3.79 ± 0.43 for health faculty students and 3.72 ± 0.47 for non-health faculty students. Overall, 258 (99.24%) health faculty students and 261 (98.86%) non-health faculty students responded with “strongly agree” or “agree” to the following statement in question number 1: “I would immediately notify my family and/or lecturers if I was diagnosed with TB.” Question number 7 had the lowest mean score, with only 70.38% of health faculty students (2.92 ± 0.74) and 74.24% of non-health faculty students (2.89 ± 0.66) responding with “strongly agree” or “agree” to the statement, “TB examinations can be easily accessed at health facilities, such as community health centers or Puskesmas.”

Students' Preventative Behavior Toward TB

Table 4 shows the students' preventative behavior toward TB. The average score for preventative behavior toward TB of health faculty students was 33.08 ± 4.49 out of a maximum score of 44, while the average score for non-health faculty students was 33.16 ± 4.40 . Question number 1 produced the highest mean scores of 3.70 ± 0.51 for health faculty students and 3.73 ± 0.48 for non-health faculty students. For this question, 256 (98.43%) health faculty students and 260 (98.48%) non-health faculty students stated that they strongly agreed or agreed that they covered their mouth when sneezing. Question number 4 produced the lowest mean scores of 2.92 ± 0.74 for health faculty students and 2.89 ± 0.66 for non-health faculty students. For this question, only 17.69% of health faculty students and 24.62% of non-health faculty students strongly agreed or agreed that they had a regular chest x-ray every year.

Differences in Knowledge, Attitudes, and Preventative Behavior According to Student Characteristics

Table 5 shows the differences in students' knowledge, attitudes, and preventative behavior toward TB according to student characteristics. Female students demonstrated greater knowledge and better attitudes toward TB than male students ($t = 3.24$, $p = 0.001$ and $t = 3.006$, $p = 0.003$, respectively). Students from health faculties had better knowledge and attitudes than students from non-health faculties ($t = 10.275$, $p < 0.001$ and $t = 4.558$, $p < 0.001$, respectively). Postgraduate students had greater knowledge ($t = -8.603$, $p < 0.001$), better attitudes ($t = -4.420$, $p < 0.001$), and engaged in more preventative behavior ($t = -3.09$, $p = 0.001$) against TB than undergraduate students. Students who did not smoke had greater knowledge about TB than students who smoked ($t = 4.672$, $p < 0.001$). In addition, students who had received information about TB engaged in more preventative behavior than students who had not received information about TB ($t = -2.390$, $p = 0.017$).

Correlations Between Knowledge, Attitudes, and Preventative Behavior

A positive correlation was found between students' knowledge and attitudes toward TB ($r = 0.381$, $p < 0.001$), between knowledge and preventative behavior ($r = 0.275$, $p < 0.001$), and between attitudes and preventative behavior ($r = 0.492$, $p < 0.001$).

Variables Affecting Students' Preventative Behavior Toward TB

Table 6 shows the variables influencing students' preventative behavior against TB, established by linear multiple regression analysis. Six variables influenced preventative behavior, with an explanatory power of 31.9% ($F = 17.342$; $p < 0.001$). These were faculty ($\beta = -0.17$), knowledge of symptoms ($\beta = 0.096$), knowledge of preventative examinations ($\beta = 0.096$), attitudes toward preventative examinations ($\beta = 0.21$), attitudes toward treatment ($\beta = -0.348$), and attitudes toward preventative education ($\beta = -0.684$). Health faculty students had greater knowledge of symptoms and preventative examinations, and more positive attitudes toward preventative examinations, treatment, and prevention education, and showed more preventative behavior.

Discussion

This study results found that female students demonstrated greater knowledge and better attitudes toward TB than male students. Moreover, students from health faculties had greater knowledge and better attitudes than students from non-

Table 4 Students' Preventative Behavior Against TB

Questions		Health Faculties						Non-Health Faculties					
		SA n (%)	A n (%)	DA n (%)	SDA n (%)	Mean (SD)	Rank	SA n (%)	A n (%)	DA n (%)	SDA n (%)	Mean (SD)	Rank
Route of infection	1. When I sneeze or cough, I cover my mouth	188 (72.31)	68 (26.15)	3 (1.15)	1 (0.38)	3.70 (0.51)	1	197 (74.62)	63 (23.86)	4 (1.52)	0	3.73 (0.48)	1
	2. I often open the window for good air circulation	153 (58.85)	98 (37.69)	9 (3.46)	0	3.55 (0.56)	3	160 (60.61)	99 (37.50)	5 (1.89)	0	3.59 (0.53)	2
	3. I cover my mouth with a handkerchief or tissue when I cough	108 (41.54)	100 (38.46)	49 (18.85)	3 (1.15)	3.20 (0.78)	5	102 (38.64)	106 (40.15)	52 (19.70)	4 (1.51)	3.16 (0.79)	5
Preventative examination	4. I have regular chest X-rays every year	9 (3.46)	37 (14.23)	152 (58.46)	62 (23.85)	1.97 (0.72)	11	13 (4.92)	52 (19.70)	157 (59.47)	42 (15.91)	2.14 (0.73)	11
	5. If I had a cough for more than 2 weeks, I would go to a community health center, medical clinic, or hospital to get myself checked	117 (45.00)	114 (43.85)	26 (10.00)	3 (1.15)	3.33 (0.70)	4	114 (43.18)	120 (45.45)	27 (10.23)	3 (1.14)	3.31 (0.69)	4
Preventative education	6. I often read materials designed to raise awareness about TB	30 (11.54)	100 (38.46)	112 (43.08)	18 (6.92)	2.55 (0.79)	9	16 (6.06)	78 (29.55)	150 (56.82)	20 (7.58)	2.34 (0.71)	9
	7. I actively participate in education about TB	23 (8.85)	80 (30.77)	133 (51.15)	24 (9.23)	2.39 (0.78)	10	14 (5.30)	62 (23.48)	161 (60.98)	27 (10.23)	2.24 (0.71)	10
Healthy lifestyle	8. I usually eat a balanced nutritious meal to maintain health	56 (21.54)	162 (62.31)	39 (15.00)	3 (1.15)	3.04 (0.64)	6	66 (25)	160 (60.61)	37 (14.02)	1 (0.38)	3.10 (0.63)	6
	9. I do not overeat because it can influence my immune system and overall health	41 (15.77)	174 (66.92)	43 (16.54)	2 (0.77)	2.98 (0.60)	7	65 (24.62)	157 (59.47)	40 (15.15)	2 (0.76)	3.08 (0.65)	7
	10. I wash my hands after going out or exercising	168 (64.62)	89 (34.23)	3 (1.15)	0	3.63 (0.51)	2	155 (58.71)	105 (39.77)	4 (1.52)	0	3.57 (0.53)	3
	11. I exercise regularly to maintain good health	38 (14.62)	119 (45.77)	98 (37.69)	5 (1.92)	2.73 (0.73)	8	56 (21.21)	131 (49.62)	72 (27.27)	4 (1.52)	2.91 (0.74)	8
					Total	33.08 (4.49)					Total	33.16 (4.40)	

Abbreviations: SA, Strongly agree; A, Agree; DA, Disagree; SDA, Strongly disagree; SD, Standard deviation; n, number of students; %, percentage.

Table 5 Differences in Students' Knowledge, Attitudes, and Preventative Behaviors Toward TB According to Students' Characteristics

Variables	Categories	Knowledge		Attitude		Preventative Behavior	
		Mean (SD)	t (p)	Mean (SD)	t (p)	Mean (SD)	t (p)
Sex	Female	6.18 (2.46)	3.24 (0.001)*	44.86 (4.15)	3.006 (0.003)*	33.23 (4.44)	1.049 (0.295)
	Male	5.32 (2.54)		43.52 (4.29)		32.73 (4.42)	
Faculties	Health faculties	7.03 (2.36)	10.275 (<0.001)*	45.40 (4.17)	4.558 (<0.001)*	33.08 (4.49)	-0.192 (0.848)
	Non-health faculties	4.98 (2.20)		43.75 (4.09)		33.16 (4.40)	
Age	<20 years	5.74 (2.28)	-1.560 (0.119)	44.16 (4.21)	-1.495 (0.136)	32.69 (4.70)	-1.489 (0.137)
	≥20 years	6.11 (2.59)		44.75 (4.21)		33.31 (4.31)	
Academic degree	Undergraduate	5.72 (2.40)	-8.603 (<0.001)*	44.33 (4.21)	-4.420 (<0.001)*	32.92 (4.43)	-3.09 (0.001)*
	Postgraduate	8.87 (1.66)		47.18 (3.21)		35.13 (3.98)	
Residence	West Java	6.05 (2.41)	0.857 (0.392)	44.75 (4.16)	1.698 (0.090)	33.32 (4.41)	1.754 (0.080)
	Outside West Java	5.83 (2.76)		44.03 (4.34)		32.52 (4.48)	
Smoking	No	6.15 (2.49)	4.672 (<0.001)*	44.62 (4.27)	0.901 (0.368)	33.19 (4.43)	1.079 (0.281)
	Yes	4.34 (2.03)		44.02 (3.53)		32.43 (4.5)	
Have obtained information about TB	No	4.69 (2.61)	-5.450 (<0.001)*	43.28 (4.84)	-3.137 (0.002)*	32.08 (4.99)	-2.390 (0.017)*
	Yes	6.25 (2.4)		44.82 (4.04)		33.33 (4.30)	

Notes: All analyses were by t-test; *Significance level was set at p-value < 0.05.

Abbreviation: SD, standard deviation.

health faculties. In addition, postgraduate students had greater knowledge, better attitudes, and more preventative behaviors than undergraduate students. The students who did not smoke had a greater knowledge than the students who smoked. Students who had received information about TB showed a more preventative behavior than students who had not received information about TB. Furthermore, students from the health faculties had greater knowledge of symptoms and preventative examinations, and a more positive attitudes toward preventative examinations, treatment, and preventative education and showed more preventative behavior against TB.

Females had greater knowledge and better attitudes than males ($p < 0.05$). This result agrees with other studies that have found that female patients with TB tend to have greater knowledge than males.^{17,18} Females having more positive attitudes than males may be because females have higher conscientiousness than males.¹⁹

Table 6 Variables Affecting Preventative Behavior Against TB

Variables	B ^a	SE	β	t	p
(Constant)	10.88	2.056		5.293	<0.001*
Sex ^b	-0.12	0.457	-0.001	-0.26	0.979
Age ^b	-0.245	0.372	-0.025	-0.659	0.510
Faculty ^b	-1.503	0.401	-0.170	-3.749	<0.001*
Academic degree ^b	-0.617	0.645	-0.039	-0.958	0.339
Smoking ^b	0.863	0.643	0.540	1.342	0.180
Residence ^b	0.502	0.379	0.049	1.324	0.186
Obtained information about TB ^b	-0.523	0.45	-0.044	-1.163	0.245
Knowledge					
Route of infection	-0.054	0.204	-0.011	-0.264	0.792
Symptoms	0.408	0.171	0.096	2.387	0.017*
Preventative examinations	0.732	0.306	0.096	2.396	0.017*
Treatment	0.023	0.206	0.005	0.11	0.913
Attitudes					
Recognition of TB	-0.026	0.122	-0.009	-0.211	0.833
Preventative examinations	0.696	0.147	0.21	4.734	<0.001*
Treatment	0.696	0.137	0.138	2.806	0.005*
Preventative education	1.354	0.212	0.287	6.374	<0.001*
R ² = 0.339; Adjusted R = 0.319; F = 17.342; p < 0.001					

Notes: *Significant; ^aUnstandardized coefficient; ^bDummy coding.

Students from health faculties had better knowledge and attitudes than students from non-health faculties. This result concurs with those of a study on final year students in Iran in which most students from health faculties had good knowledge and attitudes toward TB.²⁰ However, other studies have reported contradictory results.^{21,22} Students from health faculties receive formal training on health issues, especially TB, in the subject of infectious diseases during the undergraduate course that is integrated with the curriculum of each health faculty. Therefore, students in the health faculty have greater knowledge, good awareness, and positive behavior toward the prevention of infectious diseases, especially TB. Moreover, as students from health faculties are likely to be more susceptible to TB infection in their future careers in healthcare facilities, they need to understand more about TB, and this will contribute to the eradication of TB through the implementation of prevention, diagnosis, and treatment.²²

The educative level of students affected their knowledge, attitudes, and behavior toward TB prevention and treatment. Postgraduate students had better knowledge, attitudes, and preventative behavior than undergraduate students. This was also the case in a study in Bangladesh, which reported that those with lower levels of education tend to have inadequate knowledge of TB.²³ Another study has shown that educational level is related to the level of TB knowledge.²⁴ Postgraduate students tend to have more TB knowledge and more positive attitudes and behaviors. This may be because postgraduate students have received more formal education and have more mature personalities, equipping them with a greater ability to effectively address health risks.

Smoking status had a significant relationship with knowledge about TB ($p < 0.05$). Students who do not smoke had greater knowledge than the students who did not smoke. A study by Awaisu et al²⁵ also reported that smokers had less knowledge about TB. Educational programs related to the dangers of smoking and the negative impacts of smoking on TB are very important. The National Basic Health Research in 2018 reported that the prevalence of smoking in the population aged >10 years increased from 28.8% in 2013 to 29.3% in 2018.²⁶ Hence, it is necessary to provide an understanding of the short- and long-term benefits of quitting smoking on lung health because smoking is associated with a significantly higher risk of latent TB infection.²⁷

Obtaining information about TB and its treatment was significantly correlated with knowledge about TB ($p < 0.05$). Students who had previously received information about TB also demonstrated more preventative behavior than students who had not received information about TB. Hassan et al²⁸ also found that those who had received information about TB were more knowledgeable about the disease. Thus, it is necessary to develop interventions that improve communication and dissemination of TB information, especially for students. Educational programs can be integrated with the curriculum, providing basic health information for health and non-health faculty students. In addition, students were found to obtain information about TB through the internet and social media. Therefore, these means of information dissemination should be utilized for the education of students about TB.

Six variables were found to affect TB prevention behavior. These were faculty, knowledge of symptoms, knowledge of preventative examinations, attitudes toward preventative examinations, attitudes toward treatment, and attitudes toward preventative education. These six variables accounted for 31.9% of TB prevention behaviors. Thus, these factors should be considered in the development of university TB education programs.

The study results indicate significant differences in knowledge, attitude, and TB preventative behavior among students in the health and non-health faculties. Moreover, TB prevention is a shared responsibility of both the health and non-health faculties. Hence, the study findings can be used to develop a standardized curriculum on TB for first-year students to increase each individual's awareness about TB prevention. Further action can be taken through collaboration in the form of field studies and community service involving students from health and non-health faculties. This is important to increase knowledge and awareness about infectious diseases, especially TB.

This study had some limitations related to the data collection. First, the data were obtained from only one university in West Java, Indonesia; hence, they cannot represent the knowledge, attitudes, and preventative behaviors toward TB of all university students in Indonesia. Second, as the sampling method was consecutive and online, there may have been potential selection bias in data collection. However, verification through students' ID numbers was conducted to ensure that only students filled the questionnaire. Despite the limitation, the findings can still be useful for the development of TB education programs for university students and for assisting the Indonesian government in reducing the prevalence of TB in Indonesia.

Conclusion

This study found that six factors, including the type of faculty, knowledge of symptoms and preventative examination, attitudes toward preventative examinations, attitudes toward treatment, and attitudes toward preventative education, influence college students' TB preventative behaviors. These factors should be considered while developing TB education programs for such universities. Developing a standardized curriculum on TB for first-year students to increase each individual's awareness about TB prevention should be considered. Moreover, the internet and social media should be utilized to educate students about TB.

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Disclosure

The authors report no conflicts of interest in this work.

References

1. World Health Organization. Global Tuberculosis Report; 2020. Available from: <https://www.who.int/publications/i/item/9789240013131>. Accessed September 15, 2021.
2. Ministry of Health Republic of Indonesia. Indonesia's tuberculosis situation in 2020; 2020. Available from: <https://tbindonesia.or.id/pustaka-tbc/dashboard-tb/>. Accessed September 15, 2021.
3. Soeroto AY, Pratiwi C, Santoso P, Lestari BW. Factors affecting outcome of longer regimen multidrug-resistant tuberculosis treatment in West Java Indonesia: a retrospective cohort study. *PLoS One*. 2021;16(2):e0246284. doi:10.1371/journal.pone.0246284
4. Hogan AB, Jewell BL, Sherrard-Smith E, et al. Potential impact of the COVID-19 pandemic on HIV, tuberculosis, and malaria in low-income and middle-income countries: a modelling study. *Lancet Glob Heal*. 2020;8(9):e1132–e1141. doi:10.1016/S2214-109X(20)30288-6
5. Togun T, Kampmann B, Stoker NG, Lipman M. Anticipating the impact of the COVID-19 pandemic on TB patients and TB control programmes. *Ann Clin Microbiol Antimicrob*. 2020;19(1):1–6. doi:10.1186/s12941-020-00363-1
6. Jiang H, Zhang S, Ding Y, et al. Development and validation of college students' tuberculosis knowledge, attitudes and practices questionnaire (CS-TBKAPQ). *BMC Public Health*. 2017;17(1):949. doi:10.1186/s12889-017-4960-x
7. Dorji T, Tshering T, Wangdi K. Assessment of knowledge, attitude and practice on tuberculosis among teacher trainees of Samtse College of Education, Bhutan. *PLoS One*. 2020;15(11):e0241923. doi:10.1371/journal.pone.0241923
8. Wolde D, Tadesse M, Abdella K, Abebe G, Ali S. Tuberculosis among Jimma University undergraduate students: first insight about the burden of tuberculosis in Ethiopia Universities-Cross-Sectional Study. *Int J Bacteriol*. 2017;2017:9840670. doi:10.1155/2017/9840670
9. Pathman A, Aziah B, Zahiruddin W, et al. Knowledge, attitudes, practices and health beliefs toward leptospirosis among Urban and Rural Communities in Northeastern Malaysia. *Int J Environ Res Public Health*. 2018;15(11). doi:10.3390/ijerph15112425
10. Yusuf L, Puspitasari IM, Sinuraya RK. Recent studies on knowledge, attitude, and practice toward tuberculosis among university students. *J Appl Pharm Sci*. 2021;11(8):178–183. doi:10.7324/JAPS.2021.110823
11. Saifodine A, Gudo PS, Sidat M, Black J. Patient and health system delay among patients with pulmonary tuberculosis in Beira city, Mozambique. *BMC Public Health*. 2013;13:1. doi:10.1186/1471-2458-13-559
12. Tachfouti N, Slama K, Berraho M, Nejari C. The impact of knowledge and attitudes on adherence to tuberculosis treatment: a case-control study in a Moroccan region. *Pan Afr Med J*. 2012;12(1):1–8. doi:10.11604/pamj.2012.12.52.1374
13. Adane K, Spigt M, Johanna L, Noortje D, Abera SF, Dinant GJ. Tuberculosis knowledge, attitudes, and practices among northern Ethiopian prisoners: implications for TB control efforts. *PLoS One*. 2017;12(3):1–15. doi:10.1371/journal.pone.0174692
14. Charan J, Biswas T. How to calculate sample size for different study designs in medical research? *Indian J Psychol Med*. 2013;35(2):121–126. doi:10.4103/0253-7176.116232
15. Choi Y, Jeong GH. Army soldiers' knowledge of, attitude towards, and preventive behavior towards tuberculosis in Korea. *Osong Public Heal Res Perspect*. 2018;9(5):269–277. doi:10.2471/j.phrp.2018.9.5.09
16. Mohamad MM, Sulaiman NL, Sern LC, Salleh KM. Measuring the validity and reliability of research instruments. *Procedia Soc Behav Sci*. 2015;204:164–171. doi:10.1016/j.sbspro.2015.08.129
17. Bati J, Legesse M, Medhin G. Community's knowledge, attitudes and practices about tuberculosis in Itang Special District, Gambella Region, South Western Ethiopia. *BMC Public Health*. 2013;13(1). doi:10.1186/1471-2458-13-734
18. Naidoo P, Simbayi L, Labadarios D, et al. Predictors of knowledge about tuberculosis: results from SANHANES I, a national, cross-sectional household survey in South Africa. *BMC Public Health*. 2016;16(1):1–12. doi:10.1186/s12889-016-2951-y
19. Schaeper H. The first year in higher education: the role of individual factors and the learning environment for academic integration. *High Educ*. 2020;79(1):95–110. doi:10.1007/s10734-019-00398-0
20. Behnaz F, Mohammadzade G, Mousavi-e-roknbadi RS, Mohammadzadeh M. Assessment of knowledge, attitudes and practices regarding tuberculosis among final year students in Yazd, central Iran. *J Epidemiol Glob Health*. 2014;4:81–85. doi:10.1016/j.jegh.2013.09.003
21. Olakunle OS, Oladimeji O, Olalekan AW, Olugbenga-Bello A, Akinleye C, Oluwatoyin OA. Knowledge of tuberculosis management using directly observed treatment short course therapy among final year medical students in South Western Nigeria. *Pan Afr Med J*. 2014;4–8. doi:10.11604/pamj.2014.18.32.3553
22. Ou Y, Luo Z, Mou J, et al. Knowledge and determinants regarding tuberculosis among medical students in Hunan, China: a cross-sectional study. *BMC Public Health*. 2018;18(730):1–7. doi:10.1186/s12889-018-5636-x
23. Hossain S, Zaman K, Quaiyum A, et al. Factors associated with poor knowledge among adults on tuberculosis in Bangladesh: results from a nationwide survey. *J Heal Popul Nutr*. 2015;34(1):1–7. doi:10.1186/S41043-015-0002-4
24. Onyeonoro UU, Chukwu JN, Oshi DC, Nwafor CC, Meka AO. Assessment of tuberculosis-related knowledge, attitudes and practices in Enugu, South East Nigeria. *J Infect Dis Immun*. 2014;6(1):1–9. doi:10.5897/jidi2011.0020
25. Awaisu A, Haniki M, Mohamed MHN, et al. Tobacco use prevalence, knowledge, and attitudes among newly diagnosed tuberculosis patients in Penang State and Wilayah Persekutuan Kuala Lumpur, Malaysia. *Tob Induc Dis*. 2010;8(3):1–10. doi:10.1186/1617-9625-8-3
26. Ministry of Health Republic of Indonesia. National report basic health research 2018; 2018. Available from: https://kesmas.kemkes.go.id/assets/upload/dir_519d41d8cd98f00/files/Hasil-risikesdas-2018_1274.pdf. Accessed August 15, 2022.
27. Horne DJ, Campo M, Ortiz JR, et al. Association between smoking and latent tuberculosis in the U.S. population: an analysis of the National Health and Nutrition Examination Survey. *PLoS One*. 2012;7(11):3–8. doi:10.1371/journal.pone.0049050
28. Hassan AO, Olukolade R, Ogbuji QC, et al. Knowledge about tuberculosis: a precursor to effective TB control—findings from a follow-up national KAP Study on tuberculosis among Nigerians. *Tuberc Res Treat*. 2017;2017:1–8. doi:10.1155/2017/6309092

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