



Article

# Assessment of Students' Knowledge Regarding PTB and Its Causes at Rural Institution of Higher Learning in South Africa

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**Abstract:** Background: TB is a significant public health problem around the world, with South Africa being one of the 30 high-burden TB countries, accounting for 87 percent of all estimated incident TB cases. In South Africa, which accounts for 3% of all instances worldwide, research on students' experiences and understanding of underlying factors is lacking. These future leaders are still in a key time of physical and psychological development. This study aimed to test students' understanding of pulmonary tuberculosis (PTB) and its causes at a rural institution of higher learning. Methodology: Quantitative method was used using a cross-sectional design. The study was conducted in the 2020 Vhembe District, Limpopo, South Africa. In the poll, 199 students living in overcrowded campus housing were interviewed. A self-administered questionnaire was used to collect data at the Thohoyandou campus. Data were analysed using version 26.0 of the Statistical Package for Social Sciences (SPSS), with a Spearman's rank-order correlation run. Results: The findings of this study revealed that 25.6 percent of male students and 74.4 percent of female students, respectively, understood PTB, while students at the selected tertiary institution have insufficient awareness of the causes of PTB. The association between education and TB knowledge among the respondents was determined using Spearman's rank-order correlation. There was a statistically significant positive association between education and TB knowledge (Spearman's rho = 0.669,  $p = 0.035$ ). Conclusions: The study found that students at a higher education institution lacked sufficient general Knowledge regarding PTB. PTB control measures should be adopted to implement better the NSP, NDP, Global STOP TB strategy and the SDGs.

**Keywords:** assessment; national development plan; national strategic plan; tertiary institution; tuberculosis; pulmonary tuberculosis



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## 1. Introduction

Tuberculosis (TB) remains a major global health concern and the leading cause of infectious disease-related human mortality, caused by Mycobacterium Tuberculosis (MTB) or bacilli. It is transmitted through infectious nuclei droplets from an infected person to another while coughing, sneezing, talking and singing [1]. A single cough may carry up to 4000 droplets [2]. The chance of developing TB is much higher amongst those infected with HIV [3]; it affects and attacks mainly the lungs (Pulmonary TB) as well as any part of the human body, such as the brain, bones, kidney and the intestines is called Extra-Pulmonary TB [4,5].

In 1993, the World Health Organization (WHO) declared its global emergency [6] as more than two billion people in the world were infected with MTB, and they had the chance of developing TB disease at any stage of life [7,8] indicated that the necessity to end TB followed by the development and global implementation of a TB control programme called Directly Observed Treatment Short Course (DOTS), which is now referred to as the

most internationally recommended strategy for the control of TB. Moreover, being one of the world's worst TB epidemics driven by HIV, South Africa needs to strengthen its TB programmes as they follow the recommended approach in the international DOTS policy. Conversely, Ref. [8] assert that the central pillars of TB control include case finding, treating and preventing TB to avoid TB deaths and reduce transmissions.

TB is more common in men than women and affects most adults in the economically productive age groups [2]. In higher institutions, some factors contributing to the transmission of PTB, such as overcrowding in classrooms, sharing of rooms in the residences and close contact with the infected person, put the students' health at risk of acquiring TB. People spend most of their time indoors, whereas windows and doors are not constantly opened for ventilation. The stated factors and lack of Knowledge also put lecturers and the UNIVEN community at high risk of contracting and spreading TB. There have been 14 recorded TB cases on campus (UNIVEN) from 2014 to 2018. Most clients presented with the following main clinical signs and symptoms of TB as cough for more than 2 weeks, fever, chest pains, shortness of breath, night sweats, weight loss and loss of appetite [3].

Ramaliba et al. [9] reported that Limpopo Province is also affected by TB and ranked number seven amongst all nine provinces due to the high prevalence of HIV/AIDS, compounded by poor TB treatment outcomes. About 55% of TB patients in the province were HIV-positive. This triggered the interest of the researchers to assess the Knowledge of students regarding PTB at a selected tertiary institution in Vhembe District, Limpopo Province, which is also supported by the National Department of Health TB [10]. Further, the researchers found that many studies on students' Knowledge of PTB have been conducted in various countries [11,12]. Still, in the Vhembe District, there is no evidence of literature on the topic, and few studies have been conducted in Thohoyandou based on assessing students' knowledge regarding PTB and its causes at rural Institutions of higher learning. Moreover, Ref. [13] report that TB might be significantly prevalent at universities. Despite the level of TB knowledge among the medical students was higher than among nursing students at 15 universities, there is still a lack of data and empirical studies on students' knowledge of TB, and very little is available in Limpopo, especially at the University of Venda.

Consequently, knowledge of students on PTB should be provided to increase awareness and help in attitudes and behaviour changing towards this disease among all university students, staff and TB patients. Thus, assessing students' knowledge regarding PTB and its causes at the rural institution of higher learning in South Africa was our main aim for this study.

## 2. Methodology

### 2.1. Study Design and Sampling Technique

A descriptive cross-sectional design used to assess students' Knowledge regarding PTB and its causes at rural institution of higher learning in South Africa, were investigated through a self-administered questionnaire [14]. A descriptive cross-sectional design was adopted according to [15] to describe the respondents' knowledge regarding PTB. Students were assessed for the following causes of TB, transmission of TB, signs and symptoms of TB, whether TB is curable, the risk factors of TB, the best method of diagnosis of TB and the treatment of TB. The researchers used simple random sampling to select the sample of students from Univen. In this study, simple random sampling was appropriate because the sampling size was 200, and it was also best to work with a large sampling size to validate the study results [14]. The simple random sampling method was the most suitable sampling method for selecting a sample among the population for a wide range of areas, and every respondent was accessible.

The design was adopted to understand the knowledge of students who resided on the campus of a tertiary institution during the 2019 academic year as the inclusion criteria. However, the screening tool helped understand how TB diagnosis was performed. In this study, the researchers assessed the students' Knowledge of PTB at the University of Venda.

The study was conducted at Univen Campus Health clinic. Student were provided a full explanation of the objectives of the study. A written informed consent forms was provided. The age group of the respondents ranged from 17–35 years old. The students participated in a voluntary basis and were not remunerated for their contribution. Hence, the students were enrolled in the survey if they were registered students, had resided on-campus before and during the survey and provided informed consent. Students that were not registered at the time the study was conducted and those who were residing at residences located outside the campus were excluded from the survey.

## 2.2. Study Setting and Respondents (Population)

The study site was in a rural-based institution of higher learning in the Vhembe District of the Limpopo Province, South Africa. The study was conducted in Limpopo Province at the University of Venda (UNIVEN) Campus to assess students' Knowledge about PTB. The province is one of the most affected by TB [9]. UNIVEN is located in Thohoyandou town under the Thulamela Municipality, which falls under the Vhembe District Municipality in the Limpopo Province. The University lies on the Northern side of South Africa. It had 17,096 students who registered in the 2019 academic year. There were 8197 rooms occupied by more than 8197 students of all eleven on-campus residences. The university community access most of their health needs and services from the University Campus Health clinic. The study setting was considered because of TB statistics which showed only 14 cases of TB recorded in the period of five years. There is also a shortage of living space in the students' residences as many students are overcrowded in one room, which puts them at a higher risk of contracting the disease. Self-administered questionnaires were given to registered students in 2020. As the majority of students went home during the lockdown, only a total of a hundred and ninety-nine (199) students participated in the study, all of whom were residing at the University residences on-campus to minimize, maintain and adhere to the COVID-19 related regulations enforced by the government [16].

## 2.3. Sample Size Determination

The UNIVEN had 17,096 population for students who registered in the 2019 academic. A simple random sampling was appropriate because it was also best to work with a large sampling size to validate the study results. The sample size was determined by the following Slovin's formula ( $n = \frac{N}{(1+Ne^2)}$ ), where n = number of samples, N = Total number of population and e = margin error of 0.05%. The confidence level was 95%. The target population of this study was 8197 respondents.

$$\begin{aligned}
 n &= \frac{N}{(1+Ne^2)} \\
 &= 8197 / 1 + 8197(0.05 \times 0.05) \\
 &= 8197 / 1 + 8197 \times 0.0025 \\
 &= 8197 / 1 + 40 \\
 &= 8197 / 41 \\
 &= 199
 \end{aligned}$$

Making 199 a sample size taken.

Table 1 shows the names of on-campus student residences.

**Table 1.** Names of on-campus residences and the total number of occupants.

Name of Residences	Number of Students	Number of Respondents
Carousel	231	7
F3 Residence	909	18
F4 Residence	1620	45
F5 Residence	615	12
Lost City Residences	1360	34
Mango Groove Residence	734	17
Bernard Ncube Residence	154	4
New Male Residence	1810	58
Riverside Residence	644	3
River Estate	120	1
Total	8197	199

#### 2.4. Data Collection Tools and Data Collection Procedures

Data collection took place during the lockdown restrictions of the COVID-19 and was performed on-campus precisely at the campus health clinic and the cafeteria where respondents were in groups through a self-administered questionnaire. Data were collected by the trained staff (Professional Nurse). Structured questionnaires and a checklist were used to collect data. Surveys were conducted from May to June 2020, when the COVID-19 outbreak firstly affected the world. However, all the protocols and regulations were adhered to and observed strictly. The research instrument consisted of two sections: Section (A), respondent's demographic information and Section (B), Knowledge of respondents about PTB. A total of 8 questions on knowledge were initially included in the questionnaire and had the following key answer options of "Strongly Disagree", "Disagree", "Neutral", "Agree" and "Strongly Agree". While the answering options were on a scale of 1 to 5, the affirmative answers were scored 4 or 5 marks, the neutral answer was scored 3 marks; followed by the disagreement or negative answers scored 1 or 2 marks.

#### 2.5. Data Analysis

Both data analysis, editing and cleaning were performed to identify errors and strange values and compare them to the questionnaire for correction. Then the data were captured in Microsoft Excel and analysed using the Statistical Package for Social Sciences (IBM SPSS) software version 26.0. The eight questions in the self-administered questionnaire were grouped into indices evaluating and determining the composite knowledge score for data analysis. In descriptive statistics, Spearman's rank-order correlation was used. A positive correlation between education and the knowledge of TB was statistically regarded as significant (Spearman's  $\rho = 0.669$ ,  $p = 0.035$ ). Results were presented using tables to determine students' knowledge regarding PTB at a selected tertiary institution in the Vhembe district of Limpopo (UNIVEN).

#### 2.6. Ethical Consideration

The study adhered to the following ethical considerations: permission to conduct the study, right to privacy, principle of beneficence, principles of anonymity and confidentiality and non-maleficence. Informed consent was obtained from all respondents before the start of the questionnaire based on the objectives of the study. An Ethical Clearance Certificate with the Ethical Clearance number: SHS/20/PDC/33/0508 was granted.

### 3. Results

#### 3.1. The Socio-Demographic Profile, Student Knowledge of PTB and Distribution Based on Age and Gender

The socio-demographic profile, student knowledge of PTB and distribution based on age and gender were studied. The findings are reported based on the objective of this study. A total of 199 students from the University of Venda freely agreed to participate in the

study. Table 2 depicts students' frequency and percentage distribution with demographic variables such as age, gender, level of study, name of residence and place of origin. The findings revealed that most students (49.7%) were of the age group of 17–20 years, followed by 32.7% of the age group of 21–25 years and 15% and 2.6% were of the age group of 26–30 and 31–35 years, respectively, mostly postgraduates. Gender distribution of students indicates that 148 (74.4%) were female and 51 (25.6%) were male. This also explains that most students who visit the Campus Health clinic frequently are females compared to their male counterparts.

**Table 2.** Socio-demographic profile and characteristics distribution of students.

Variables	Frequency	Percentage
<b>Age</b>		
17–20	99	49.7%
21–25	65	32.7%
26–30	30	15.0%
31–35	5	2.6%
<b>Gender</b>		
Male	51	25.6%
Female	148	74.4%
<b>Level of Study</b>		
1st	27	13.6%
2nd	40	20.1%
3rd	79	39.7%
4th or Honours	51	25.6%
Masters	1	0.5%
PhD	1	0.5%
<b>Name of residence</b>		
New Residence	58	29.1%
F4	45	22.6%
Lost City	34	17.1%
F3	18	9%
Mango Groove	17	8.5%
F5	12	6%
Carousel	7	3.5%
Bernard Ncube	4	2%
Riverside	3	1.5%
River Estate	1	0.5%
<b>Place of origin</b>		
Limpopo	139	69.8%
Mpumalanga	47	23.6%
Zimbabwe	6	3%
Gauteng	4	2%
Eastern Cape	1	0.5%
KZN	1	0.5%
North-West	1	0.5%

*N* = 199.

The distribution of students' level of the study shows that 39.7% were in the third year, 25.6% were in the fourth year, 20.1% were in the second year, 13.6% were in the first year, followed by those who were in the Masters and PhD level by 0.5% each. Regarding residences, those inhabited were on-campus accommodations. Most of the students (29.1%) were residing at the new residence, 22.6% were at F4, 17.1% reported staying at Lost City, 9% living at F3, 8.5% stayed at Mango Groove, 6% at F5, 3.5% at Carousel, 2% at Bernard Ncube; then 1.5% Riverside and 0.5% at River Estate. Regarding the place of origin of students, 69.8% were from Limpopo, 23.6% were from Mpumalanga, 3% were from Zimbabwe, 2% from Gauteng and lastly, Eastern Cape, KZN and Northwest had had 0.5%, respectively. Study respondents were expected to respond to questions such as the causes of TB, the knowledge of signs and symptoms of TB, the risk factors of TB, if TB is curable, knowledge

of the best test to diagnose TB, knowledge of the treatment of an ordinary TB and their knowledge on measures to prevent TB.

Regarding the distribution to age and gender (Table 3), the results indicate that the highest percentage was among female students at age group 17–20 years (31.1%) and 26–30 years (11.0%), while at the same time the lower percentage was also among female aged 31–35 years (0.6%). There was a highly significant association between the age and gender of students regarding their knowledge of PTB.

**Table 3.** Students’ knowledge of PTB according to age and gender.

Variables Age	Gender				Total	
	Male		Female		Frequency	Percentage
	Frequency	Percentage	Frequency	Percentage		
17–20	37	18.6	62	31.1	99	49.7%
21–25	46	23.1	19	9.6	65	32.7%
26–30	8	4.0	22	11.0	30	15.0%
31–35	4	2.0	1	0.6	5	2.6%
<b>Total</b>	<b>51</b>	<b>25.6%</b>	<b>148</b>	<b>74.4%</b>	<b>199</b>	<b>100.0</b>

The distribution of PTB knowledge and its association with students’ demographic data on gender and students’ residence is presented in Table 4. Results revealed that 40.8% agreed, especially female students with 22.7% compared to their male counterparts with 18%; and 37.7% strongly agreed that TB is caused by Mycobacterium Tuberculosis, with male students more knowledgeable with 20.7% while females with 17%; 14% were neutral, 2% disagreed while 5.5% strongly disagreed. The respondents had a decent knowledge of the agent that causes TB. However, the distribution of students’ Knowledge from their place of residence showed that the highest percentage of PTB knowledge was among students living at the F4 residence, who agreed with 14% and those living at the new residence, who strongly agreed with 15%. There was a significant association between gender and name of students’ residence regarding their knowledge of PTB, especially female ones.

**Table 4.** Distribution of PTB knowledge and its association with students’ demography.

Variables	TB Is Caused by Mycobacterium Tuberculosis					Frequency	Percentage
	SD	D	N	A	SA		
<b>Gender</b>							
Male	7 (3.5%)	0 (0.0%)	18 (9.0%)	36 (18.0%)	41 (20.7%)	102	51.2
Female	4 (2.0%)	4 (2.0%)	10 (5.0%)	45 (22.7%)	34 (17.0%)	97	48.8
	<b>11 (5.5%)</b>	<b>4 (2.0%)</b>	<b>28 (14.0%)</b>	<b>81 (40.8)</b>	<b>75 (37.7%)</b>	<b>199</b>	<b>100.0</b>
<b>Name of residence</b>							
F3	4 (2.0%)	0 (0.0%)	0 (0.0%)	7 (3.5%)	7 (3.5%)	18	9.0
F4	0 (0.0%)	0 (0.0%)	4 (2.0%)	28 (14.0%)	13 (6.6%)	45	22.6
F5	0 (0.0%)	0 (0.0%)	3 (1.5%)	9 (4.5%)	0 (0.0%)	12	6.0
Carousel	0 (0.0%)	1 (0.5%)	2 (1.0%)	4 (2.0%)	0 (0.0%)	7	3.5
New Residence	2 (1.0%)	0 (0.0%)	10 (5.0%)	16 (8.0%)	30 (15.0%)	58	29.1
Lost City	1 (0.5%)	2 (1.0%)	5 (2.5%)	6 (3.0%)	20 (10.0%)	34	17.1
Mango Groove	3 (1.5%)	1 (0.5%)	3 (1.5%)	7 (3.5%)	3 (1.5%)	17	8.5
Bernard Ncube	1 (0.5%)	0 (0.0%)	1 (0.5%)	1 (0.5%)	1 (0.5%)	4	2.0
Riverside	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (1.0%)	1 (0.5%)	3	1.5
River Estate	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (0.5%)	0 (0.0%)	1	0.5
	<b>11 (5.5%)</b>	<b>4 (2.0%)</b>	<b>28 (14.0%)</b>	<b>81 (40.8%)</b>	<b>75 (37.7%)</b>	<b>199</b>	<b>100.0</b>

SD: Strongly Disagree; D: Disagree; N: Neutral; A: Agree; SA: Strongly Agree.

3.2. The Students' Knowledge on Pulmonary Tuberculosis (Signs and Symptoms), Knowledge about Risk Factors of TB and Knowledge about TB Prevention Risk Factors of PTB on Students

The students' knowledge on pulmonary tuberculosis (signa and symptoms), knowledge about risk factors of TB and knowledge about TB prevention were studied in Table 5. On the students' knowledge on pulmonary tuberculosis, students were asked about the transmission, signs, symptoms and curability of TB. Only 87.4% agreed in terms of transmission that TB is transmitted from one person to another, while 5% were neutral and 7.5% disagreed. This means that respondents had appropriate knowledge and understanding of TB transmission dynamics. Furthermore, 87.5% of the respondents who both agreed and strongly agreed affirmed that 'coughing for more than three weeks, night sweating, losing weight and chest pains are the signs and symptoms of TB; however, 2.5% disagreed with the question while 10% were neutral about the statement. The majority understand the signs and symptoms of TB, which implies that respondents have adequate knowledge of the subject. This could be due to educational programmes from public healthcare. The result also indicated that TB is curable according to 27.1% who agreed, 54.3% strongly agreed, 14.1% were neutral, whereas 3.5% strongly disagreed and 1% disagreed. The results show that respondents had a sound knowledge about the cure of TB. One can speculate that the subject is now common to almost everyone.

**Table 5.** Students' knowledge regarding Pulmonary Tuberculosis (signs and symptoms), knowledge about risk factors of TB and knowledge about TB prevention.

Variables	Knowledge Regarding Pulmonary Tuberculosis (Signs and Symptoms)					Frequency	Percentage
	SD	D	N	A	SA		
TB is transmitted from one person to another through coughing and sneezing	12 (6.0%)	3 (1.5%)	10 (5.0%)	56 (28.1%)	118 (59.3%)	199	100.0
Coughing for more than three weeks, night sweating, losing weight and chest pains are the signs and symptoms of TB	4 (2.0%)	1 (0.5%)	20 (10.0%)	60 (30.2%)	114 (57.3%)	199	100.0
TB is curable	7 (3.5%)	2 (1.0%)	28 (14.1%)	54 (27.1%)	108 (54.3%)	199	100.0
Knowledge about risk factors for TB							
Variables	SD	D	N	A	SA	Frequency	Percentage
Squatting and overcrowding	14 (7.0%)	17 (8.5%)	39 (19.6%)	55 (27.7%)	74 (37.1%)	199	100.0
Smoking	12 (6.0%)	7 (3.5%)	21 (10.6%)	65 (32.7%)	94 (47.2%)	199	100.0
HIV Positive people	31 (15.6%)	24 (12.1%)	30 (15.1%)	44 (22.1%)	70 (35.1%)	199	100.0
Diabetes Mellitus	33 (16.6%)	26 (13.0%)	48 (24.1%)	58 (29.1%)	34 (17.1%)	199	100.0
Kissing	32 (16.1%)	37 (18.6%)	51 (25.6%)	41 (20.6%)	38 (19.1%)	199	100.0
Knowledge about TB prevention							
Variables	SD	D	N	A	SA	Frequency	Percentage
Proper coughing techniques	11 (5.5%)	9 (4.5%)	13 (6.5%)	62 (31.2%)	104 (52.3%)	199	100.0
Avoiding overcrowding	14 (7.0%)	9 (4.5%)	21 (10.6%)	63 (31.7%)	92 (46.2%)	199	100.0
Proper spitting technique	14 (7.0%)	8 (4.0%)	34 (17.1%)	55 (27.7%)	88 (44.2%)	199	100.0
Early diagnosis and treatment	11 (5.5%)	4 (2.0%)	14 (7.0%)	62 (31.2%)	108 (54.3%)	199	100.0
Eating a balanced diet	10 (5.0%)	9 (4.5%)	26 (13.1%)	70 (35.2%)	84 (42.2%)	199	100.0

Regarding the question raised about the knowledge of the risk factors of TB, the findings displayed in Table 5 showed that 37.1% of the respondents strongly agreed and 27.7% of the respondents agreed, respectively, that 'squatting and overcrowding' is a risk factor for TB, followed 19.6% who were neutral. In comparison, 8.5% disagreed and 7% strongly disagreed. Concerning 'smoking', approximately half of the respondents, 47.2%, strongly agreed and 32.7% also agreed that smoking increases the risk of contracting TB, followed by 10.6% who were neutral, followed by 6% who strongly disagreed and 3.5% who disagreed about smoking being a risk factor. In line with HIV-positive people, out of 199 respondents, 35.1% strongly agreed and 22.1% agreed. 15.1% of respondents were neutral, while 12.1% and 15.6% disagreed and strongly disagreed that being HIV positive is a risk factor for contracting TB. As depicted in Table 5, out of the respondents, 29.1% agreed and 24.1% were neutral, followed by 17.1% of respondents who strongly agreed. 16.6% of the respondents strongly disagreed and 13% disagreed that diabetes mellitus increases the risk of TB. Considering kissing as a risk factor, 25.6% of the respondents were

neutral, followed by 20.6% and 19.1%, who, respectively, agreed and strongly disagreed that kissing is a risk factor. The techniques to prevent the spread of TB are equally shown in Table 5. The majority, 52.3%, strongly agreed and 31.2% agreed that proper coughing techniques could prevent TB transmission, while 6.5% were neutral, 4.5% disagreed and 5.5% strongly disagreed on the matter. Among the techniques, 46.2% strongly agreed and 31.7% agreed, followed by 10.6% neutral respondents. However, 4.5% disagreed and 7% strongly disagreed, respectively, that avoiding overcrowding prevents the transmission of TB. Regarding spitting, 44.2% strongly agreed and 27.7% agreed on one hand, while 17.1% were neutral. Whereas on the other hand, 4% disagreed and 7% strongly disagreed that proper spitting prevents the spread of TB.

Moreover, respondents were asked to indicate their views on 'early diagnosis and treatment'. A vast majority strongly agreed, with 54.3% and 31.2%, while only 7% were neutral, but only 2% disagreed and 6% strongly disagreed. Additionally, on eating a balanced diet as one of the prevention techniques, most of the respondents agreed strongly with 42.2% and 35.2% agreed, followed by those who were neutral on eating a balanced diet with 13.1%. Among them, 4.5% disagreed and 5% strongly disagreed about eating a balanced diet being a preventive technique for TB.

#### 4. Discussion

In the present study, we assessed the students' knowledge regarding PTB and its causes at the rural institution of higher learning at Vhembe District of Limpopo Province, South Africa. This study supported by [13] report that TB might be significantly prevalent at universities. Despite the level of TB knowledge among the medical students was higher than among nursing students at 15 Italian universities, there is still a lack of data and empirical studies on students' knowledge of TB, and very little is available in Limpopo, especially at the University of Venda, confirming that TB is prevalent in universities. This confirms that universities are places where TB is contracted and as well as an assessment of the knowledge of students regarding PTB and its causes at the rural institution of higher learning, especially in South Africa. Thus, Ref. [17] emphasized that early disease detection correlates with public awareness. Further, continuous knowledge and attitude improvement towards TB is vital for TB control. Therefore, knowledge of TB is significantly associated with positive attitudes towards treatment and care, prevent disease transmission [18].

Moreover, the results of this study showed that a lack of accurate information about the cause of PTB among students still exists, as supported by [19]. The major results of this study revealed that 59.3%, 57.3% and 54.3% of students have basic knowledge regarding PTB on the one hand. In contrast, on the other hand, there is insufficient knowledge regarding the causes of PTB among students at the selected tertiary institution. Moreover, students need public health education campaigns to increase their knowledge on PTB, and non-medical Univen students have insufficient knowledge about PTB. Further, the results also revealed that there is a moderate positive correlation between education and knowledge of PTB among students.

Centred on students' knowledge regarding PTB, this discussion was based on assessing students' knowledge of PTB and its causes at the rural institution of higher learning in South Africa. Good knowledge from the respondents demonstrated that TB is transmitted from one person to another through coughing. Furthermore, more than half of the respondents indicated that coughing for more than three weeks, night sweating, losing weight and chest pains are the signs and symptoms of PTB.

Contrary to previous studies of high school students conducted in China by Zhang et al. [20] on their experiences with PTB, the authors indicated that these students generally lacked awareness of TB. In Bangladesh, Ref. [6] indicated that nearly half of the students knew that TB is a communicable disease and spread from person to person as they heard the term TB from various sources, such as electronic media and print media, relatives and friends. A remarkable number of students at the University of Rajshahi had no knowledge

on TB as a communicable disease. Lesser involvement of students in TB-related sessions, meetings or workshops indicated a lack of knowledge [6].

In Indonesia, Ref. [21] mentioned that one causing factor in the high incidence of TB is the lack of students' knowledge about TB, with a particular mention on the lack of knowledge due to the cause, prevention, transmission and symptoms of TB resulting in poor behaviour seeking treatment. However, a high burden of PTB was found among students, reflecting the high TB prevalence at Ethiopian universities. Moreover, students spent a great deal of time in crowded lecture rooms, libraries and dining halls with hundreds to thousands of students [11,22] Thus, Ref. [11] suggested that certain university characteristics may have increased PTB risk due to statistically significant differences in PTB prevalence between universities. This could also be a risk for the University of Venda and requires further investigation. According to the [23] even though all age groups are at risk of being affected with TB, it affects mostly adults in their most productive years. Moreover, alcohol use disorder and tobacco smoking increase the risk of TB disease by a factor of 3.3 and 1.6, respectively. So, students at UNIVEN are still in their productive years and sexually active.

Regarding the risk factors of TB, it was observed by the researchers that 37.1% of students had sound knowledge that poor living conditions such as squatting and overcrowding increase TB risk. In addition, smoking increases the risk of contracting TB by 47.2%, which could be due to educational programmes delivered by public healthcare players. Surprisingly, approximately 35.1% of the students were unaware that HIV-positive individuals are at a higher risk of contracting TB. Hence, they have no decent knowledge of HIV as a risk factor for TB. About 17.1% of students do not have sufficient awareness regarding diabetes mellitus. Furthermore, 19.1% of students have no sound acquaintance that TB is not spread through kissing, which implies that they are not aware that the TB bacteria are spread through the air from one person to another.

Concerning knowledge about TB prevention, 52.3% of the respondents have solid knowledge concerning proper coughing as a prevention technique. Similarly, 46.2% have a sound awareness of the technique of avoiding overcrowding. About 44.2% of the respondents understand that spitting can promote the spread of the disease, which implies that 3 out of 10 people are unaware of the effect of spitting. This implies that respondents have good knowledge of the subject. About 42.2% of the study reveals that participants have good knowledge concerning a balanced diet and the prevention of TB.

In this study, the relationship between education and knowledge of TB, the Spearman's correlation and its significance value were computed, and most of respondents mentioned that the deficiency in knowledge about PTB transmission modes, therapy, clinical signs and symptoms and causes of PTB could promote the spread of the disease at the University of Venda, which was coherent with study conducted by [6]. Illustrating that non-medical university students have insufficient knowledge about PTB, which was what this study also confirmed.

The researchers estimate that universities are highly compacted settings where most students attending their higher education are at their productive years, and most of them abuse substances while at higher education institutions, especially in South Africa. This could continue to affect students, especially those from key remote areas concerning this deadly disease. Although the SA government has made considerable progress in improving the diagnosis of pulmonary tuberculosis and extra-pulmonary TB (EPTB), as highlighted by [24] many university students lack adequate knowledge of the disease.

This study does not only contribute to the existing body of knowledge on students' knowledge regarding PTB at a selected tertiary institution in general but also brings new knowledge specifically for such a rural-based higher institution of learning in the Vhembe District such as UNIVEN. Adding to this, the relationship between the University, Campus Health and the government sought to be improved.

The study results showed that knowledge is important for reducing PTB infections among the stakeholders, such as students and lecturers, from being affected with PTB. Furthermore, hostel allocation should be carried out per the number required in the residences,

following the policy during room allocation. Residence monitoring should continue to avoid overcrowding and squatting. The budgetary allocation from the government may be used cost-effectively, reducing the burden on the management of PTB cases. No money would be spent on PTB medications because of fewer TB cases. The outcome of this study shows that students' knowledge regarding PTB is significant to benefit their health and be free from PTB infection, as they are knowledgeable about the prevention, causes, clinical manifestations, management and its complications. The result also indicated that TB is curable according to 27.1% who agreed, 54.3% strongly agreed, 14.1% were neutral, whereas 3.5% strongly disagreed and 1% disagreed. The results show that respondents had a sound knowledge about the cure of TB. One can speculate that the subject is now common to almost everyone.

## 5. Strength and Limitations of the Study

### 5.1. Strength

Efforts were made during the COVID-19 pandemic in this study to assess students' Knowledge about PTB at the University of Venda in the Limpopo Province of South Africa.

### 5.2. Limitations

Two limitations were observed by the researchers in this study. Firstly, the findings of this study cannot be generalised because only on-campus students were interviewed whilst excluding off-campus students. Secondly, the COVID-19 disease pandemic had affected the study negatively by delaying the data collection process, as well as limiting the budget.

## 6. Conclusions

The current study established that students at UNIVEN (a higher educational institution) lacked sufficient general understanding regarding PTB. Moreover, a substantial decrease in TB service delivery on-campus was caused due to the COVID-19 pandemic. So, students at UNIVEN are still in their productive years and sexually active. Regarding the risk factors of TB, it was observed by the researchers that 37.1% of students had sound knowledge that poor living conditions such as squatting and overcrowding increase TB risk. In addition, smoking increases the risk of contracting TB by 47.2%, which could be due to educational programmes delivered by public healthcare players. Surprisingly, approximately 35.1% of the students were unaware that HIV-positive individuals are at a higher risk of contracting TB. Hence, they have no decent knowledge of HIV as a risk factor for TB. About 17.1% of students do not have sufficient awareness regarding diabetes mellitus. Furthermore, 19.1% of students have no sound acquaintance that TB is not spread through kissing, which implies that they are not aware that the TB bacteria are spread through the air from one person to another.

As a result, to limit TB transmission among students residing at UNIVEN Campus, the University, through its Campus Health clinic, should improve infrastructure, establish and develop effective TB infection control guidelines and policies, including a requirement for PTB screening upon university admission and at regular intervals, will be important to limit TB transmission among students; and then adopt more effective PTB control measures to better implement the Global STOP TB strategy and the NSP in order to achieve a large-scale battle against TB by 2030, as specified in the NDP and SDGs. Further, regular TB training focusing on behaviour change knowledge, attitude and practice and measures toward TB Prevention should be given to students.

## 7. Recommendations

Results from this study should be used to orient tuberculosis control programmes on campus, especially those aimed at mobilizing students for TB awareness, control and eradication. Furthermore, a health education programme is required to improve university students' knowledge of PTB and its causes throughout all campus residences. Furthermore, this paper's results could significantly contribute to the planning and policy level, which

would help develop an effective health education programme, including adopting more effective PTB control measures at the University.

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