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# ASSESSING KNOWLEDGE, ATTITUDES, AND PRACTICES RELATED TO TUBERCULOSIS IN FUTURE HEALTHCARE PROVIDERS: A QUANTITATIVE CROSS-SECTIONAL STUDY

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## ABSTRACT

***Background:*** *Mycobacterium tuberculosis is the causative agent of tuberculosis (TB), the most common infectious agent-related cause of death. The knowledge, skills, and self-efficacy of future healthcare students in managing high-risk groups are crucial to the management of TB.* ***Objective:*** *To assess the knowledge, attitude and practice of the health sciences students regarding TB.* ***Methods:*** *A descriptive cross-sectional study was conducted among health sciences students at a public sector university in Karachi from February to May, 2025. Students enrolled in accredited health science programs including medicine, nursing, pharmacy and public health related disciplines were considered for the study while those pursuing non–health science fields were excluded. A standardized questionnaire assessed demographically, TB knowledge, attitudes, and preventive practices. Stratified random sampling was used to gather data from 391 participants, sample size calculated by using OpenEpi version 3.01. SPSS version 26 was used to analyze the data.* ***Results:*** *Despite a high level of understanding about TB symptoms and transmission, noticeable gaps were found. Preventive practices were uneven, with 59.8% seeking medical attention for persistent coughs and 67.5% reporting mask use. Formal education was a significant knowledge source, with 54% learning about TB from college. Nursing and medical students were more knowledgeable about airborne transmission (p = 0.010). Timely healthcare seeking was associated with mask effectiveness belief (p = 0.0006).* ***Conclusion:*** *Despite strong baseline knowledge, behavioral and attitude gaps persist. Focused anti-stigma initiatives and TB control teaching in medical curricula are crucial. Expanding awareness efforts to non-medical peers could strengthen community-level TB control.*

***Keywords:*** *Tuberculosis, BCG, GeneXpert, MDR–TB, LTBI*

## INTRODUCTION

Mycobacterium tuberculosis (MTB), a highly effective pathogen that mostly infects the lungs and causes the characteristic symptom of pulmonary TB, is the causative agent of tuberculosis (TB), a communicable infectious illness. A condition known as extra pulmonary

tuberculosis can also impact all other organs and tissues, such as the brain, kidneys, spine, and lymph nodes (1). Since health sciences students works on the front lines of healthcare delivery and are regularly in contact with patients who have infectious TB disease, nurses are more susceptible to nosocomial TB infection (2). MTB is the causative agent of TB, the most common infectious agent-related cause of death (3). The knowledge, skills, and self-efficacy of healthcare workers in managing high-risk groups are critical to the management of TB (4). Nurses spent more time with the patients than the other HCP since to help nurses understand the importance of information in lowering sickness and death and improving the quality of care, quality control training programs must be put in place (5, 6). Prior studies indicate students attending universities in may be at increased risk for active tuberculosis (TB) relative to the general population, mainly due to the dramatic increase in expansion of the enrollment scale of universities(7).

However, the primary high-risk group for PTB is adolescents between the ages of 19 and 22, the majority of whom are college and university students (8). Enhancing the effectiveness and precision of TB diagnosis aids in the effectiveness in treatment strategies. When patients exhibit traditional symptoms such fevers, night sweats, weight loss, hemoptysis, and a persistent cough, pulmonary tuberculosis should be recognized. There are several ways that extra pulmonary TB manifests itself, including TB lymphadenitis, TB meningitis, laryngeal TB, Pott's disease, and abdominal TB (9). In addition to their occupational exposure, healthcare personnel are more likely to contract tuberculosis. Additionally, if a tuberculosis infection is not recognized in a timely manner, transmission between patients and visitors may occur. Therefore, healthcare professionals' knowledge of tuberculosis and appropriate infection control procedures is crucial (10, 11). Tuberculosis (TB) remains a major global health issue, causing significant morbidity and mortality due to its contagious nature. In 2021, there were an estimated 10.6 million active TB cases, resulting in 1.6 million deaths (12).

Although future health care providers are essential to the management, care, and support of TB patients throughout their treatment, a number of obstacles may prevent them from carrying out their duties effectively. Challenges become more obvious due to their direct and close involvement in the care of patients in environments and their knowledge(13, 14). One of the most fundamental techniques for detecting TB in developing nations is still sputum smear microscopy. Another danger to the global control of tuberculosis is drug-resistant tuberculosis (15). Delays in seeking medical attention are caused by a lack of awareness and inadequate information about the signs of tuberculosis. As a result, raising health care professionals' awareness of TB improves disease control and treatment results. The treatment protocol involved an initial eight weeks of pyrazinamide and ethambutol, followed by 24 weeks of rifampin and isoniazid. Four strategy groups were established for the initial eight weeks, each receiving different combinations: high-dose rifampin with linezolid, high-dose rifampin with clofazimine, rifapentine with linezolid, and bed aquiline with linezolid, all alongside isoniazid, pyrazinamide, and ethambutol. In the rifapentine-linezolid group, ethambutol was replaced with levofloxacin (16, 17). Mycobacterium Vaccine (MV), a rapidly expanding environmental mycobacterium with limited potential for human pathogenicity, was first identified in the milk and dung of cattle (named cow vaccine). A strain of (MV) that was discovered in an area of Uganda and linked to improved protective efficacy of BCG

immune responses to tuberculosis was used to manufacture the vaccine. One of the most fundamental techniques for detecting TB in developing nations is still sputum smear microscopy (18). For active case finding in people living with human immune virus (PLHIV) of all ages, close contacts of TB cases, and other targeted populations. Furthermore WHO, advised four ways of diagnosis the TB, one is clinical correlation secondly AFB smear, chest X-rays with the conjunction of immune response markers like C-reactive protein. (19, 20). TB is treatable and preventable. In contrast to traditional nucleic acid amplification tests, it relies on a single cartridge system that uses automated assays to amplify and detect PCR (Polymerase Chain Reaction) in roughly two hours, needing little biosafety precautions and training (21). Endogenous reactivation and external reinfection are the two main categories of recurrent tuberculosis. While different strains are categorized as external reinfection, people with TB identified with similar strains both before and after recurrence will be regarded as patients suffering endogenous reactivation (22). In order to improve the success of the activities taken by these professionals, nursing work aimed at adhering to disease treatment involves the development of technical, ethical, and, most importantly, political abilities (23, 24).This risk is worsened by the increased exposure of future health care providers to infectious TB patients, especially when there is inadequate implementation of TB infection control (TBIC) (25).This study aimed to assess the knowledge of future health care providers regarding TB.

## METHODOLOGY

### Design and Setting of the study

From February to May, 2025, a cross-sectional descriptive survey was carried out among undergraduate students in Karachi, Pakistan. Students enrolled in nursing, medicine, pharmacy, and other faculties at public colleges provided the data. The sample size was determined using Open Epi Version 3.01, considering the total population, with the following parameters: expected proportion (p) of 0.5, 95% confidence interval, 5% margin of error, and 10% non-response allowance. The calculated sample size was 391, and all participants completed the survey, resulting in a 100% response rate. To guarantee representation throughout academic years 1–4 and study fields (nursing, medical, pharmacy, and other), a stratified proportionate sample technique was employed. Participants were chosen from class lists using basic random sampling within each stratum.

### Eligibility Criteria

All those students, currently enrolled in accredited health sciences programs, including medicine, nursing, pharmacy, dentistry, physiotherapy, public health, and other allied health disciplines were included. On the other hand, students enrolled in non–health sciences programs, such as engineering, business, arts, or law, were excluded from the study. Moreover, students who were missing during data collection, on leave, or who declined to participate in the study were excluded. In addition, those students who refused to give their consent or were not present when the data was being collected were not included.

### Data Gathering Tool

Based on previously released TB tools, a structured, self-administered questionnaire was created and modified for the local environment. There were four sections on the questionnaire: ***Socio-demographic Section***: Age, Gender, Academic Field, Year, Smoking status, and the Source or sources of TB knowledge (Family, Media, College, etc.). ***Information***: 12 items that address vaccination

awareness, extra-pulmonary TB information (e.g., bone involvement), curability, treatment regimen and duration, typical symptoms (cough, fever, weight loss, and night sweats), and awareness of tuberculosis (TB) and its primary route of transmission (airborne). Responses received a score of 1 for being right and 0 for being wrong or unsure. Using a predetermined cut-off, such as ≥75% right, a total knowledge score (range 0–12) was calculated and categorized for analysis (e.g., good vs. poor knowledge).

**Attitudes:** 6–8 statements on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree) that gauge perceived seriousness, perceived vulnerability, stigma in the community, and readiness to assist TB patients (e.g., "I would like to help someone with TB"). Where appropriate, reverse scoring was used, and a composite attitude score was determined. Another binary/ordinal indicator that was taken into consideration was stigma, which was expressed as "perceive community stigma: yes/no."

**Practices:** questions on health-seeking (e.g., "Would you see a doctor if you've been coughing for more than three weeks?"), preventive measures (wearing a mask, using personal hygiene products in public), and what to do if you're diagnosed (speak to your doctor or family). Mask belief was measured as a distinct item (agree, disagree, or don't know). The questionnaire took about 15 to 20 minutes to complete and was available in English.

**Reliability and Validity**

*Validity:* Three subject-matter experts (public health and infectious disease tutors) evaluated and amended the questionnaire items.

*Reliability:* Internal consistency for attitude and practice scales assessed by Cronbach's alpha; acceptable reliability defined as $\alpha \geq 0.70$.

**Gathering data**

Data were collected directly from the selected participants using written questionnaires in classrooms. To minimize missing data, completed questionnaires were collected immediately. All responses were anonymized during the collection process and securely stored.

**Statistical Analysis and Data Management**

SPSS version 26 was used to analyze the data and look for missing values and discrepancies. For categorical variables like frequency (n) and percentage (%), descriptive statistics were employed. Depending on the distribution, continuous variables are reported as median (IQR) or mean ± SD. The results (n = 391) are reflected in the demographic and tables. Composite scores for knowledge, attitude, and practice are calculated as previously mentioned. A priori definitions of knowledge categories, such as good versus poor, were established (for example, ≥75% correct equals good knowledge). For measures of association chi square were used.

**Ethical Considerations**

The assigned Institutional Review Board/Ethics Committee provided ethical approval for the study (*Reference # RC/23/04/221/2025*). Participants were informed about the purpose of the study, and written informed consent was obtained prior to participation. Respondents were allowed to discontinue participation at any moment without any penalty. Data was kept anonymous by allotting a secret ID number. Soft data were kept in the password-protected devices while hard copy data was kept in locker of primary investigator. Referral details for campus health services were given to responders who reported having active TB symptoms.

## *RESULTS*

A total of 391 university students participated in this study. The majority were female (n = 273; 69.8%), and most were from the nursing field (n = 234; 59.8%). Students represented various academic years, with a relatively even spread; 3rd and 4th-year students were the most represented (n = 83 and n = 92, respectively). Most participants were non-smokers (n = 241; 61.6%).

***Table 1:*** *Demographics characteristics of the study participants (n = 391)*

| Variable | Frequency (%) |
|---|---|
| **Gender** | |
| Female | 273 (69.8%) |
| Male | 118 (30.2%) |
| **Field of Study** | |
| Nursing | 234 (59.8%) |
| Pharmacy | 59 (15.1%) |
| Medicine | 72 (18.4%) |
| Other | 26 (6.7%) |
| **Year of Study** | |
| 1st | 42 (10.7%) |
| 2nd | 63 (16.1%) |
| 3rd | 83 (21.2%) |
| 4th | 92 (23.5%) |
| 5th | 52 (13.3%) |
| 6th | 59 (15.1%) |
| **Smoking Status** | |
| Yes | 104 (26.6%) |
| No | 241 (61.6%) |
| Sometimes | 46 (11.8%) |

**Table 2 Knowledge of TB:** Most nursing students had strong baseline knowledge of tuberculosis. 90% had heard of TB, and 88% correctly identified airborne transmission as the main route of spread. A large majority (85.2%) knew TB is curable, and 82.1% recognized that treatment involves specific medications. Around 71% could name at least three TB symptoms, while 68% understood that treatment lasts 6–12 months. Awareness of the TB vaccine (56%) and knowledge that TB can affect the bones (43.7%) were relatively lower. Attitudes toward TB**.** Students generally held serious attitudes toward the disease. Nearly 78% viewed TB as a very serious health issue, and 65% believed they were personally at risk. Despite this, only 29.9% expressed a desire to help people with TB, and 48.1% acknowledged existing stigma in their communities. Just 33.8% felt well-informed, but two-thirds (65.5%) wanted to learn more. TB-Related Practices**.** Regarding health-seeking and prevention behaviors, 59.8% of students reported they would immediately visit a doctor if they experienced a persistent cough lasting over three weeks. About 70% said they use hygiene products in public spaces, and 67.5% agreed that masks can prevent airborne disease spread. 54% had learned about TB through college, and 79.8%

would speak to a doctor or family member if diagnosed.

**Table 2:** Knowledge, Attitude and Practice of health care professionals regarding TB

| Category | Variable | Frequency (%) |
|---|---|---|
| **Knowledge** | Heard of TB | 352 (90.0%) |
| | Knows airborne transmission | 344 (88.0%) |
| | Knows TB is curable | 333 (85.2%) |
| | Knows treatment is specific medication | 321 (82.1%) |
| | Recognized ≥3 TB symptoms | 277 (70.8%) |
| | Knows treatment lasts 6–12 months | 265 (67.8%) |
| | Aware of TB vaccine | 219 (56.0%) |
| | Knows TB can affect bones | 171 (43.7%) |
| **Attitude** | Think TB is very serious | 305 (78.0%) |
| | Believe they could get TB | 254 (65.0%) |
| | Feel compassion/desire to help | 117 (29.9%) |
| | Perceive community stigma | 188 (48.1%) |
| | Feel well-informed | 132 (33.8%) |
| | Want more TB information | 256 (65.5%) |
| **Practice** | Would go to doctor if coughing >3 weeks | 234 (59.8%) |
| | Use hygiene products in public | 273 (69.8%) |
| | Believe mask helps prevent airborne spread | 264 (67.5%) |
| | Learned about TB from college | 211 (54.0%) |
| | Would talk to family/doctor if diagnosed | 312 (79.8%) |

**Figure 1:** Association between belief in masks and action taken when experiencing TB Symptoms

A significant association was found between students' belief in the effectiveness of masks and their likelihood of seeking medical attention when experiencing TB-related symptoms ($\chi^2 = 14.62$, df = 2, p = 0.0006). As shown in **Figure 1,** students who believed that masks help prevent airborne diseases were much more likely to report that they would visit a doctor immediately if they had a persistent cough or TB-like symptoms (208 out of 264). In contrast, those who did not believe in masks were far more likely to delay care or attempt self-treatment, with only 22 out of 69 opting for immediate medical attention.

This finding suggests that accurate understanding of infection prevention methods (like mask use) is linked to more proactive health-seeking behaviors, highlighting a critical connection between knowledge and responsible practice.

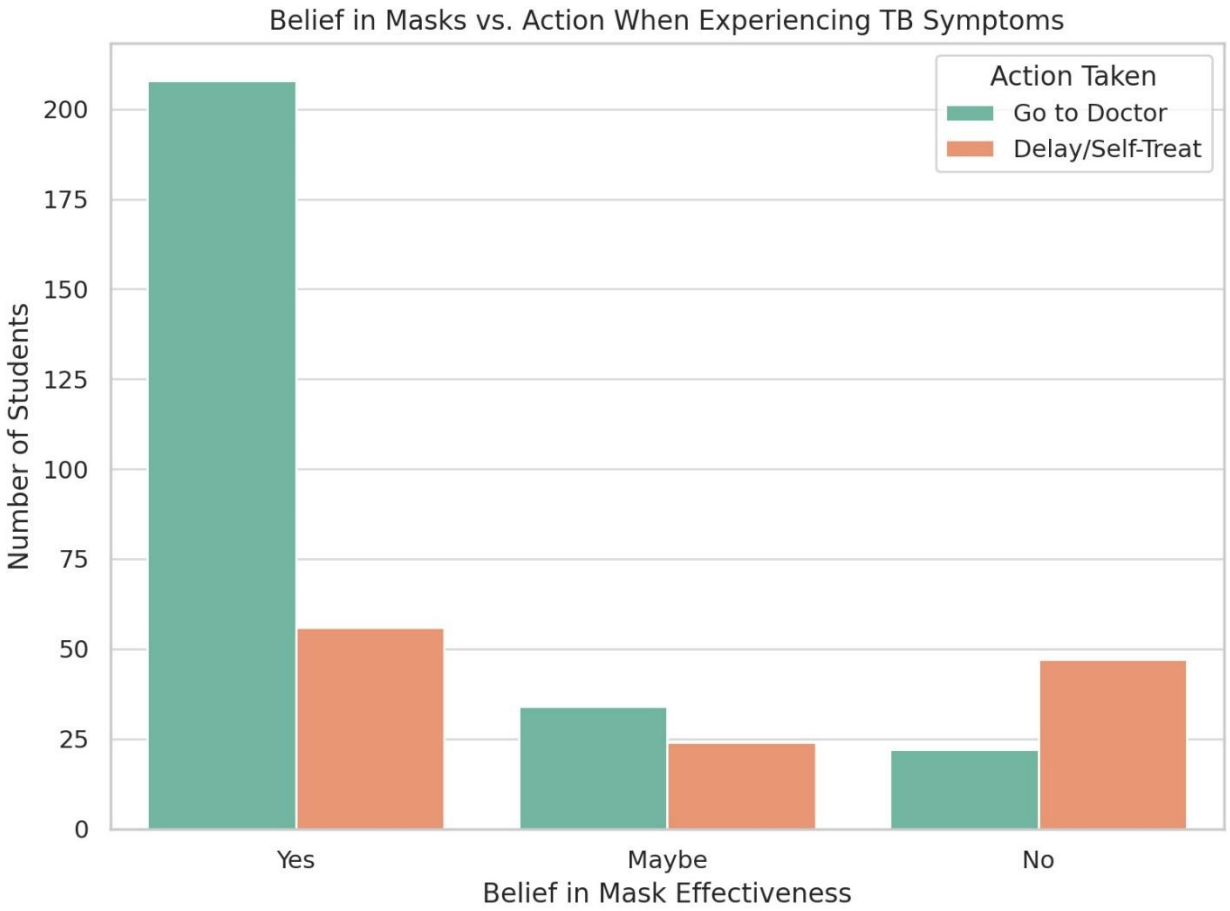


**Figure 1:** Association between belief in masks and action taken when experiencing TB Symptoms

**Figure 2** Association between field of study and knowledge that TB is airborne

A second significant relationship was observed between students' academic field and their knowledge of how TB is transmitted ($\chi^2$ = 11.28, df = 3, p = 0.010). Figure 2 shows that students from the medical fields—particularly medicine and nursing—were far more likely to correctly identify that TB spreads through airborne droplets (70 out of 72 medicine students, and 200 out of 234 nursing students). In contrast, knowledge levels were notably lower among students from non-medical or allied health fields.

This finding emphasizes the role of formal medical education in improving factual understanding of TB transmission routes and supports targeted education efforts in less-informed student populations.

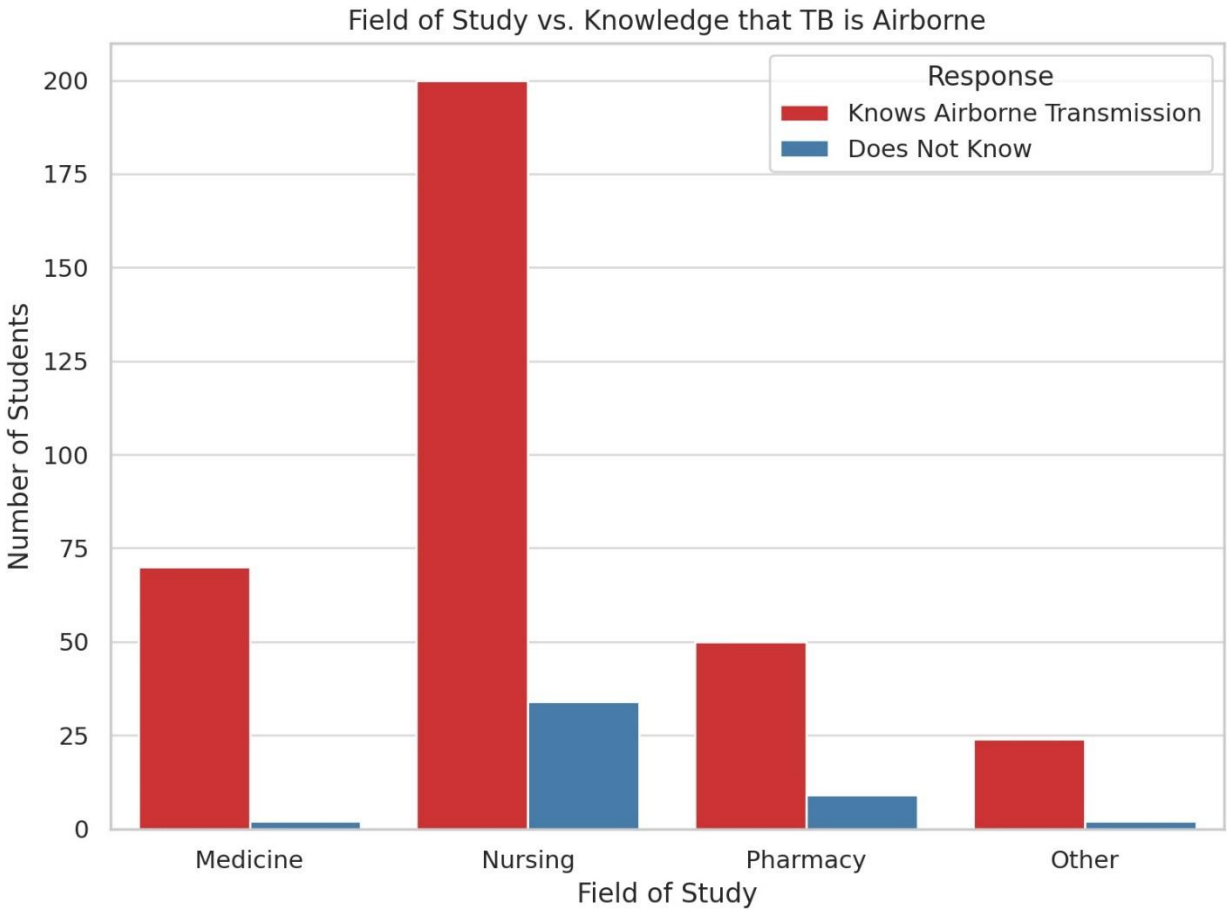


**Figure 2** Association between field of study and knowledge that TB is airborne

## DISCUSSION

This study explored the knowledge, attitudes, and practices of university students predominantly from nursing and other health-related fields regarding tuberculosis (TB). The findings reveal generally strong baseline knowledge, with notable gaps in certain areas, and show important associations between beliefs, education, and preventive practices. According to comparable surveys conducted among health science students in poor nations, the majority of students showed a good degree of awareness on the causes, modes of transmission, curability, and treatment of tuberculosis. (85.2%) of respondents was aware that tuberculosis is curable, and the majority (88%), correctly identified airborne transmission. However, less than half recognized that TB can harm bones, and only (56%) were aware of the TB vaccine. These discrepancies can be the result of a curriculum that places more emphasis on pulmonary TB and less on extra-pulmonary types and vaccination against them. Research studies, conducted in Ethiopia and Pakistan has also shown a high level of general awareness but a lack of understanding of less common symptoms and ways to prevent them. This implies that more thorough TB education is required, even in health-related sectors. The majority of participants thought they were individually at risk (65%) and saw tuberculosis as a critical public health issue (78%), respectively which is in line with prior findings that indicate health students consider

infectious diseases as potential workplace dangers (26, 27).

However, nearly half acknowledged the stigma in the community, and only (29.9%) said they wanted to support those who have TB. These results point to a troubling attitude gap: despite high levels of awareness, stigma and a lack of desire to interact with TB patients may make it more difficult for patients to receive assistance and stick with their treatment plans. Anti-stigma education ought to be incorporated into health curriculum, as previous research has demonstrated that stigma still poses a barrier, even for healthcare trainees. Mixed preventative and health-seeking behaviors were found in the study. Similarly, a study has been done in Dalian where more than (57%) of medical students had negative opinions about TB patients. Notably, discrimination was reduced among students who had directly known someone with TB or who had received official TB instructions (28).

Even while (59.8%) of people would see a doctor if their cough lasted longer than three weeks, a sizable percentage might put off getting help. While not universal, preventive measures including wearing masks (67.5%) and utilizing hygiene products in public (70%) were widespread. Only (54%) of respondents said they heard about tuberculosis from college, which emphasizes the value of formal education over unofficial or inadvertent sources. Another study results aligned with this study results conducted in University Students in Jordan where (40%) said they always used personal hygiene products in public, while (43.9%) said they did so occasionally. Remarkably, many people did not think that masks prevented airborne illnesses (15.9%) or were not sure (25.1%) (29).

Pupils who thought masks prevented airborne illness were significantly more likely to get help quickly if they experienced symptoms similar to tuberculosis ($p = 0.0006$). According to the Health Belief Model, which holds that action is influenced by perceived advantages, this supports the theory that a thorough understanding of infection control leads to improved personal preventive action.

The relationship between HBM components and TB preventive behaviors and care-seeking intentions was investigated in a cross-sectional study conducted in China assessed the preventive measures including covering one's mouth when coughing ($\beta = 0.24, 0.33$) and avoiding other people's coughs ($\beta = 0.13, 0.25$) were strongly predicted by knowledge and perceived benefits(30). Students in nursing and medical programs were substantially more likely to be aware that TB spreads through airborne droplets ($p = 0.010$), highlighting the role that professional education plays in forming disease knowledge. According to this research, community-level TB control may be enhanced by focused awareness programs for non-medical students. On the other hand, another study in Saudi Arabian University reported that students in healthcare disciplines were familiar with a great deal more about TB-related issues, such as symptoms, treatment, and transmission through coughing or breathing. For example, compared to 47.5% of non-healthcare students, (72.3%) of healthcare students were aware that airborne TB transmission occurs (31).

**Conclusion**

The study findings concluded that students demonstrated strong knowledge and awareness of tuberculosis, particularly in the medical domain. However, there are still gaps in our understanding of vaccines, extra-pulmonary TB, and stigma. Early detection, prevention, and compassionate treatment for TB patients may be improved by educational initiatives that cover these areas, especially for non-medical students.

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