**RESEARCH**
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# FACTORS AFFECTING KNOWLEDGE, AWARENESS, AND PRACTICE PARAMETERS OF TUBERCULOSIS AMONG PATIENTS WITH PULMONARY TUBERCULOSIS IN NORTH INDIA

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**Abstract**
Background: Knowledge, awareness, and practice parameters regarding tuberculosis (TB) are crucial factors for checking the spread of TB. We assessed the knowledge, awareness, and healthcare-related practices concerning TB among patients with pulmonary tuberculosis (PTB) and the factors influencing them. Methods: Two hundred patients with PTB comprising cases on treatment exceeding one month, new cases, and previously treated cases were assessed for the knowledge, awareness, and healthcare-related practice parameters regarding TB at a referral hospital in Uttarakhand in North India. Results: Forty-one percent of patients had good awareness, 42.5% had good knowledge whereas 45% had good healthcare-related practice scores regarding TB. Literacy status ($p < 0.0001$) and type of case (new/old) ($p < 0.0001$) were important determinants for awareness whereas residence (rural/urban) ($p = 0.02$), literacy status ($p < 0.0001$), socio-economic status ($p = 0.001$) and type of case ($p = 0.0002$) were important determinants for knowledge. Residence ($p = 0.016$), literacy status ($p < 0.0001$), socio-economic status ($p = 0.040$) and type of case ($p = 0.030$) were important determinants for healthcare-related practices. Literacy status ($p = 0.037$) and type of case ($p < 0.0001$) were independent predictors for awareness of TB whereas type of case ($p = 0.025$) was an independent predictor for knowledge. Literacy status ($p = 0.006$) was an independent predictor for healthcare-related practices. Conclusions: Knowledge, awareness, and healthcare-related practices regarding TB lack among the majority of patients with PTB and require urgent improvement to curtail the spread of TB. Literacy and type of case were important determinants of awareness, knowledge and healthcare-related practices.
Keywords: Awareness; Knowledge; Practice; Tuberculosis; India

## Introduction

Worldwide, tuberculosis (TB) is a leading cause of death. TB was responsible for a total of 1.5 million deaths in 2020 and was the second foremost infectious killer after coronavirus disease (COVID-19) [1].

For raising the level of awareness, diagnosis, and treatment of TB, the directly observed treatment short-course (DOTS) strategy was implemented by the World Health Organization (WHO). In spite of the implementation of the WHO's recommended "Stop TB Strategy", and DOTS by the Revised National Tuberculosis Control Program (RNTCP) to address the emerging issues and challenges in TB control, people are unaware of medical facilities for TB in many places in India [2]. Improvement in TB diagnosis, treatment, and control efforts worldwide over the past decade has been associated with improvements in TB control in many parts of the world. This progress has been affected considerably by the HIV-1 epidemic, the growing drug resistance challenge, and other important epidemiological factors that continue to sustain the TB epidemic [3]. Moreover, the impact of the COVID-19 pandemic alone has led to a reversal of years of global progress in reducing TB mortality, with the estimated number of deaths in 2020 back to the level of 2017 [1].

Drug-resistant TB is an important public health issue in many developing countries, as treatment is longer and requires more expensive drugs. According to WHO estimates, multidrug-resistant (MDR)/rifampicin-resistant (RR)-TB was detected in 3.3% of new and 18% of previously treated TB cases occurring globally in 2019, which draws closer to about half a million new cases of MDR/RR-TB [4, 5]. The magnitude of the problem is more in developing countries like India, where 49679 MDR/RR-TB patients, including 21613 multidrug and extensively drug-resistant TB (M/XDR-TB) patients were diagnosed during 2020 [6].

Default is considered one of the unfavorable outcomes for patients receiving DOTS and is an important challenge for the TB control program. Inadequate adherence to treatment is regarded as a potential cause of drug resistance [7].

Gender, alcoholism, poor knowledge of TB, treatment after default [8], socioeconomic status, and irregular treatment are some of the factors associated with higher default rates [9]. Non-completion of treatment may also be due to factors related to the disease, patients, and service providers [10]. The other risk factors playing a vital role in treatment default are age, gender (males are more affected than females) [11], overcrowding in the urban area, and distance factors in rural areas [12].

Given excessive morbidity and mortality associated with TB and the emergence of MDR–TB and extremely drug-resistant TB, the community must be aware of the importance of checking the spread of this disease and the need for proper treatment of TB patients. Gaining an insight into the psychology of community also can help in this regard.

Therefore, this study was planned to assess the knowledge, awareness, and healthcare-related practices concerning TB among pulmonary tuberculosis (PTB) patients which may help plan the strategies to control this disease.

## Methods

This was a hospital-based observational study conducted from January 2017 to December 2020 in a tertiary care hospital catering to the health care needs of the population residing in Uttarakhand in India. Uttarakhand is mainly a hilly state, situated at the foothills of the Himalayan Mountain ranges in the northern part of India. Uttarakhand has a population of 11.9 million (69.77% living in rural areas).

The study was performed in accordance with the Declaration of Helsinki. Ethical clearance for this study was obtained from the institutional ethics committee. Patients of pulmonary tuberculosis (PTB) attending medical/chest OPD or admitted in medical/chest wards in the Himalayan Institute Hospital, Dehradun, India were randomly selected for the study after obtaining written informed consent from the patients.

All the patients included in the study were asked questions regarding their knowledge, awareness, and health-seeking practices concerning TB as per special pro forma. The questions in the questionnaire covered information on the socio-demographic characteristics of the respondent's knowledge and awareness regarding TB including its signs and symptoms, mode of spread, cause, investigations and treatment, prevention methods, choice of treatment facilities for TB, and health-seeking practices towards TB. For each knowledge, awareness, and health-related practice question concerning TB, a score of one was awarded for a correct response and a zero score for the incorrect or 'do not know' response. Questions concerning knowledge, awareness, and practice parameters were rated and the scores were added together to generate a knowledge score ranging from 0 to 30, an awareness score ranging from 0 to 12, and health-related practice score ranging from 0 to 12.

The median score was computed for each category. Patients with a total score equal to or below the median were considered as having poor scores, whereas those above the median were regarded as having good scores.

For the statistical comparison, all patients other than new cases i.e. patients receiving anti-tuberculosis treatment (ATT) the first time for more than one month and previously treated cases were considered as old cases.

Statistical Analysis

Results were analyzed by SPSS (version 23). The student's unpaired T-test was used for comparison of continuous data of the two groups. Variables found to show statistically significant differences between knowledge, awareness, and health-related practice scores of different subcategories were assessed as potential independent predictors for TB by multivariate analysis using logistic regression. A p-value of $<0.05$ was considered to be statistically significant.

## Results

Two hundred patients with pulmonary tuberculosis (PTB) were taken up for the study. Most patients with PTB belonged to the category of the new cases (53.5%) followed by previously treated (29%). Baseline characteristics of patients are shown in table 1. About half of patients with PTB belonged to the age group >50 yrs (48%). Male predominance was seen in our study with a Male: Female ratio of 2.7:1. The majority of patients were from rural areas and were illiterate (87%).

**Table 1. Baseline characteristics of patients with PTB (n=200)**

| Characteristics | | No. of patients with PTB | | | | | |
|---|---|---|---|---|---|---|---|
| | | On treatment for >1 month [n=35] | New cases [n=107] | Treatment after default [n=20] | Relapse [n=27] | Treatment after failure [n=11] | Total [n=200] |
| **Age (years)** | 18—30 | 10 | 23 | 4 | 4 | 2 | 43 |
| | 31-50 | 9 | 38 | 5 | 8 | 1 | 61 |
| | >50 | 16 | 46 | 11 | 15 | 8 | 96 |
| **Sex** | Male | 24 | 75 | 15 | 24 | 8 | 146 |
| | Female | 11 | 32 | 5 | 3 | 3 | 54 |
| **Residence** | Rural | 33 | 104 | 20 | 26 | 11 | 194 |
| | Urban | 2 | 3 | 0 | 1 | 0 | 6 |
| **Socio-economic Status** | High[a] | 1 | 1 | 1 | 0 | 0 | 3 |
| | Middle[b] | 9 | 29 | 2 | 9 | 7 | 56 |
| | Low[c] | 25 | 77 | 17 | 18 | 4 | 141 |
| **Literacy** | Illiterate | 34 | 93 | 18 | 21 | 8 | 174 |
| | Literate | 1 | 14 | 2 | 6 | 3 | 26 |
| **Smoking** | Smoker[d] | 4 | 23 | 1 | 6 | 0 | 34 |
| | Non-smoker | 31 | 84 | 19 | 21 | 11 | 166 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Alcohol use** | Alcoholic | 5 | 20 | 2 | 4 | 1 | 32 |
| | Non-alcoholic | 30 | 87 | 18 | 23 | 10 | 168 |
| **Diet** | Mixed | 23 | 53 | 10 | 14 | 6 | 106 |
| | Vegetarian | 12 | 54 | 10 | 13 | 5 | 94 |

PTB- Pulmonary tuberculosis; [a]Annual family income > INR 850,000 (INR 1= USD 0.013); [b]Annual family income INR 50,000–850,000; [c]Annual family income < INR 50,000); [d]A person who smoked any tobacco product, either daily or occasionally.

The most common symptoms of the patients were cough, fever, and weight loss while the most common sign was pallor. Sputum AFB positivity was present in 81% of patients. Maximum patients had tuberculous infiltration in chest x-rays followed by consolidation.

The distribution of patients showing awareness regarding various aspects of TB among different categories of patients with PTB is shown in table 2. The majority of patients were aware of TB. The awareness regarding preventable nature (52.5%), communicable nature (70.5%), and treatable nature (65%) of disease were relatively less.

**Table 2. Distribution of patients showing awareness regarding various aspects of TB among different categories of patients with PTB**

| Awareness Parameter | No. of patients (%) | | | | | |
|---|---|---|---|---|---|---|
| | On treatment for >1 month [n=35] | New cases [n=107] | Treatment after default [n=20] | Relapse [n=27] | Treatment after failure [n=11] | Total [n=200] |
| TB | 96 (48%) | 34 (17%) | 19 (9.5%) | 26 (13%) | 11 (5.5%) | 186 (93%) |
| Preventable nature of disease | 46 (23%) | 17 (8.5%) | 13 (6.5%) | 20 (10%) | 9 (4.5%) | 105 (52.5%) |
| Communicable nature of disease | 67 (33.5%) | 24 (12%) | 17 (8.5%) | 23 (11.5%) | 10 (5%) | 141 (70.5%) |
| Treatable nature of disease | 53 (26.5%) | 29 (14.5%) | 17 (8.5%) | 22 (11%) | 9 (4.5%) | 130 (65%) |
| Fatal nature of TB if not treated | 55 (27.5%) | 30 (15%) | 13 (6.5%) | 21 (10.5%) | 11 (5.5%) | 130 (65%) |
| Need for prolonged treatment for PTB | 42 (21%) | 18 (9%) | 11 (5.5%) | 15 (7.5%) | 9 (4.5%) | 85 (42.5%) |
| DOTS program is a government-sponsored program for TB | 12 (6%) | 34 (17%) | 17 (8.5%) | 15 (7.5%) | 1 (0.5%) | 79 (39.5%) |
| Presence of DOTS center locally | 29 (14.5%) | 4 (2%) | 12 (6%) | 13 (6.5%) | 8 (4%) | 66 (33%) |
| Availability of free treatment at DOTS center | 27 (13.5%) | 5 (2.5%) | 10 (5%) | 13 (6.5%) | 8 (4%) | 63 (31.5%) |
| Under DOTS, ATT is taken under supervision | 34 (17%) | 11 (5.5%) | 11(5.5%) | 15 (7.5%) | 6 (3%) | 77 (38.5%) |
| Free treatment under DOTS Plus for MDR TB | 16 (8%) | 2 (1%) | 11(5.5%) | 8 (4%) | 4 (2%) | 41 (20.5%) |
| In DOTS Plus, ATT is taken under supervision | 16 (8%) | 2 (1%) | 8 (4%) | 9 (4.5%) | 3 (1.5%) | 38 (19%) |

TB- Tuberculosis; PTB- Pulmonary tuberculosis; DOTS- Directly observed therapy short course; ATT- anti-tuberculosis treatment; MDR TB- Multidrug-resistant tuberculosis

The distribution of patients having knowledge regarding various aspects of TB is shown in table 3. The proportion of patients having knowledge regarding various aspects of TB ranged from 11% to 74%.

**Table 3. Distribution of patients having knowledge regarding various aspects of TB among different categories of patients with PTB**

| Knowledge parameter | No. of patients (%) | | | | | |
|---|---|---|---|---|---|---|
| | On treatment for >1 month [n=35] | New cases [n=107] | Treatment after default [n=20] | Relapse [n=27] | Treatment after failure [n=11] | Total [n=200] |
| What is TB? | 68 (34%) | 29(14.5%) | 15 (7.5%) | 25 (12.5%) | 11 (5.5%) | 148(74%) |
| TB is caused by bacteria. | 21(10.5%) | 7 (3.5%) | 8 (4%) | 14 (7%) | 6 (3%) | 56 (28%) |
| Mode of transmission | 40 (20%) | 10 (5%) | 10 (5%) | 19 (9.5%) | 7 (3.5%) | 86 (43%) |

| | | | | | | |
|---|---|---|---|---|---|---|
| Spread of TB via air droplets | 31 (15.5%) | 10 (5%) | 8 (4%) | 16 (8%) | 7 (3.5%) | 72 (36%) |
| Low grade fever and cough as symptoms of TB | 24 (12%) | 7 (3.5%) | 9 (4.5%) | 12 (6%) | 6 (3%) | 58 (29%) |
| Need to investigate fever and cough of >2 weeks for TB | 29 (14.5%) | 10 (5%) | 9 (4.5%) | 12 (6%) | 7 (3.5%) | 67 (33.5%) |
| Affection of organs other than lungs by PTB | 25 (12.5%) | 7 (3.5%) | 4 (2%) | 11 (5.5%) | 8 (4%) | 55 (27.5%) |
| How is TB diagnosed? | 19 (9.5%) | 12 (6%) | 3 (1.5%) | 14 (7%) | 7 (3.5%) | 55 (27.5%) |
| Mantoux test is done for TB | 18 (9%) | 3 (1.5%) | 5 (2.5%) | 10 (5%) | 15 (7.5%) | 51 (25.5%) |
| BCG vaccination is done for preventing TB | 14 (7%) | 2 (1%) | 4 (2%) | 4 (2%) | 4 (2%) | 28 (14%) |
| Need of sputum examination for diagnosis of PTB | 36 (18%) | 13 (6.5%) | 10 (5%) | 12 (6%) | 6 (3%) | 77 (38.5%) |
| Need of 2 sputum samples on consecutive days to diagnose PTB | 25 (12.5%) | 12 (6%) | 11 (5.5%) | 17 (8.5%) | 7 (3.5%) | 72 (36%) |
| Confirmation of TB by sputum culture in sputum negative cases | 6 (3%) | 2 (1%) | 2 (1%) | 8 (4%) | 4 (2%) | 22 (11%) |
| Chest x-ray is done to diagnose PTB | 39 (19.5%) | 25 (12.5%) | 14 (7%) | 17 (8.5%) | 7 (3.5%) | 102 (56%) |
| Sputum sample more reliable than chest x-ray for confirmation of TB | 12 (6%) | 4 (2%) | 6 (3%) | 8 (4%) | 4 (2%) | 34 (17%) |
| Need to wear a mask if sputum AFB positive | 67 (33.5%) | 24 (12%) | 17 (8.5%) | 23 (11.5%) | 10 (5%) | 141 (70.5%) |
| Need of regular treatment for TB | 46 (23%) | 26 (23%) | 12 (6%) | 17 (8.5%) | 9 (4.5%) | 110 (55%) |
| Not taking treatment can result in the spread of disease | 29 (14.5%) | 19 (9.5%) | 10 (5%) | 13 (6.5%) | 8 (4%) | 79 (39.5%) |
| Not taking treatment can result in complications /morbidity | 41 (20.5%) | 25 (12.5%) | 9 (4.5%) | 18 (9%) | 8 (4%) | 101 (50.5%) |
| Irregular treatment can lead to drug-resistant TB | 20 (10%) | 4 (2%) | 7 (3.5%) | 6 (3%) | 5 (2.5%) | 42 (21%) |
| Requirement of 4 drugs for 2 months and 2 drugs for 4 months | 22 (11%) | 5 (2.5%) | 8 (4%) | 11 (5.5%) | 6 (3%) | 52 (26%) |
| Around 6-8 weeks required for the fever to subside after starting ATT | 22 (11%) | 4 (2%) | 8 (4%) | 10 (5%) | 4 (2%) | 48 (24%) |
| Drug-resistant TB | 26 (13%) | 8 (4%) | 7 (3.5 %) | 9 (4.5%) | 5 (2.5%) | 55 (27.5%) |
| If not treated properly can lead to MDR TB | 14 (7%) | 1 (.5%) | 5 (2.5%) | 9 (4.5%) | 4 (2%) | 33 (16.5%) |
| Special and additional drugs needed for treating MDR TB | 17 (8.5%) | 1 (0.5%) | 8 (4%) | 7 (3.5%) | 3 (1.5%) | 36 (18%) |
| Duration of MDR TB treatment is 2 years | 4 (2%) | 2 (1%) | 7 (3.5%) | 8 (4%) | 4 (2%) | 25 (12.5%) |
| Malnutrition increases the risk of PTB | 24 (12%) | 8 (4%) | 8 (4%) | 14 (7%) | 4 (2%) | 58 (29%) |
| Overcrowding increases the risk of TB | 20 (10%) | 4 (2%) | 7 (3.5%) | 8 (4%) | 4 (2%) | 43 (21.5%) |
| Smoking is a risk factor for TB | 30 (15%) | 13 (6.5%) | 11 (5.5%) | 11 (5.5%) | 4 (2%) | 69 (34.5%) |
| Alcohol is a risk factor for TB | 29 (14.5%) | 11 (5.5%) | 10 (5%) | 14 (7%) | 3 (1.5%) | 67 (23.5%) |

TB- Tuberculosis; PTB- Pulmonary tuberculosis; BCG- Bacillus Calmette Guerin; ATT- Anti-tuberculosis treatment; MDR TB- Multidrug-resistant tuberculosis

The distribution of patients showing a positive response to questions concerning TB-related practices among different categories of patients with PTB is shown in table 4. Patients showing a positive response to questions concerning TB-related practices ranged from 19.5% to 47%.

The most common source of information regarding TB was from television (TV) (87.5%), radio (57.5%), and doctors (50.5%). Regarding defaulters, the most common cause of stopping the treatment prematurely was lack of awareness (75%), followed by felt better and cured (35%), lack of finances to visit DOTS center (15%), non-availability of drugs at the DOTS center (15%), DOTS center closed (15%), and others.

The mean TB awareness score for the 12 selected questions in the study sample was 6.155 ± 3.41 (range 0–11, median 6). Eighty-two patients had values of more than the median with good awareness, while 118 were having scores below the median and poor awareness regarding PTB.

The mean TB knowledge score for the 30 selected questions in the study sample was 9.96 ± 8.03 (range 0–27, median 8). Ninety-five patients had values of more than the median and good knowledge, while 105 had scores below the median and poor knowledge regarding PTB.

The mean TB-related practices score for the 12 selected questions in the study sample was 3.69 ± 3.44 (range 0–11, median 3). Ninety patients had values of more than the median and good TB-related practices, while 110 were having scores below the median and poor TB-related practices.

**Table 4. Distribution of patients showing a positive response to questions concerning TB-related practices among different categories of patients with PTB.**

| Practice Parameter | No. of patients (%) | | | | | |
|---|---|---|---|---|---|---|
| | On treatment for >1 month [n=35] | New cases [n=107] | Treatment after default [n=20] | Relapse [n=27] | Treatment after failure [n=11] | Total [n=200] |
| Getting contacts investigated for TB if low-grade fever/cough >2weeks | 20 (10%) | 4 (2%) | 9 (4.5%) | 9 (4.5%) | 4 (2%) | 46 (23%) |
| Wearing a mask to prevent the spread of TB | 35 (17.5%) | 15 (7.5%) | 8 (4%) | 14 (7%) | 7 (3.5%) | 79 (39.5%) |
| Whether taking ATT drugs regularly as prescribed | 17 (8.5%) | 35 (17.5%) | 11 (5.5%) | 15 (7.5%) | 7 (3.5%) | 85 (42.5%) |
| Visiting doctor regularly at specified intervals | 42 (21%) | 17 (8.5%) | 12 (6%) | 16 (8%) | 7 (3.5%) | 94 (47%) |
| Getting follow-up investigations as per schedule | 38 (19%) | 9 (4.5%) | 8 (4%) | 13 (6.5%) | 7 (3.5%5) | 75 (37.5%) |
| Taking DOTS under supervision | 0 (0%) | 9 (4.5%) | 12 (6%) | 13 (6.5%) | 5 (2.5%) | 39 (19.5%) |
| Preferring to use DOTS rather than treatment from private doctors | 28 (14%) | 6 (3%) | 10 (5%) | 11 (5.5%) | 5 (2.5%) | 60 (30%) |
| Encouraging others to avail treatment at DOTS | 19 (9.5%) | 5 (2.5%) | 9 (4.5%) | 9 (4.5%) | 4 (2%) | 46 (23%) |
| Ensuring proper nutrition for family | 31 (15.5%) | 9 (4.5%) | 9 (4.5%) | 11 (5.5%) | 4 (2%) | 64 (32%) |
| Trying within resources to avoid overcrowding | 27 (13.5%) | 12 (6%) | 8 (4%) | 13 (6.5%) | 5 (2.5%) | 65 (32.5%) |
| If smoker, whether left/ reduced smoking | 20 (10%) | 2 (1%) | 1 (0.5%) | 6 (3%) | 0 (0%) | 29 (14.5%) |
| If alcoholic, whether left/ reduced alcohol | 2 (1%) | 3 (1.5%) | 1 (0.5%) | 2 (1%) | 1 (0.5%) | 9 (4.5%) |

TB- Tuberculosis; ATT- anti-tuberculosis treatment; DOTS- Directly observed therapy short course

Comparison of the awareness, knowledge and health-related practice scores of patients with PTB as per various socio-demographic factors is shown in table 5. Significant differences were seen between awareness scores of literates and illiterate ($p<0.0001$) and new and old patients of PTB ($p<0.0001$) but no significant differences were seen regarding age, gender, socioeconomic status, place of residence, smoking, and alcohol status ($p>0.05$ each). Significant differences were seen between knowledge scores of patients with PTB regarding residence (rural/urban) ($p=0.02$), literacy status ($p<0.0001$), socio-economic status ($p=0.001$), and type of case (new/old) ($p=0.0002$) but no significant differences were seen regarding age, gender, smoking and alcohol status ($p>0.05$ each). Significant differences were seen between health-seeking practice scores of patients with PTB concerning residence (urban/rural) ($p= 0.016$), literacy status ($p<0.0001$), socio-economic status ($p=0.040$), and type of case (new/old) ($p=0.030$) but no significant differences were seen regarding age, gender, smoking, and alcohol status ($p>0.05$ each).

**Table 5: Comparison of the awareness, knowledge, and health-related practice scores of patients with PTB as per various socio-demographic factors.**

| Category | No. of patients | Awareness | | Knowledge | | Practice | |
|---|---|---|---|---|---|---|---|
| | | Mean score ± SD | p-value | Mean score ± SD | p-value | Mean score ± SD | p-value |
| Urban | 6 | 7±3.45 | 0.400 | 17±8.20 | 0.020 | 7±3.84 | 0.016 |
| Rural | 194 | 5.12±3.38 | | 9.2±8.07 | | 3.58±3.41 | |
| Male | 146 | 6.13±3.39 | | 9.91±8.15 | 0.187 | 3.95±3.44 | 0.068 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Female | 54 | 5.12±3.37 | 0.060 | 8.20±8.01 | | 2.96±3.28 | |
| Literate | 26 | 8.46±3.39 | <0.0001 | 16.3±8.17 | <0.0001 | 6.11±3.46 | <0.0001 |
| Illiterate | 174 | 5.47±3.38 | | 8.42±8.07 | | 3.32±3.41 | |
| High/ middle class* | 59 | 6.50±3.36 | 0.084 | 12.23±7.95 | 0.001 | 4.44±3.38 | 0.040 |
| Low class* | 141 | 5.59±3.39 | | 8.28±8.17 | | 3.37±3.44 | |
| New case | 107 | 4.95±3.40 | <0.0001 | 7.44±8.15 | 0.0002 | 3.20±3.45 | 0.030 |
| Old case | 93 | 6.91±3.38 | | 11.75±8.07 | | 4.24±3.41 | |
| Smoker | 34 | 6.11±3.40 | 0.638 | 9.15±8.07 | 0.261 | 4.02±3.45 | 0.534 |
| Non-smoker | 166 | 5.81±3.38 | | 10.88±8.17 | | 3.62±3.41 | |
| Alcoholic | 32 | 5.03±3.41 | 0.121 | 8.84±8.17 | 0.647 | 3.43±3.45 | 0.649 |
| Non-alcoholic | 168 | 6.02±3.28 | | 9.56±8.17 | | 3.73±3.41 | |
| Age <50 years | 104 | 6.61±3.40 | 0.238 | 10.11±8.15 | 0.246 | 3.94±3.45 | 0.285 |
| Age >50 years | 96 | 5.52±3.36 | | 8.78±8.0 | | 3.42±3.41 | |

PTB- Pulmonary tuberculosis; *Class refers to socio-economic status

Multivariate analysis using logistic regression performed to determine the independent predictors of awareness, knowledge, and practice-related scores showed that literacy status (p=0.037) and type of case (new/old) (p<0.0001) were independent predictors for awareness of TB among patients with PTB. The type of case (new/old) (p=0.025) was an independent predictor for knowledge of TB among patients with PTB, but socioeconomic status (p=0.088), place of residence (p=0.207), and literacy status (p=0.057) were not found to be independent predictors. The literacy status (p=0.006) was an independent predictor for health-seeking practices of TB among patients with PTB, but socioeconomic status (p=0.372), residence status (p=0.167), and duration of disease (p=0.134) were not found to be independent predictors (Table 6).

**Table 6. Showing independent predictors of patient knowledge, awareness, and health-related practice level concerning TB by multivariate analysis using logistic regression.**

| Predictor variables | | Unstandardized Coefficients | p-value | Exp (B) | 95% CI for Exp (B) | |
|---|---|---|---|---|---|---|
| | | B | | | Lower | Upper |
| Awareness | Constant | 1.811 | 0.001 | 6.119 | | |
| | Type of case (New/old) | -.641 | .037 | .527 | .289 | .962 |
| | Literacy status | -2.101 | 0.000 | .122 | .043 | .345 |
| Knowledge | Constant | 3.051 | 0.012 | 6.119 | | |
| | Type of case (New/old) | -.448 | .134 | .639 | .356 | 1.147 |
| | Socio-economic status | -.313 | .372 | .731 | .368 | 1.456 |
| | Residence | -1.578 | .167 | .206 | .022 | 1.931 |
| | Literacy | -1.428 | 0.006 | .240 | .086 | .669 |
| Practice | Constant | 2.933 | 0.015 | 18.776 | | |
| | Type of case (New/old) | -.668 | 0.025 | .513 | .286 | .920 |
| | Socio- economic status | -.595 | 0.088 | .551 | .278 | 1.093 |
| | Residence | -1.443 | .207 | .236 | .025 | 2.216 |
| | Literacy | -.966 | 0.057 | .381 | .141 | 1.029 |

TB- Tuberculosis; CI- Confidence Interval

**Discussion**

Knowledge and awareness concerning various aspects of tuberculosis (TB) among the masses are essential for the prevention of spread and early diagnosis of tuberculosis [13]. The success of a national TB program depends upon multiple factors. Community awareness, treatment adherence, accessibility to quality care, prescription of appropriate treatment regimens and follow-up of treatment, and accessible TB-related services constitute important components of a successful TB program. So community members must have awareness and ability to suspect TB in persons who show symptoms and signs suggestive of TB, such as persistent fever, prolonged cough, and weight loss [14].

The majority of our patients with PTB had their knowledge, awareness, and health-seeking practice scores regarding TB less than the median value of these scores signifying poor levels of knowledge awareness and health-seeking practices among them. However, it is not surprising that old TB patients among our respondents showed a good level of knowledge on the symptoms and modes of transmission of TB, attributable to caregiver education during treatment.

Twenty-eight percent of our patients knew about the correct etiology of TB i.e. infective organism. Regarding investigation to be performed for diagnosing TB, sputum examination was stated by 38.5% and x-ray chest by 56% of patients. However, in contrast to our findings, in a study at DOTS Centre, Safdarjung Hospital, New Delhi, India, 62.6% of the patients responded that for diagnosing TB, sputum examination was the best test followed by X-ray [15].

Our study subjects regarded overcrowding (43, 21.5%), smoking (69, 34.5%), and malnutrition (58, 29%) as factors

contributing to transmission and spread of TB which is in agreement with results of studies conducted in Ethiopia [16] and Thailand [17]. However, another study conducted in Sudan on patients with TB who were on regular clinical follow-up, showed that their knowledge was generally poor regarding the nature of the causative organism, modes of transmission, and measures needed for the control and prevention [18]. Similarly, another study conducted on adult miners and their families in Gaza province, Mozambique, showed that only 2.8% of participants knew the basic principles of TB transmission [19].

In our study, BCG vaccination is meant for TB was known to 14% cases, whereas BCG as a vaccine for TB was known to only 15.6% in a study in rural south Indian community [13]. Thus the mass media and information, education, and communication activities should constantly endeavor to deliver messages regarding the importance of BCG and other vaccine-preventable diseases. Most of our study participants (65%) regarded TB as curable. In a study in New Delhi, India, 53.3% of the TB patients knew that the anti-TB treatment was to be taken for 6 – 9 months [15]. It warrants putting more stress on the completion and the duration of TB treatment through health education.

In our study, 39.5% of patients were aware of the DOTS program being run by the government, 38.5% were aware that under DOTS, ATT is taken under supervision, 33% were aware of the presence of DOTS center locally but only 31.5% of patients were aware of the availability of free treatment at DOTS center. Similar results were seen in a study conducted in rural Tamil Nadu in India in which only 34% of people were aware of the availability of free treatment for TB [20]. In another study performed in Pakistan, less than half (urban 48.1%, rural 49.2%) of the patients were aware of the availability of the facility for diagnosis and treatment free of cost [21].

Only 42.5% of our patients were taking ATT regularly, even though 50.5% of patients knew that not taking treatment could result in complications/morbidity.

This study showed an overall mean awareness score of 6.15, knowledge score of 9.96, and practice score of 3.69. Various studies performed in other countries reported a knowledge score of TB from 2.2 to7.6, and an attitude and practice score from 3.9 to 6.7 [22-26]. The majority (93%) of our study participants had heard of TB which indicates that TB is well-known to people in our study area. A study from Puducherry, India reported that out of 422 presumptive TB cases, 67.3% had heard about tuberculosis but only 32.2% knew that the TB spreads from one person to another [27]. Previous studies conducted in Ethiopia [26] and Nigeria [28] showed similar findings where 94.3% and 86.0% of the study participants were aware of TB, respectively. However, very few of our study participants were aware of bacteria as a causative agent of TB which is in accordance with results of earlier studies in Ethiopia [26], Nigeria [28], and Uganda [29].

The commonest symptom reported by the study participants was persistent cough similar to the finding reported in a study in Brazil [30]. The other symptoms reported were fever, hemoptysis, breathlessness, and weight loss. This is important while deciding about the content of TB awareness campaigns. Only 43% of participants knew about the mode of transmission of TB. Lack of awareness regarding the mode of transmission among the majority (57%) of cases is of concern as they should have been educated by the treating doctors regarding various aspects of TB at the start of treatment. Literacy has been identified as an important factor concerning the level of awareness. A study among sandstone quarry workers in Rajasthan, India showed that literate people had significantly higher levels of awareness and knowledge about TB [31]. All these findings are in accordance with our findings.

Our study picked up some deficiencies in knowledge, particularly those associated with the etiology of the disease and the transmission methods which should be considered when starting TB awareness campaigns. Sixty-five percent of the study participants mentioned that TB is a fatal disease if not treated, but only 42.5 % of them knew that a prolonged treatment was required to be taken for TB.

Many people having TB remain under-reported due to their lack of knowledge regarding treatment and the TB control program. Poor knowledge of patients with TB about their disease may be a factor for the high prevalence of TB [32]. However, the misconception that lifelong treatment is required for TB may discourage patients with TB from starting treatment at all [33].

The study also showed the mean knowledge level among the patients identified as new cases was lower than the patients recorded as old cases. (7.44±8.15 vs 11.7±8.07; p=0.0002). Similar results were obtained in a study done in Bangladesh [34].

WHO has reported a higher prevalence of TB among men than women [1]. In our study, a large number of patients seeking treatment at the study sites were males, having a marginally higher level of knowledge than females (9.91±8.15 vs 8.20±8.01; p=0.187). Gender differences in TB prevalence appear to be due to socio-economic and cultural factors as illiteracy and disadvantageous position of women in the household particularly in the rural areas may account for lesser knowledge scores and underutilization of medical facilities leading to underdiagnosis of TB among females. This is supported by observations of another Indian study that reaching health facilities is often not possible for female patients because a woman's position in the family, economic dependence, and illiteracy would act as restricting factors [35].

In our study, poor knowledge about TB was significantly associated with new cases, rural residence, literacy, and low income. The educated patients had significantly higher scores for general knowledge regarding TB. This shows that education is a key determinant of general knowledge regarding TB in this study. Our observations corroborate the results of previous studies in Croatia [24], Ethiopia [22], Nigeria [28], Pakistan [30] and China [36]. Therefore, TB awareness programs should focus on young people, less educated groups, and poor persons to improve their knowledge of TB. Educational strategies should be focused and adjusted to reach these groups,. Likewise, TB-related unfavorable practices had a significant association with less education, rural residence, and low income. These observations corroborate the results of previous studies in Ethiopia [26] and Tajikistan [37].

Several studies observed that the majority of respondents heard about TB for the first time from family members, relatives, health workers, and means of mass communication [21, 23]. We also observed similar findings. This implies that health workers, close relatives, TV, and radio were instrumental in spreading awareness about TB and could be a promising means in this

regard. However, we noted that the internet contributed very little in spreading information regarding TB. This may be a result of the majority of subjects not having internet because they were in rural areas and were illiterate.

In our study, a majority of respondents (65%) considered TB as a disease that could be cured by modern treatment while only 39.5% of the respondents were aware of the facility regarding free TB diagnosis and treatment. This was in accordance with a study conducted by Mushtaq et al in Pakistan [38]. Several studies reported that the place of residence [17] and educational background [24, 38, 39] of respondents were important determinants of knowledge regarding TB. Our study also found that a low level of knowledge score had a significant association with residence in rural areas and illiteracy.

Regarding treatment default in our study, the most common cause of stopping the treatment prematurely was lack of awareness (75%), followed by felt better and cured (35%), lack of finances to visit DOTS center (15%) non–availability of drugs at DOTS center (15%), DOTS center closed (15%) and others. Similar results were seen in a study done in Armenia [40].

In our study, 110 (55%) study participants had health-related practice scores below the median implying unfavorable health-related practices whereas 90 (45%) had attitude and practices scores above the median. For knowledge regarding TB, 105 (52.5%) had poor knowledge and 95 (42.5%) had good knowledge. These results were in agreement with a study done in Navi Mumbai, India [41]. However, in a study in Malaysia, involving 1600 patients with TB, the respondents possessed a high level of awareness regarding TB, and positive attitudes towards TB and health-seeking behaviors [42].

In this study, literacy status ($p<0.0001$) and type of case (new/old) ($p<0.0001$) were found to be important determinants for awareness regarding TB while age, gender, socioeconomic status, place of residence, smoking, and alcohol status did not affect awareness significantly ($p>0.05$ each). Multivariate analysis showed that literacy status ($p=0.037$) and type of case (new/old) ($p<0.0001$) were independent predictors for awareness of TB among PTB patients.

Similarly, residence (rural/urban) ($p= 0.02$), literacy status ($p<0.0001$), socio-economic status ($p=0.001$), and type of case (new/old) ($p=0.0002$) were found to be important determinants for knowledge regarding TB but age, gender, smoking, and alcohol status did not affect the knowledge regarding TB significantly ($p>0.05$ each). Multivariate analysis showed that type of case (new/old) ($p=0.025$) was an independent predictor for knowledge of TB among PTB patients, but socioeconomic status ($p=0.088$), place of residence ($p=0.207$), and literacy status ($p=0.057$) were not found to be the independent predictors, which was not in agreement with the results of a study done in Ethiopia that being a rural resident was independently associated with a low knowledge score [22].

Residence (urban/rural) ($p=0.016$), educational status ($p<0.0001$), socio-economic status ($p=0.040$), and type of case (new/old) ($p=0.030$) were found to be important determinants for health-seeking practices of TB among patients with PTB but age, gender, smoking, and alcohol status did not affect health-seeking practices significantly ($p>0.05$ each). Multivariate analysis showed that education status ($p=0.006$) was an independent predictor for health-seeking practices of TB among patients with PTB, but socioeconomic status ($p=0.372$), residence status ($p=0.167$), and duration of disease ($p=0.134$) were not found to be the independent predictors.

Consequently, correct knowledge and positive attitude of the patient toward TB and its management are prerequisites for seeking early healthcare and need promotion at all levels to check the spread of TB and lower its prevalence in the community.

## Conclusions

Knowledge, awareness, and health-seeking practices regarding TB were lacking on many fronts among the majority of patients with PTB. Awareness regarding TB was affected by the level of education and type of case (new/old) and both factors were independent predictors of awareness level concerning TB among patients with PTB. Knowledge about TB was determined by residence, level of education, socioeconomic status, and type of case (new/old) but the type of case (new/old) alone was an independent predictor of patient knowledge level concerning TB among patients with PTB. Health-seeking practices regarding TB were affected by residence, literacy status, socioeconomic status, and type of case (new/old) but literacy status was the only independent predictor for health-seeking practices. Thus, existing levels of knowledge, awareness, and health-seeking practices regarding TB need improvement among TB patients which may help curtail the incidence of TB.

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