



Journal of Science Innovations and Nature of Earth

International, Double-Blind, Quarterly, Peer-Reviewed, Refereed,
 Edited and Open Access Research Journal
 Journal homepage: <https://jsiane.com/index.php/files>



Awareness, Clinical Features, and Risk Factors of Tuberculosis among Adolescents and Young Adults in Gautam Buddha Nagar, India: A Cross-Sectional Study

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DOI- <https://doi.org/10.59436/jsiane.v6i3.1.2583-2093>

ARTICLE INFO

Article history:

Received 5 July 2026

Received in revised form

14 August 2026

Accepted 20 August 2026

Available online 03 September 2026

Keywords:

Tuberculosis, Adolescents, Awareness, Risk factors, Public health

ABSTRACT

Tuberculosis (TB) continues to be a significant public health challenge, particularly among adolescents and young adults who play an important role in disease transmission within the community. This study was conducted to evaluate TB-related symptoms, awareness levels, and associated risk factors among individuals aged 10–25 years in Gautam Buddha Nagar, India. A community-based cross-sectional survey design was adopted, involving 100 participants through a structured questionnaire to assess symptoms, knowledge, and awareness related to TB. In addition, 50 clinical records including chest X-ray and sputum reports were reviewed to determine radiological and microbiological patterns of disease presentation. The findings revealed that respiratory symptoms were commonly reported among participants, while awareness regarding TB transmission and curability was generally high. However, knowledge about availability of free diagnostic and treatment services under national health programs was limited. Radiological evaluation indicated a predominance of pulmonary involvement, with bilateral lung affection being the most frequently observed pattern, suggesting that a considerable number of cases present at a relatively advanced stage of disease. Overall, the study highlights a gap between general awareness and utilization of available TB services, emphasizing the need for strengthened health education, early screening, and targeted intervention strategies for adolescents and young adults to improve TB control and prevention outcomes.

Introduction

Tuberculosis (TB) remains one of the most significant infectious diseases worldwide, posing a major public health challenge despite considerable advances in diagnosis and treatment. It is caused by *Mycobacterium tuberculosis*, a slow-growing bacterium that primarily affects the lungs but can also involve other organs such as the lymph nodes, bones, and central nervous system (Lewinsohn *et al.*, 2016). TB is transmitted through airborne droplets released when an infected individual coughs, sneezes, or speaks, making it highly contagious in crowded and poorly ventilated environments. Although TB is both preventable and curable, it continues to affect millions of people annually, particularly in low- and middle-income countries. Globally, TB remains a leading cause of morbidity and mortality, especially among vulnerable populations. Factors such as poverty, malnutrition, overcrowding, and limited access to healthcare significantly contribute to the persistence and spread of the disease (Narasimhan *et al.*, 2013). In countries like India, where population density is high and socio-economic disparities exist, TB continues to be a major health burden. The disease not only affects physical health but also has profound social and psychological consequences, including stigma, discrimination, and reduced quality of life (Bala *et al.*, 2025). In recent years, increasing attention has been directed toward adolescents and young adults as a critical yet often neglected group in TB research and control programs. Adolescence is a transitional phase marked by significant biological, psychological, and social changes that can influence susceptibility to infectious diseases. Studies have shown that TB incidence rises

during adolescence and peaks in early adulthood, indicating that this age group plays a crucial role in the transmission dynamics of the disease (Snow *et al.*, 2018). Unlike younger children, adolescents often develop adult-type pulmonary TB, which is more infectious and contributes significantly to community spread (Sang *et al.*, 2024). The increased risk of TB in adolescents and young adults can be attributed to several factors. Social behaviors such as increased mobility, frequent interaction with peers, and participation in activities in crowded settings like schools, colleges, and workplaces enhance the likelihood of exposure to infectious individuals (Laycock *et al.*, 2021). Additionally, lifestyle factors such as smoking, alcohol consumption, and poor nutritional status further increase susceptibility to TB infection and progression (Narasimhan *et al.*, 2013). These risk factors are often compounded by a lack of awareness and delayed health-seeking behavior, which can result in late diagnosis and increased transmission. Another important aspect influencing TB control in this population is the level of awareness and knowledge regarding the disease. Awareness about TB symptoms, modes of transmission, prevention strategies, and availability of treatment plays a critical role in early diagnosis and successful management. While some studies suggest that general awareness about TB is improving, significant gaps remain, particularly regarding government-provided free treatment services and vaccination programs (Laycock *et al.*, 2021). Lack of awareness can lead to misconceptions about the disease, delayed treatment, and increased risk of complications. The Bacillus Calmette–Guérin (BCG) vaccine is widely used as a preventive measure against TB, especially in countries with high disease burden. However,

awareness regarding vaccination status and its importance is often limited among adolescents and young adults (Verkuijl *et al.*, 2022). Furthermore, many individuals are unaware of national TB control programs that provide free diagnosis and treatment, which can hinder access to timely care. Psychosocial factors also play a crucial role in TB management among adolescents. Stigma associated with the disease often discourages individuals from seeking medical help, leading to delays in diagnosis and treatment (Moscibrodzki *et al.*, 2021). Adolescents may experience emotional stress, anxiety, and social isolation due to their illness, which can negatively impact treatment adherence and outcomes (Bala *et al.*, 2025). Studies have highlighted the importance of providing psychosocial support, including counseling and peer support, to improve treatment outcomes in this age group (Parwitha *et al.*, 2025). Despite the growing recognition of the importance of adolescents in TB epidemiology, this group remains underrepresented in research and public health strategies. Most studies have traditionally focused on children or older adults, with limited attention given to adolescents and young adults. Additionally, many studies are hospital-based, focusing primarily on diagnosed TB patients, thereby overlooking community-level awareness, risk factors, and health-seeking behavior among the general population (Verkuijl *et al.*, 2022). Another significant gap in existing research is the lack of focus on behavioral and environmental factors that influence TB transmission and awareness. Family habits such as tobacco use and alcohol consumption have been identified as important risk factors for TB, yet their impact on awareness and prevention behaviors among adolescents has not been adequately explored (Narasimhan *et al.*, 2013). Similarly, the effectiveness of TB awareness programs conducted in schools and colleges remains insufficiently evaluated. Gautam Buddha Nagar, located in Uttar Pradesh, represents a unique setting for studying TB among adolescents and young adults. The district is characterized by rapid urbanization, a high population density, and a significant migrant population, all of which contribute to increased risk of TB transmission. Crowded living conditions, occupational exposure, and socio-economic disparities further exacerbate the burden of the disease in this region. Given these challenges, there is a need for community-based studies that assess not only the prevalence of TB-related symptoms but also the level of awareness, risk factors, and healthcare-seeking behavior among adolescents and young adults. Understanding these factors is essential for designing effective interventions and improving TB control strategies. Therefore, the present study aims to evaluate the awareness, clinical symptoms, and associated risk factors of tuberculosis among adolescents and young adults in Gautam Buddha Nagar. By addressing existing gaps in knowledge and focusing on a neglected yet high-risk population, this study seeks to contribute to the development of targeted public health interventions aimed at reducing the burden of TB and improving health outcomes in this age group.

Materials and Methods

Study Design- The present study was conducted using a cross-sectional research design to assess the awareness, symptoms, and risk factors associated with tuberculosis (TB) among adolescents and young adults. A cross-sectional approach was considered appropriate as it allows the collection of data from a defined population at a single point in time, enabling the evaluation of prevalence and associated factors without the need for long-term follow-up.

Study Area- The study was carried out in Gautam Buddha Nagar district, located in the state of Uttar Pradesh, India. This region is characterized by rapid urbanization, high population density, and a significant proportion of migrant population, which may contribute to increased risk of TB transmission. The presence of diverse socio-economic groups and varying levels of healthcare accessibility makes this area suitable for assessing awareness and risk factors related to TB.

Study Population- The study population comprised adolescents and young adults aged between 10 and 25 years. This age group was selected due to its increased vulnerability to TB infection and its critical role in disease transmission, as individuals in this group are

socially active and frequently interact in educational institutions, workplaces, and community settings.

Sample Size and Sampling Technique- A total of 100 participants were included in the questionnaire-based survey. Additionally, 50 chest X-ray and sputum test reports were reviewed to assess clinical and radiological findings related to TB. Participants for the questionnaire were selected using a convenience sampling method through online platforms. Individuals who were willing to participate and fell within the specified age group were included in the study. For the diagnostic component, available X-ray and sputum reports were collected and analyzed.

Inclusion and Exclusion Criteria

Inclusion Criteria:

- Individuals aged 10–25 years
- Residents of Gautam Buddha Nagar or nearby areas
- Participants who provided informed consent

Exclusion Criteria:

- Individuals outside the specified age group
- Incomplete questionnaire responses
- Participants unwilling to provide consent

Data Collection Tools and Procedure

Data were collected using a structured, pre-designed online questionnaire developed through Google Forms. The questionnaire consisted of both closed-ended and multiple-choice questions designed to assess:

- Demographic details (age, gender, education)
- Awareness regarding TB (cause, transmission, curability)
- Knowledge of symptoms (persistent cough, fever, weight loss, etc.)
- Risk factors (family history, tobacco/alcohol use)
- Vaccination status (BCG)
- Healthcare-seeking behavior

Awareness of TB-related programs

The questionnaire link was distributed through digital platforms, and responses were collected over a defined period.

In addition to survey data, 50 chest X-ray reports and sputum test results were reviewed to evaluate lung involvement and confirm TB-related findings. These reports were analyzed to identify patterns such as unilateral or bilateral lung involvement and extra-pulmonary manifestations.

Data Analysis- The collected data were organized and analyzed using simple descriptive statistical methods. Frequencies and percentages were calculated for all variables to summarize the findings. The results were presented in the form of tables and graphs to facilitate clear interpretation of data.

Ethical Considerations- Ethical principles were strictly followed throughout the study. Informed consent was obtained from all participants prior to data collection. Participants were informed about the purpose of the study, and their participation was entirely voluntary. Confidentiality and anonymity of the participants were maintained by not collecting personally identifiable information. The collected data were used solely for academic and research purposes.

Limitations of the Study- Although efforts were made to ensure accuracy, the study had certain limitations. The use of convenience sampling and online data collection may limit the generalizability of the findings. Additionally, self-reported data may be subject to recall bias. The relatively small sample size and limited number of diagnostic reports may also affect the representativeness of the results.

Results

Demographic Characteristics of Participants- A total of 100 participants were included in the questionnaire-based survey. The age-wise distribution (Fig.1) revealed that the majority of respondents belonged to the 20–25 years age group (56%), followed by the 15–19 years group (43%), while only 1% were aged between 10–14 years. This indicates that the study population was predominantly composed of late adolescents and young adults.

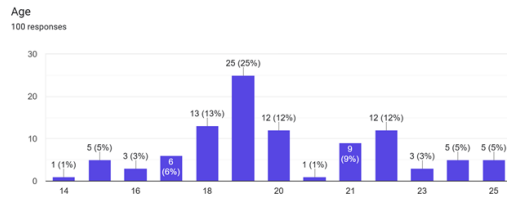


Fig.1 Age distribution of participants

Gender-wise distribution (Figure 2) showed that males constituted 58% of the study population, whereas females accounted for 42%. This suggests a slightly higher participation of male respondents in the study.

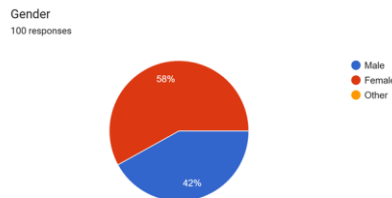


Fig.2 Gender distribution of participants

Clinical Symptoms of Tuberculosis-The distribution of commonly reported TB-related symptoms is presented in Figure 3. Persistent cough was identified as the most prevalent symptom, reported by 72% of participants. Other symptoms included fever (8%), night sweats (8%), weight loss (7%), and chest pain (5%). The predominance of persistent cough highlights its significance as a key clinical indicator of tuberculosis among adolescents and young adults.

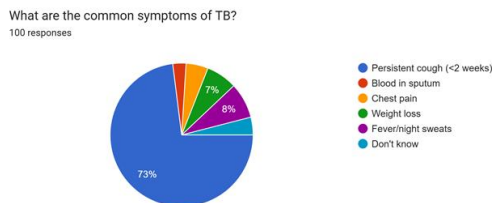


Fig.3 reported TB-related symptoms by participants

Family History of Tuberculosis-Table 4 illustrates the family history of tuberculosis among respondents. A total of 14% reported having a family history of TB, while the majority (83%) reported no such history. A small proportion (3%) were uncertain as seen in Figure 4. These findings suggest that although TB is not widespread in most families, household exposure remains a notable risk factor.

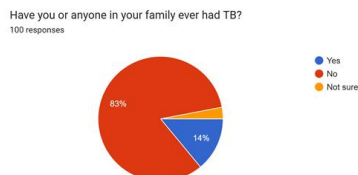


Fig.4 Family history of T.B

Knowledge Regarding Cause of Tuberculosis-As shown in Figure 5, the majority of respondents (88%) correctly identified bacteria as the causative agent of tuberculosis. However, 9% incorrectly believed TB to be caused by a virus, and 3% were unaware of the cause. This indicates a generally good level of basic knowledge, although some misconceptions still persist.

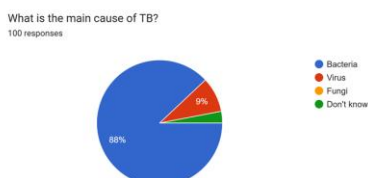


Fig.5 Causative agent identified by the participants

Awareness About Tuberculosis-Awareness levels regarding TB are summarized in Figure 6. A high proportion of respondents demonstrated correct knowledge regarding key aspects of the disease: 93% recognized TB as an infectious disease, 93% were aware that it spreads through the air, and 91% knew that TB is curable as per Figure 7.

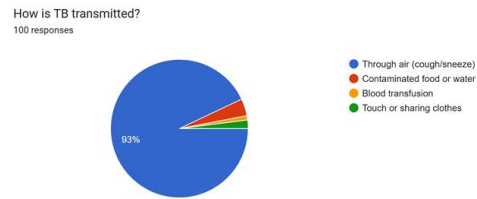


Fig.6 Understanding of respondents about TB transmission

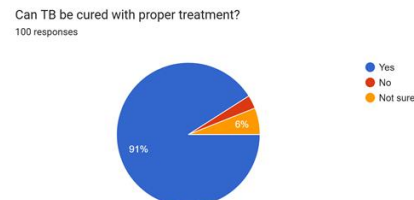


Fig.7 Awareness about cure of TB

Tobacco and Alcohol Use in Families- Figure 8 presents data on tobacco and alcohol use among family members. A total of 40% of respondents reported the presence of tobacco or alcohol use within their families, whereas 60% reported no such habits. This highlights the presence of behavioral risk factors that may contribute to TB susceptibility.

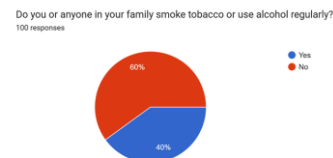


Fig.8 Use of tobacco and alcohol in families of respondents

Awareness of BCG Vaccination Status- As shown in Figure 9, only 28% of respondents reported being vaccinated with Bacillus Calmette-Guérin (BCG), while 64% were either not vaccinated or unaware of their vaccination status. Additionally, 8% were unsure. These findings indicate a significant lack of awareness regarding TB vaccination among the study population.

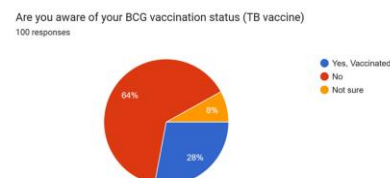


Fig. 9 Awareness about BCG vaccination

Healthcare-Seeking Behavior-Figure 10 illustrates the preferred first point of consultation among participants experiencing TB-like symptoms. The majority (56%) preferred private clinics, followed by 34% who opted for government hospitals. A small proportion chose local pharmacies (6%), home remedies (3%), or did not seek care at all (1%). This indicates a strong preference for private healthcare facilities over public services.

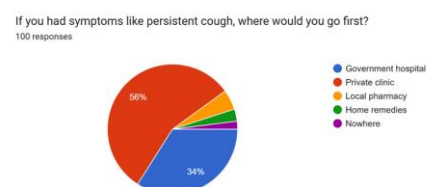


Fig.10 Preferred first point of consultation among participants experiencing TB

Awareness of TB Awareness Programs-Awareness regarding TB awareness programs is presented in Figure 11. A majority of respondents (76%) reported being aware of such programs conducted in schools, colleges, or communities, while 24% were unaware. This suggests that awareness initiatives are reaching a considerable proportion of the target population.

Are you aware of any TB awareness programs in your school/college or community?
100 responses

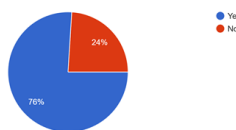


Fig.11 Awareness regarding TB awareness programs

Age and Gender Distribution of X-ray Cases-The distribution of 50 individuals whose chest X-ray reports were analyzed is shown in Table 1. Among these, 18 were males and 32 were females. The age range of participants was 14 to 25 years. The highest number of cases was observed in the age group of 22–23 years, particularly among females, indicating a higher representation of females in the diagnostic dataset.

Lung Involvement Based on Chest X-ray Findings

Table 2 presents lung involvement patterns based on chest X-ray and sputum test findings. Bilateral lung involvement was the most common finding, observed in 44% of cases. Right lung involvement was noted in 24% of cases, while left lung involvement was observed in 22%. Additionally, 8% of cases showed no lung involvement and were classified as extra-pulmonary TB. Only 2% of cases were confirmed through sputum testing. The predominance of bilateral lung involvement suggests possible delayed diagnosis or advanced disease progression among affected individuals. The dataset shows a total of 50 tuberculosis cases with a clear female predominance (32 cases, 64%) compared to males (18 cases, 36%). Pulmonary TB is the dominant form, with the majority of patients showing lung involvement, particularly bilateral pulmonary infiltration, indicating more extensive or advanced disease presentation. Unilateral involvement of the right and left lungs is also present but less frequent, suggesting localized infection in some cases. Extra-pulmonary TB and cases without lung involvement are relatively rare, highlighting that most patients present with pulmonary disease rather than isolated extrapulmonary involvement. Overall, the pattern suggests a higher burden of bilateral pulmonary TB in this population, with females being more affected in this dataset.

Table 1. Chest X-ray reports and sputum test results summary

Male	Female	Total Cases	Lungs involvement	Findings
0	1	1	Right lung	Unilateral pulmonary infiltration
4	0	4	Bilateral lungs	Bilateral pulmonary infiltration
2	0	2	left lung	Unilateral pulmonary infiltration
0	4	4	Bilateral lungs	Bilateral pulmonary infiltration
1	0	1		Sputum test
1	0	1	left lung	Unilateral pulmonary infiltration
0	1	1	Right lung	Unilateral pulmonary infiltration
0	7	7	Bilateral lungs	Bilateral pulmonary infiltration

0	3	3	left lung	Unilateral pulmonary infiltration
3	0	3	Bilateral lungs	Bilateral pulmonary infiltration
0	3	3	No lungs involvement	Extra Pulmonary TB Finding only
0	2	2	Right lung	Unilateral pulmonary infiltration
0	3	3	Bilateral lungs	Unilateral pulmonary infiltration
0	1	1	No lungs involvement	Extra Pulmonary TB Finding only
0	2	2	left lung	Unilateral pulmonary infiltration
0	2	2	Right lung	Unilateral pulmonary infiltration
6	0	6	Right lung	Unilateral pulmonary infiltration
1	0	1	Bilateral lungs	Bilateral pulmonary infiltration
0	3	3	left lung	Unilateral pulmonary infiltration
18	32	50		

Table 2. lung involvement patterns based on chest X-ray and sputum test findings.

Lungs involvement	Chest X-ray findings	Number of cases	Percentage (%)
Right lung	Unilateral pulmonary infiltration	12	24%
Left lung	Unilateral pulmonary infiltration	11	22%
Bilateral lung	Bilateral pulmonary field infiltration	22	44%
No lung involvement	Extra pulmonary TB findings only	4	8%
Sputum test	—	1	2%
Total		50	100%

Overall, the results indicate that while general awareness about tuberculosis is relatively high among adolescents and young adults, significant gaps remain in knowledge regarding treatment services and vaccination. Furthermore, clinical and radiological findings highlight the importance of early detection and timely intervention.

Discussion

This study highlights TB as a significant health concern among adolescents and young adults. The predominance of persistent cough as a symptom is consistent with earlier studies (Snow *et al.*, 2017; Krishnamoorthy *et al.*, 2023). Although awareness regarding transmission and curability is high, the extremely low awareness of free treatment services is concerning and may delay treatment initiation. Similar findings have been reported by Laycock *et al.* (2021), emphasizing the role of awareness in TB control. The presence of tobacco and alcohol use within families further increases susceptibility to TB, as documented by Narasimhan *et al.* (2013). Additionally, poor awareness of BCG vaccination highlights gaps in preventive healthcare knowledge. The preference for private healthcare suggests perceived limitations in public health services. Psychosocial factors such as stigma, fear, and emotional stress also

influence treatment-seeking behavior (Moscibrodzki *et al.*, 2021; Bala *et al.*, 2025). Radiological findings showing high bilateral lung involvement indicate delayed diagnosis and treatment, which increases disease transmission risk. Adolescents often face barriers such as stigma, lack of targeted healthcare services, and insufficient support systems (Snow *et al.*, 2021; Parwitha *et al.*, 2025).

Conclusion

The study concludes that TB remains a major public health issue among adolescents and young adults. While general awareness about TB exists, critical gaps remain in knowledge regarding free treatment services and vaccination. Persistent cough is the most prominent symptom, and delayed diagnosis is evident from radiological findings. Addressing these gaps through targeted awareness programs, early screening, and improved healthcare access is essential for effective TB control.

Recommendations

- Increase awareness of free TB treatment programs
- Strengthen school and college-based TB education
- Promote early diagnosis and screening
- Improve awareness of BCG vaccination
- Develop adolescent-friendly healthcare services

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