



RESEARCH ARTICLE

Utility of the Mantoux Test in the Diagnosis of Tuberculosis in Pediatric Population of a Tertiary Care Hospital, Patna

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ABSTRACT

Background: Tuberculosis (TB) is a serious public health concern, particularly in children, where identification is sometimes difficult due to vague symptoms and paucibacillary illness. The Mantoux test (tuberculin skin test) is still commonly used as a screening tool, particularly in resource-limited situations.

Objective: To assess the diagnostic usefulness of the Mantoux test in detecting tuberculosis in children at a tertiary care hospital.

Methods: Prospective observational research was carried out on 150 paediatric patients suspected of tuberculosis. Mantoux testing was performed for all patients. Clinical, radiological, and microbiological findings were obtained. The diagnosis was established either by microbiological confirmation of *Mycobacterium tuberculosis* or by a composite clinical diagnosis based on compatible clinical features, radiological findings and the treating physician's assessment, as per NTEP guidelines. Diagnostic characteristics such as sensitivity, specificity, and predictive values were measured.

Results: Out of 150 paediatric patients, 95 (63.3%) were Mantoux-positive and 55 (36.7%) were Mantoux-negative. Among the Mantoux-positive children, 75 were confirmed to have TB according to the predefined diagnostic criteria, while 20 were TB-negative. Among the Mantoux-negative children, 15 were confirmed TB cases and 40 were TB-negative. The Mantoux test demonstrated a sensitivity of 83.3% and a specificity of 66.7%, with a positive predictive value (PPV) of 78.9% and a negative predictive value (NPV) of 72.7%. A positive Mantoux test was significantly associated with confirmed tuberculosis ($p < 0.001$).

Conclusion: The Mantoux test remains a helpful diagnostic tool in paediatric tuberculosis, although it should be used in conjunction with clinical and radiographic findings.

Keywords: Tuberculosis, paucibacillary illness, Mantoux test, tuberculin skin test, paediatric

Indian J. Pharm. Biol. Res. (2026); <https://doi.org/10.30750/ijpbr.14.3.60>

INTRODUCTION

Tuberculosis (TB) is one of the most common infectious illnesses in the world, with children accounting for a major but typically underdiagnosed portion of the burden. According to the WHO Global Tuberculosis Report 2023, an estimated 10.6 million persons contracted tuberculosis in 2022, with around 12% being children under 15 years. India accounts for almost 27% of global tuberculosis cases, demonstrating both significant transmission and persisting diagnostic deficiencies[1].

Diagnosing TB in youngsters is especially difficult. Paediatric tuberculosis is often paucibacillary, with low bacillary loads, making bacteriological confirmation via smear or culture challenging. Collecting appropriate specimens such as sputum or stomach aspirates can be technically difficult, particularly in very young children. As a result, the diagnosis of paediatric TB often relies on a combination of clinical assessment, radiological findings, epidemiological history, and available microbiological and immunological investigations[2].

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How to cite this article: Kumari R, Kumari N, Kumar R, Gupta AK, Muni S, Kumari N. Utility of the Mantoux Test in the Diagnosis of Tuberculosis in Pediatric Population of a Tertiary Care Hospital, Patna. Indian J. Pharm. Biol. Res. 2026;14(3):380-384.

Source of support: Nil

Conflict of interest: None.

Received: 05/08/2026 **Revised:** 01/09/2026 **Accepted:** 02/09/2026

The Mantoux test (tuberculin skin test, TST) is still one of the most extensively utilised diagnostic techniques

in children, as recommended by both the National TB Elimination Programme (NTEP, 2023) and the WHO latent tuberculosis infection recommendations (2020). It is simple, affordable, and viable in low-resource environments[3]. However, the interpretation of the Mantoux test has important limitations. False positives can occur owing to prior BCG vaccination or environmental mycobacteria, and false negatives can occur due to severe malnutrition or immunosuppression. The test still has significant diagnostic significance when combined with clinical and radiological findings[4].

A tertiary care centre study in India indicated that utilising higher cut-offs (≥ 15 mm) resulted in a sensitivity of $\sim 95.9\%$ and a specificity of $\sim 95.2\%$ (6). In rural communities with significant malnutrition prevalence, Mantoux positive was lower ($\sim 33.3\%$), indicating the role of host variables [5].

Despite modern molecular technologies such as GeneXpert MTB/RIF, the Mantoux test remains vital, particularly in resource-constrained places such as Bihar, where access to molecular diagnostics is limited [6]. Given the local disease load, high malnutrition incidence, and limited availability of molecular diagnostics, it is critical to evaluate the Mantoux test's diagnostic usefulness in the paediatric population of Patna, Bihar. Such evidence can help physicians and boost local tuberculosis control initiatives in line with national and international objectives.

MATERIALS & METHODS

This hospital-based prospective observational study was conducted in the Department of Microbiology, Indira Gandhi Institute of Medical Sciences (IGIMS), Patna, over a period of six months. The study population comprised children younger than 12 years of age who presented with clinical suspicion of tuberculosis (TB). A total of 150 paediatric patients meeting the eligibility criteria were enrolled consecutively during the study period.

Children were considered eligible if they had clinical features suggestive of TB, including a history of close contact with a confirmed TB case, persistent fever lasting more than two weeks, persistent cough for more than two weeks, or significant lymphadenopathy suggestive of tuberculous involvement. Children who had previously received anti-tubercular treatment, those with known immunodeficiency disorders such as HIV infection, children suffering from severe malnutrition, and those with severe skin conditions that precluded the administration or interpretation of the Mantoux tuberculin skin test (TST) were excluded from the study.

Demographic, clinical, laboratory, and microbiological

Table 1: Demographic Characteristics

Parameter	Number (%)
Total Patients	150
Male	87 (58.0)
Female	63 (42.0)
Mean age (years)	8.5 $\pm$ 3.2

data were collected using a structured data collection form. Mantoux testing was performed for all enrolled patients according to standard guidelines. The test was done by injecting 0.1 mL of tuberculin intradermally into the middle one third of the volar surface of right or preferably left forearm with 5 TU PPD-S using tuberculin syringe with 27-gauge needle without massaging or pressing the area and the induration was measured in good light, along the transverse axis of forearm after 48–72 hours by a trained healthcare personnel using the “ball point pen” technique of Sokal. A Mantoux reaction measuring ≥ 10 mm of induration was considered positive, while an induration of < 10 mm was considered negative. The same cutoff was applied uniformly to all study participants.

The diagnosis of tuberculosis was established based on a combination of clinical findings, radiological investigations, microbiological evidence, and the treating physician's assessment in accordance with national guidelines.

All collected data were entered into Microsoft Excel and analysed using SPSS version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean $\pm$ standard deviation (SD), whereas categorical variables

Table 2: Association between Mantoux Test and TB Diagnosis

Mantoux Result	TB Positive	TB Negative	Total	p-value
Positive	75	20	95	<0.001
Negative	15	40	55	
Total	90	60	150	

Table 3: Diagnostic Performance

	Value (%)	95% confidence interval
Sensitivity	83.3	74.6-89.8
Specificity	66.7	54.1-77.2
PPV or Positive predictive value	78.9	69.8-85.8
NPV or Negative predictive value	72.7	59.8-82.7

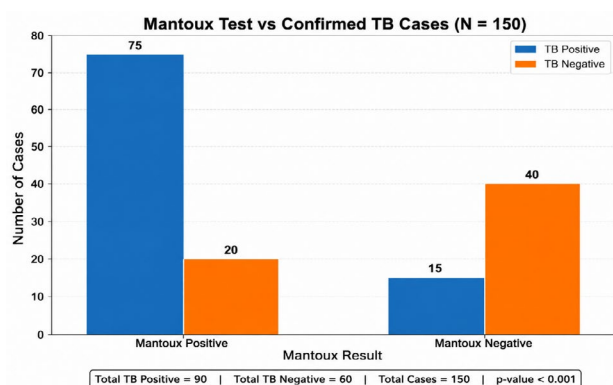


Figure 1: Mantoux test Vs confirmed TB cases

were presented as frequencies and percentages. The association between Mantoux test results and the predefined tuberculosis diagnostic classification was assessed using the Chi-square test of independence, with Fisher's exact test used where appropriate. The diagnostic performance of the Mantoux test was evaluated by calculating sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV). A p-value <0.05 was considered statistically significant, and all estimates were reported with 95% confidence intervals.

RESULTS

The Mantoux test demonstrated a sensitivity of 83.3%, specificity of 66.7%, positive predictive value of 78.9%, and negative predictive value of 72.7%. These findings indicate that the Mantoux test has good sensitivity for detecting tuberculosis among pediatric patients, although its specificity remains moderate. The association between

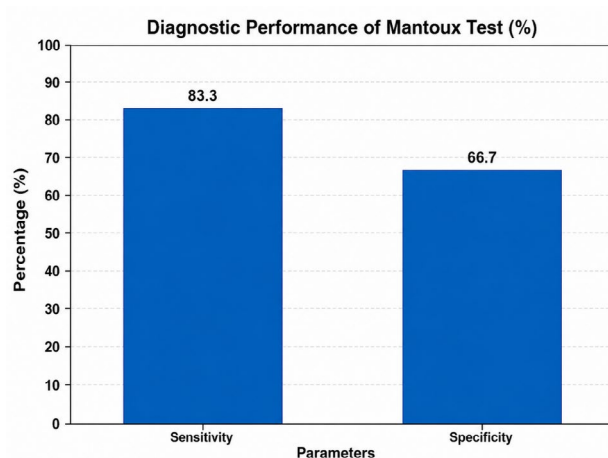


Figure 2: Diagnostic performance of the Mantoux test (%)

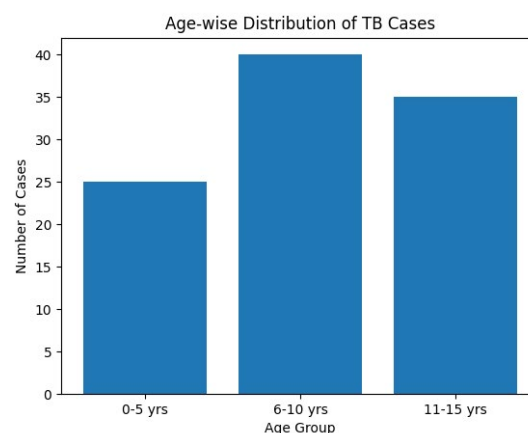


Figure 3: Age-wise distribution of TB cases

Mantoux positivity and confirmed tuberculosis was statistically significant ($p < 0.001$).

DISCUSSION

The current study evaluated the efficacy of the Mantoux test in identifying paediatric tuberculosis. The results demonstrated that the Mantoux test has moderate sensitivity and specificity, indicating that although it should not be considered a definitive stand-alone diagnostic modality, it remains a valuable supplementary tool. The Mantoux test continues to be useful as an accessible and affordable screening test in paediatric practice, where bacteriological confirmation is often difficult because of the paucibacillary nature of the disease and challenges in obtaining sputum samples [2].

In the present study, the Mantoux test demonstrated a sensitivity of 83.3% and a specificity of 66.7%, findings that are comparable to those reported by Khan et al. (2022) (8). The observed sensitivity indicates good diagnostic performance in identifying paediatric tuberculosis. However, false-negative results were observed in a proportion of confirmed tuberculosis cases, emphasizing that a negative Mantoux test does not exclude the disease, particularly in immunocompromised or malnourished children [9]. Therefore, despite its widespread use, the Mantoux test alone is not sufficiently reliable for the diagnosis of tuberculosis, and confirmation through more advanced diagnostic modalities remains essential.

A comparatively higher proportion of false-positive results was reflected in the specificity of 66.7%. Several factors common in endemic settings may explain this finding. Previous Bacillus Calmette–Guérin (BCG)

vaccination can lead to cross-reactivity and induration, particularly when vaccination is recent or repeated [11]. Exposure to environmental non-tuberculous mycobacteria may also trigger a positive cutaneous reaction, as reported by Balasankar and Balasubramanian (2017) [12]. Furthermore, latent tuberculosis infection without active disease may result in a positive Mantoux test, thereby reducing specificity when the objective is to diagnose active tuberculosis.

Mantoux positivity demonstrated a statistically significant association ($p < 0.001$) with confirmed cases of tuberculosis, supporting its clinical utility as a screening and supportive diagnostic test, consistent with findings reported by Loh (2011) [13]. A positive test should prompt further evaluation and timely initiation of treatment, particularly in children who are symptomatic and have a history of tuberculosis contact or suspicious radiological findings [14].

However, a negative Mantoux test does not rule out tuberculosis. This is especially relevant in immunocompromised individuals, malnourished children, and patients with severe illnesses, in whom anergy may suppress the delayed hypersensitivity response and result in false-negative outcomes. In the present study, severely malnourished children and those with known immunodeficiency disorders were excluded; therefore, the direct impact of these conditions on Mantoux test performance could not be assessed. Similar variations in diagnostic performance across different populations have been reported in previous studies [2]. Differences in nutritional status, BCG vaccination history, endemic exposure, interpretation criteria, and disease burden may influence test outcomes.

Consequently, reliance on the Mantoux test alone is not appropriate for diagnosing paediatric tuberculosis. A comprehensive diagnostic approach incorporating clinical evaluation, nutritional assessment, chest radiography, microbiological investigations whenever feasible, and immunological testing is essential for the accurate diagnosis and management of paediatric tuberculosis [15]. Limitation: The relatively small sample size may limit the generalizability of the results to the wider paediatric population. In addition, IGRAs were not included for comparison with the Mantoux test. Children with known immunodeficiency disorders and severe malnutrition were excluded; therefore, the performance of the Mantoux test in these groups could not be evaluated. Further multicentric studies with larger sample sizes and comparison with other diagnostic methods are needed to provide a more comprehensive assessment of the role of the Mantoux test in paediatric tuberculosis.

CONCLUSION

The Mantoux test is still a useful, straightforward, and inexpensive method for evaluating paediatric tuberculosis in its early stages. However, because of its moderate sensitivity and specificity, it should not be utilised alone. A multidisciplinary diagnostic strategy is required for an accurate diagnosis. The Mantoux exam remains an important support tool, particularly in resource-constrained situations.

Ethical Approval

The study was approved by the Institutional Ethics Committee of Indira Gandhi Institute of Medical Sciences (IGIMS), Patna, Bihar. The study was conducted in accordance with the ethical principles governing research involving human participants, and confidentiality of participant information was maintained throughout the study.

ACKNOWLEDGMENTS

The authors sincerely acknowledge the Department of Microbiology, Indira Gandhi Institute of Medical Sciences (IGIMS), Patna, for institutional support and laboratory facilities to conduct this study. We are grateful to the clinicians, nursing staff, laboratory personnel, and other healthcare workers for their valuable assistance throughout the study. We also sincerely thank all the children and their parents or legal guardians for their participation and cooperation.

No external funding was received for this study.

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