

# Mantoux's Test and Diagnostic BCG for Diagnosis of Tuberculosis in Children

FAHAD NAZIR<sup>1</sup>, QIAM UD DIN<sup>2</sup>, ZUBARIAH<sup>3</sup>, SABA AFZAL SHAIKH<sup>4</sup>, IBRAHIM<sup>5</sup>, ABID RAFIQ CHAUDHRY<sup>6</sup>

<sup>1</sup>Senior Registrar, Department of Pediatric, Sialkot Medical College, Sialkot

<sup>2</sup>District Children Specialist, Department of Pediatric Medicine, District Headquarter hospital Timergara Lower Dir, kpk

<sup>3</sup>Department of Pediatric, Women Medical Officer isfandyar Bukhari hospital, DHQ, Attock

<sup>4</sup>Associate Professor, Paediatrics, Akhtar Saeed medical college Rawalpindi

<sup>5</sup>Associate Professor, Paeds Medicine, Swat Medical College/Swat Medical Complex Teaching Hospital Saidu sharif, Swat

<sup>6</sup>Consultant Pediatric Critical Care medicine, FMH College of Medicine and Dentistry, Lahore

Corresponding author: Qiam ud Din, Email: [kashafqiamuddin@yahoo.com](mailto:kashafqiamuddin@yahoo.com)

## ABSTRACT

**Objective:** To determine the diagnostic accuracy of Mantoux's test and diagnostic BCG test in the diagnosis of tuberculosis in children by taking AFB (acid fast bacilli) sputum test as gold standard.

**Study Design:** Cross Sectional study.

**Setting:** Imran Idrees Teaching Hospital Sialkot.

**Duration of Study:** This study was conducted from 1st August 2021 to 31st August 2022.

**Subjects and methods:** A total of 260 patients of both gender presented with history of cough, fever and weight loss with history of close contact with tuberculosis were included. Mantoux's test and diagnostic bacilli calmette Guerin was applied simultaneously to all the subjects. Data regarding Mantoux's test, diagnostic bacilli calmette Guerin and AFB (acid fast bacilli) sputum test was recorded.

**Results:** Mantoux's test diagnosed 10.4% patients, Diagnostic BCG test 13.8% and AFB diagnosed 16.9% patients with Tuberculosis. Mantoux's test has shown sensitivity of 29.54%, specificity 93.5%, diagnostic accuracy by 83%, PPV 48.1%, NPV 86.7% in diagnosis of Tuberculosis. Diagnostic BCG test has shown sensitivity of 59.09%, specificity 95.4%, diagnostic accuracy by 89%, PPV 72.2%, NPV 91.9% in diagnosis of Tuberculosis.

**Conclusion:** BCG test is more sensitive than the Mantoux's test but the specificity of Mantoux's test was equal to the BCG test.

**Keywords:** Tuberculosis, Mantoux's test, Diagnostic BCG, Diagnostic accuracy

## INTRODUCTION

Underdiagnosis of paediatric pulmonary tuberculosis (PTB) continues to be a barrier to proper treatment anywhere in the world. There is low risk of community-wide spread of tuberculosis from a child's case because paucibacillary illness is the norm for paediatric cases. Consequently, TB control initiatives have not prioritised the diagnosis and treatment of children with TB until recently. In tuberculosis-endemic regions, children bear a disproportionate share of the illness burden. In 2012, researchers attempted to put a number on the prevalence of TB among youngsters, and their best estimate was that there were 490,000 new cases in 2011 and 65,000 deaths [1]. Nonetheless, many cases of tuberculosis in children go unreported. Whereas estimates from tuberculosis endemic areas show proportions of 10-15% [2], the number of children with TB is considered to be fewer than 6% of total incident cases. In addition, limited access to diagnostic services in most tuberculosis hotspots results in often sketchy reports of childhood TB from national tuberculosis control programmes. Non-microbiological diagnostics in these settings are unreliable and of low quality [3].

For many years, the Mantoux test was the sole available method of detecting latent tuberculosis infection [4]. Many false positives can be attributed to the Mantoux test because of its cross-reactions with the Bacillus Calmette-Guérin (BCG) vaccination and environmental mycobacteria. False negative results can also be caused by things like deep injection or viral infections. An improved diagnostic tool for latent tuberculosis infection would be a novel test that is more specific than the Mantoux test and whose result is not influenced by prior BCG vaccination.

Protective against tuberculosis, especially tuberculous meningitis, Bacillus calmette Guerin is essentially a live attenuated vaccine. Kock's phenomenon forms the basis of the diagnostic use of Bacille calmette Guerin. When administered to a kid with tuberculosis, Bacillus calmette Guerin causes an immediate reaction at the immunisation site, rather than the typical delayed reaction seen in children without tuberculosis (after 3-6 weeks) [5].

Diagnostic BCG had a sensitivity of 60.6% and specificity of 70% with a positive predictive value of 38.46% and a negative predictive value of 85.22%, while the Mantoux test had a sensitivity

of 30.30%, specificity of 83.17%, a PPV of 35.71%, an NPV of 79.46%, and an accuracy of 70.71%. BCG was found to have an accuracy of 67.85% in the diagnosis of paediatric tuberculosis [6].

Justification: There is a lack of information on this topic among the general public. To now, research from Lahore is limited to a single study [6]. Using the AFB (acid fast bacilli) sputum test as the gold standard, the current study will compare the sensitivity of the Mantoux test and the diagnostic BCG test for identifying paediatric tuberculosis. Better tuberculosis diagnosis is a direct result of the information gleaned from my study, which will inform future investigations on the subject.

## MATERIALS AND METHODS

This cross-sectional study was conducted at Department of Pediatric Medicine, Allama Iqbal Memorial Teaching Hospital Sialkot, during from the period 1<sup>st</sup> August 2021 to 31<sup>st</sup> August 2022. A sample size of 260 is calculated at 95% confidence interval and taking expected prevalence of tuberculosis was 15% and sensitivity and specificity of BCG was 60.6% and 70% respectively at 13% margin of error [6].

### Inclusion Criteria:

- Children age 1-12 years
- Both Gender
- Presented with history of cough and fever (>101°F by thermometer) >14days
- History of weight loss on medical record
- History of close contact with tuberculosis for at least three months
- Height and weight less than 50th centile for age on physical examination

### Exclusion Criteria:

- H/o Asthma on medical record
- H/o Bronchiolitis on medical record
- H/o Viral or bacterial meningitis on medical record
- H/o Malignancies on medical record
- Patients who are already on anti-tuberculous therapy

**Data Collection Procedure:** Following approval from the hospital's ethics council, 260 children who met the inclusion criteria were recruited from the Pediatrics Medicine inpatient unit at Allama Iqbal Memorial Teaching Hospital in Sialkot. Patients' basic

characteristics (age, gender, and weight) were recorded. Children whose parents or guardians gave their permission to participate in the study were assured of privacy and knew that their children were not at risk in any way.

All of the participants were given both the Mantoux test and the diagnostic bacilli calmette Guerin at the same time. The Mantoux test requires injecting 0.1 ml of a pure protein derivative intradermally on the volar surface of the arm using a tuberculin syringe. The diagnostic bacilli calmette Guerin was administered intradermally over the left deltoid with 0.1 ml of standard bacilli calmette guerin vaccination using a tuberculin syringe. A perimeter was set up around the inoculated zone. The Mantoux test result was interpreted at 72 hours, and the bacilli calmette guerin result was also recorded at 72 hours. Everything was carried out under the watchful eye of a consultant paediatrician with three years' experience after fellowship. After that, sputum was collected from everyone in a jar and sent to the lab for an AFB (acid fast bacilli) sputum test. The researcher himself documented the results of the Mantoux's test, the diagnostic bacilli calmette Guerin test, and the AFB (acid fast bacilli) sputum test on a specially created proforma.

IBM-SPSS version 22 was used for data entry and analysis. All quantitative factors, including age, weight, and complaint duration, were subjected to a mean standard deviation analysis. Quantitative data was also analysed, including the distribution of qualitative variables like gender. Mantoux's test/diagnostic bacilli calmette Guerin's sensitivity, specificity, Positive predictive value, Negative predictive value, and diagnostic accuracy were determined using a 2X2 model for the detection of AFB (acid fast bacilli) in sputum. Diagnostic accuracy was measured for both groups,  $p < 0.05$  was regarded statistically significant.

**RESULTS**

Age range in this study was from 1 to 12 years with mean age of  $6.465 \pm 2.28$  years, mean duration of complain was  $24.665 \pm 5.45$  days and mean weight was  $7.696 \pm 1.25$  Kg as shown in Table-I.

Table-1: Mean± SD of age, duration of complain and weight (n=260)

Demographic variables	Mean ± SD
Age(years)	6.465± 2.28
Duration of Complain (days)	24.665±5.45
Weight (Kg)	7.696± 1.25

Out of 260 patients, 115 (44.2%) were males while 145 (55.8%) patients were females as shown in figure 1.

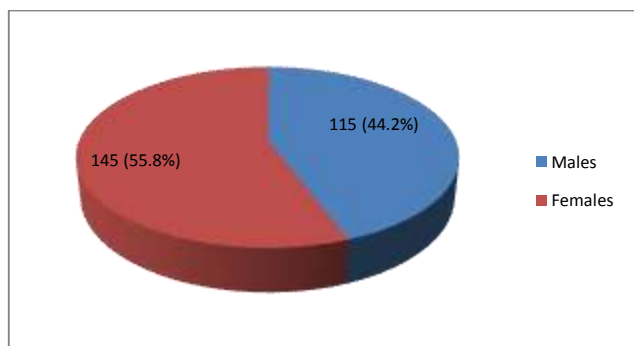


Figure 1: Gender-wise distribution

Mantoux's test diagnosed 27(10.4%) patients, Diagnostic BCG test 36(13.8%) and AFB diagnosed 44(16.9%) patients with Tuberculosis as shown in Table-II.

Table-2: Overall results of Mantoux's test, diagnostic BCG test and AFB

Tuberculosis	Mantoux's test	Diagnostic BCG test	AFB
Positive	27(10.4%)	36(13.8%)	44(16.9%)
Negative	233(89.6%)	224(86.2%)	216(83.1%)
Total	260 (100%)	260 (100%)	260 (100%)

Mantoux's test has shown sensitivity of 29.54%, specificity 93.5%, diagnostic accuracy by 83%, PPV 48.1%, NPV 86.7%, ( $p=0.000$ ) in diagnosis of Tuberculosis as shown in Table-III respectively.

Table-3: Comparison of Mantoux's test versus AFB

Mantoux's test	AFB (Gold Standard)		Total
	Positive	Negative	
Positive	13 (TP)	14 (FP)	27
Negative	31 (FN)	202 (TN)	233
Total	44	216	260

Chi square = 20.89, P value = 0.000

Sensitivity 29.54%, Specificity 93.5%, PPV 48.1%, NPV 86.7%, Diagnostic Accuracy 86.7%

Diagnostic BCG test has shown sensitivity of 59.09%, specificity 95.4%, diagnostic accuracy by 89%, PPV 72.2%, NPV 91.9%, ( $p=0.000$ ) in diagnosis of Tuberculosis as shown in Table-IV.

Table-4: Comparison of diagnostic BCG test versus AFB

Diagnostic BCG test	AFB (Gold Standard)		Total
	Positive	Negative	
Positive	26 (TP)	10 (FP)	36
Negative	18 (FN)	206 (TN)	224
Total	44	216	260

Chi square = 90.89, P value = 0.000

Sensitivity 59.09%, Specificity 95.4%, PPV 72.2%, NPV 91.9%, Diagnostic Accuracy 89%

**DISCUSSION**

Since the year 2000, the number of people who have been infected with tuberculosis has steadily climbed, eventually reaching 10 million in 2005 [7], with nearly 2 million people losing their lives to the disease. This epidemic is primarily affecting low-income countries, which are home to 86 percent of the world's population. Pakistan comes up at number seven on the list of countries having a disease burden comparable to that of other nations [8]. It can be difficult to diagnose tuberculosis in children due to the low success rate of conventional laboratory tests and the absence of recognisable symptoms in the early stages of the disease. However, there are newer diagnostics that have a higher success rate. In undeveloped nations, a diagnosis of tuberculosis is still established based on a positive tuberculin test, clinical and radiological symptoms, and a history of contact with an adult source case. This is the case despite the availability of tests that are both more quick and sensitive. The tuberculin skin test continues to be an important diagnostic tool for tuberculosis even in areas with limited resources. Infection with Mycobacterium TB results in a heightened sensitivity to tuberculins, which are components of the bacterium that may be isolated from culture extracts. In cases of tuberculous meningitis, miliary tuberculosis, measles, severe malnutrition, and immunosuppression, however, it has a high false-negative rate [10]. In a similar vein, the findings of radiographic examinations performed on children who have tuberculosis are inconclusive. There have been a number of studies, both older and more recent ones, that have investigated the possible diagnostic value of the BCG test in tuberculosis with PPD. According to the findings of this study, patients with confirmed cases of tuberculosis had a greater rate of positive BCG test results (81%) compared to positive Mantoux test results (61%). This study is comparable to one that was conducted by Iqbal MJ et al. [10], in which the researchers discovered that 81% of patients tested positive for BCG and that 50% of patients tested positive for Mantoux. According to Shrivastava et al. [11], positive outcomes for BCG and PPD were determined to be 87% and 19% respectively. Udani observed results that were comparable to those of my own research [12], finding that 88% of patients had

positive BCG test results and 52% had positive Mantoux test results. During the course of this investigation, it was discovered that the sensitivity of the BCG test was 59.09%, whereas the sensitivity of the Mantoux test was found to be 29.54%. On the other hand, the specificity of the BCG test was found to be 95.4%, whereas the specificity of the Mantoux test was found to be 93.5%. In confirmed cases of tuberculosis, the BCG test had a sensitivity of 77.1% but only a specificity of 39.0%, whereas the Mantoux test had a sensitivity of 44.0% but a specificity of 80.0%. The findings of my study are comparable to those published by Ayhan et al. [13], who discovered that the BCG test had a sensitivity of 77.1% but only a specificity of 39.0%. The BCG test has a higher sensitivity (i.e., 81-92%) than the tuberculin test (i.e., 45.5-52.3%), however their respective specificities (i.e., 82.5-100%) are equivalent to one another. This is according to study that was conducted by Bothamley et al. [14]. According to this research, the BCG test was accurate 89% of the time, while the Mantoux test was only successful 83% of the time.

In comparison, the Mantoux test had a sensitivity of 30.30%, specificity of 83.17%, a PPV of 35.71%, an NPV of 79.46%, and an accuracy of 70.71%. The diagnostic BCG had a sensitivity of 60.6% and a specificity of 70%, with a positive predictive value of 38.46% and a negative predictive value of 85.22%. When applied to the process of diagnosing tuberculosis in children, BCG was found to have an accuracy of 67.85% [6].

It is frequently difficult to offer a fast and correct diagnosis of tuberculosis in undeveloped nations such as Pakistan due to the lack of proper health care infrastructure in these countries. Paediatric tuberculosis is not the same as tuberculosis that affects adults in any manner, shape, or form. This is due to the fact that children typically do not exhibit the traditional TB symptoms. Confirming or diagnosing tuberculosis using microbiological methods is an extremely difficult task.

This study had some shortcomings, notably the fact that the diagnosis of tuberculosis in children was based on an AFB sputum smear examination rather than culture, which is considered to be the gold standard.

## CONCLUSION

BCG test is more sensitive than the Mantoux's test but the specificity of Mantoux's test was equal to the BCG test. Also the accuracy of BCG was not significantly different from Mantoux's test neither was the positive or negative predictive value.

## REFERENCES

- 1 World Health Organization . Global tuberculosis report. Geneva: World Health Organization; 2012.
- 2 Perez-Velez CM, Marais BJ. Tuberculosis in children. *N Engl J Med*. 2012;367:348-61.
- 3 Marais BJ, Graham SM, Maeurer M, Zumla A, Emerging S. Progress and challenges in childhood tuberculosis. *Lancet Infect Dis*. 2013;13:287-9.
- 4 Masoumi-Asl H, Alborzi A, Pourabbas B, Kalani M. QuantiFERON-TB gold and tuberculin skin test for the diagnosis of latent tuberculosis infection in children. *Iran J Med Sci*. 2015;40(5):411-7.
- 5 Zheng Y, Naguib YW, Dong Y, Shi Y, Bou S, Cui Z. Applications of bacillus calmette-guerin and recombinant bacillus calmette-guerin in vaccine development and tumor immunotherapy. *Expert Rev Vaccines*. 2015;14(9):1255-75.
- 6 Jabeen U, Umer H, Malik SS, Hamid S. Comparison of mantoux's test with diagnostic bcg in children with tuberculosis. *Proceeding SZPGMI*. 2016;30(2):95-9.
- 7 World Health Organization. Global tuberculosis control: surveillance, planning, financing. Geneva: WHO, 2005.
- 8 World Health Organization. Global tuberculosis control. Geneva: WHO, 2003.
- 9 Hussain A, Mirza Z, Qureshi F, Hafeez A. Adherence of private practitioners with the national tuberculosis treatment guidelines in Pakistan: a survey report. *J Pak Med Assoc* 2005; 55:17-9.
- 10 Iqbal MJ, Sarfraz M. Comparison of diagnostic BCG with mantoux's test with suspicion of tuberculosis. *Ann KE Med Coll* 2003; 9:24-9.
- 11 Shrivastava DK, Shingwekar AG, TH awrani Y. Evaluation of BCG test in childhood tuberculosis. *Indian J Pediatr* 1977; 14:993- 98.
- 12 Udani PM. Tuberculosis in children. *Pediatr Clin India*.1983; 18:143-56.
- 13 Ayhan C, Atlyhan F, Can D, Genel F, Cevik B, Yzmir D et al. Value of BCG test and PPD test to assist the diagnosis of childhood tuberculosis. *Turkish Respiratory Journal*. 2007; 8:95-8.
- 14 Bothamley GM, Cooper E, Shingadia D, Mellanby A. Tuberculin testing before BCG vaccination. *BMJ* 2003; 327:243-4