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The Spectrum of Radiographic Appearances of Pulmonary Tuberculosis in Children

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HIGHLIGHTS

- Diverse PTB radiological patterns.
- HRCT detects more cavities.
- HRCT shows lymphadenopathy better.
- CXR may miss lesions.
- CT detects complications.

Key Words:

Pediatric pulmonary tuberculosis
Chest radiography
HRCT chest
Mediastinal lymphadenopathy

ABSTRACT

Introduction: The Pediatric pulmonary tuberculosis (PTB) is diagnostically challenging because of nonspecific clinical manifestations, paucibacillary disease, and difficulties in obtaining microbiological confirmation. The Radiological imaging plays an important role in identifying the diverse manifestations of PTB. **Aim & Objective:** This study aimed to describe the spectrum of radiographic appearances of pulmonary tuberculosis in children and compare chest radiography (CXR) with computed tomography (CT). **Material & Methods:** This prospective observational study was conducted in the Department of Radiodiagnosis, G.R. Medical College, Gwalior, from April 2023 to March 2025. Fifty-five children aged 2 months to 18 years with suspected or confirmed pulmonary tuberculosis were included. Patients underwent digital CXR and HRCT chest according to clinical requirements. Demographic, clinical, radiographic, and CT findings were recorded and analyzed. **Results:** Of 55 patients, 54.55% were males and 45.45% females, with the 12–18-year age group predominating (43.64%). Persistent cough was the commonest clinical presentation (50.91%), followed by chronic fever (40%). On CXR, inhomogeneous opacities were most frequent (30.9%), followed by cavities and bulky hilum (18.2% each), pleural effusion (14.5%), and miliary tuberculosis (7.3%). HRCT demonstrated cavities in 58.2%, mediastinal lymphadenopathy in 43.6%, consolidation in 25.5%, centrilobular nodular/tree-in-bud opacities in 23.6%, pleural effusion in 10.9%, and miliary tuberculosis in 9.1%. Final diagnoses included primary TB (60%), pleural effusion (12.73%), and miliary TB (18.18%). **Conclusion:** The Pediatric PTB demonstrates a broad spectrum of radiological manifestations. The HRCT provides greater visualization of parenchymal lesions, cavities, fibrosis, endobronchial communication, and mediastinal lymphadenopathy than CXR. CT should therefore be considered when the radiographic findings are inconclusive or complications are suspected.



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INTRODUCTION

The World Health Organization (WHO) estimates that approximately one-quarter of the global population is infected with *Mycobacterium tuberculosis* (MTB). Among the estimated 10 million people affected by tuberculosis (TB) in 2018, nearly one million were children. Pulmonary tuberculosis (PTB) remains a major global cause of morbidity and mortality. Its burden has been influenced by the HIV epidemic, unfavorable socioeconomic conditions, substance abuse, and migration from high-burden regions. Children represent an important high-risk population; however, pediatric TB often receives inadequate attention within healthcare systems and consequently remains under diagnosed [1-3].

Tuberculosis is broadly classified into primary and post-primary forms. Primary TB is particularly common in children, whereas post-primary disease is more characteristic of adults. Pediatric PTB differs from adult disease in its clinical and radiological manifestations and carries a greater risk of severe complications, including miliary tuberculosis and tuberculous meningitis. Diagnosis in children is particularly difficult because the disease is usually paucibacillary. Microbiological confirmation is obtained in only approximately 25–50% of cases, while sputum smear microscopy is positive in fewer than 10–15% of children with suspected TB. Consequently, obtaining adequate specimens for bacteriological confirmation remains challenging, making early recognition and prompt initiation of treatment essential [2,4,5].

The diagnosis of pediatric TB is further complicated by nonspecific clinical manifestations, difficulties in obtaining suitable clinical specimens, and the low bacillary burden characteristic of childhood disease. Clinical presentation may range from classical symptoms of TB to relatively subtle manifestations such as poor weight gain, failure to thrive, or

generalized weakness. Furthermore, the radiological appearance of PTB in younger children differs considerably from the adult pattern, necessitating careful interpretation of imaging findings. The WHO and Stop TB Partnership emphasize that improved diagnostic approaches, greater access to healthcare services, and better coordination of healthcare programs could substantially reduce morbidity and mortality among children affected by TB [5,6].

In high-income countries, advanced molecular diagnostic techniques are increasingly used for the detection of childhood TB, whereas many developing countries continue to depend considerably on conventional diagnostic approaches. According to the diagnostic framework described in the source, clinical symptoms, close contact with a TB case, tuberculin skin-test positivity, and radiological findings contribute to the diagnosis, alongside microbiological confirmation when available. Because bacteriological confirmation is frequently difficult in children, radiological assessment and tuberculin skin testing remain important components of diagnostic evaluation. The interpretation of radiological abnormalities is influenced by the local prevalence of TB and the pre-test probability of disease. Chest radiography (CXR), although widely available, may have limited sensitivity for detecting mediastinal and hilar lymphadenopathy, an important manifestation of primary pediatric PTB [7,8].

The increasing availability of computed tomography (CT) has enhanced evaluation of suspected pediatric TB, particularly in developed healthcare settings. CT can provide additional anatomical detail when CXR findings are equivocal; however, its use must be considered carefully because of radiation exposure, cost, and accessibility. Despite increasing utilization, standardized guidelines and scoring systems for interpreting CT

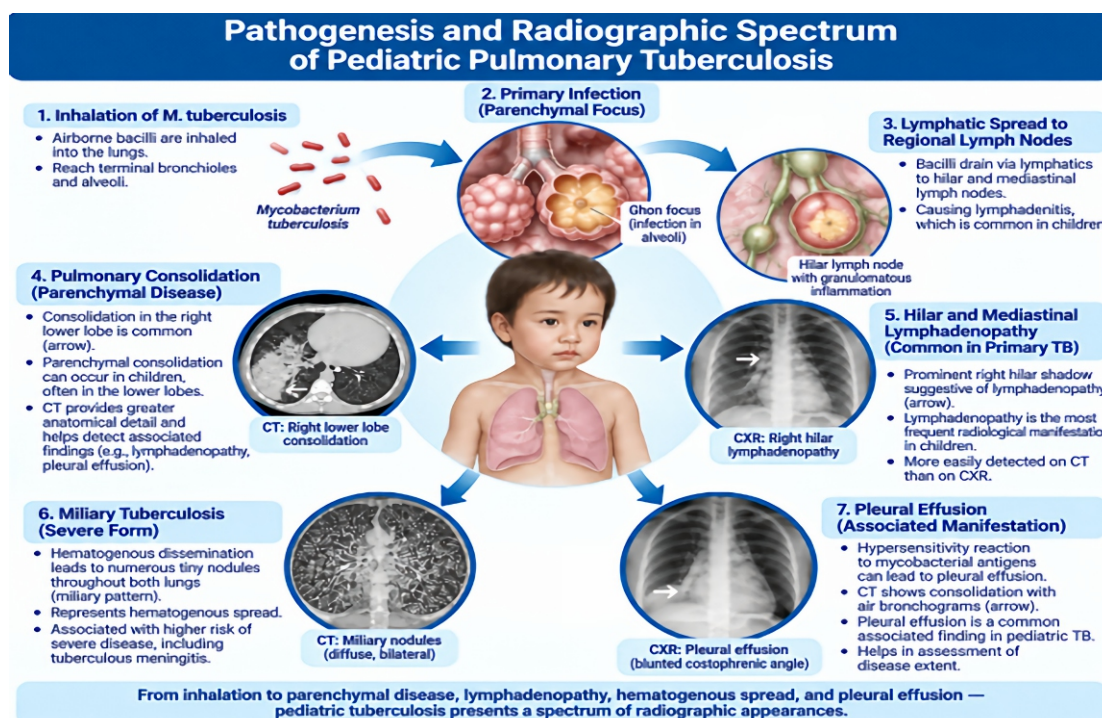


Figure 1: Radiographic manifestations of childhood pulmonary tuberculosis, including consolidation, lymphadenopathy, miliary TB, and pleural effusion.

findings in suspected pediatric TB remain limited. Therefore, interpretation of both CXR and CT continues to depend substantially on radiologist expertise and the available literature. A systematic understanding of the radiological spectrum of pediatric PTB and the complementary roles of CXR and CT is consequently important for improving diagnostic confidence and facilitating timely management [9]. **Figure 1:** Mechanism of cytotoxic T cell (CD8⁺)–mediated killing of virus-infected cells through antigen recognition, degranulation, perforin–granzyme–induced apoptosis, and target-cell clearance. **Figure 1:** Spectrum of radiographic manifestations of pulmonary tuberculosis in children, including pulmonary consolidation, hilar & mediastinal lymphadenopathy, miliary tuberculosis, & pleural effusion.

The study aimed to recognize the patterns of pulmonary tuberculosis in children on chest radiographs, identify the spectrum of pediatric pulmonary tuberculosis, including primary tuberculosis, progressive pulmonary disease, miliary tuberculosis, tubercular mediastinal lymph node disease, and healed pulmonary disease, and compare the findings obtained on chest radiography with those observed on computed tomography (CT) scans.

MATERIAL & METHODS

This prospective observational study was conducted at the Department of Radio diagnosis at Gajra Raja Medical College, Gwalior from April 2023 to March 2025. Ethical approval has been obtained from the Ethical Approval Committee of Gajra Raja Medical College, Gwalior.

Study Population

The study population comprised patients aged 2 months to 18 years presenting with persistent fever or unremitting cough for more than 2 weeks, unexplained weight loss or failure to gain weight despite adequate nutrition, or a family history of tuberculosis with clinical symptoms. NTEP-registered cases undergoing chest radiography or CT for clinical correlation were included. Patients without consent, aged outside the specified range, with syndromic diseases, immunodeficiencies, or extra-pulmonary tuberculosis were excluded.

Data Analysis

Data were systematically recorded in a structured proforma and subsequently entered into an Excel database for analysis. Demographic, clinical, chest radiographic, and HRCT findings were summarized using frequencies and percentages. CXR findings were compared with HRCT findings for selected abnormalities, including pleural effusion, cavity, miliary tuberculosis, and collapse. Diagnostic performance was assessed using sensitivity, specificity, positive and negative predictive values, accuracy, and area under the curve where applicable. Statistical significance was evaluated using appropriate tests, with $p < 0.05$ considered statistically significant.

RESULTS

The present prospective observational study was conducted in the Department of Radiodiagnosis, G.R.M.C., Gwalior, from April 2023 to March 2025 and included 55 pediatric patients evaluated for pulmonary tuberculosis based on clinical history, chest radiography, and HRCT findings. The majority belonged to the 12–18-year age group (43.64%), followed by 6–11 years (25.45%), 2–5 years (12.73%), 13 months–2 years (10.91%), and 2–12 months (7.27%). Males constituted 54.55% and females 45.45% of the study population. Persistent cough was the most common clinical presentation (50.91%), followed by chronic fever (40%), weight loss (32.73%), haemoptysis (16.36%), dyspnoea (14.55%), and night sweats (12.73%). Less frequent manifestations included fatigue and respiratory distress (7.27% each), recurrent pneumonia, poor feeding, wheezing, and failure to thrive (5.45% each), and lymph-node swelling, pleuritic pain, chest pain, and breathlessness (3.64% each). Regarding symptom duration, 40% had symptoms for 2 to <3 months and another 40% for ≥ 3 months, while 18.18% had symptoms for 1 to <2 months and 1.82% for <1 month. On chest radiography, inhomogeneous opacities were the predominant finding, particularly in the upper zones, occurring in 30.9% overall, followed by cavities and bulky hila (18.2% each), pleural effusion (14.5%), miliary tuberculosis (7.3%), and collapse (3.6%); no bronchiectasis was identified on CXR. Inhomogeneous opacities were more frequently observed in the right upper zone (27.28%) and left upper zone (16.37%). Cavities were also predominantly located in the upper zones, with 14.55% in the right upper zone and 5.46% in the left upper zone. Collapse was observed in 1.82% each in the right and left upper zones. Pleural effusion was present on both sides, with 10.91% involving the right side and 10.91% the left side. Bulky hilar enlargement was observed in 18.19% of patients on both the right and left sides. Overall, the radiographic findings demonstrate that inhomogeneous pulmonary opacities, cavitation, bulky hilar enlargement, and pleural effusion were the principal chest X-ray abnormalities in this pediatric study population.

HRCT demonstrated predominantly right-sided consolidation and centrilobular nodular (tree-in-bud) opacities, with cavities, bronchiectasis, and collapse mainly involving the upper and middle lung zones; pleural effusion was present in 9.09% on the right and 5.46% on the left (**Table 1**).

Overall, HRCT showed cavities as the most frequent finding (58.2%), followed by mediastinal lymphadenopathy (43.6%), consolidation (25.5%), and centrilobular nodular/tree-in-bud opacities (23.6%), with pleural effusion (10.9%), miliary TB (9.1%), fibrosis (7.3%), bronchiectasis and collapse (5.5% each), and endobronchial communication (1.8%) also observed (**Figure 2**). Pleural effusion was detected in 6 patients on HRCT, with chest X-ray identifying 6 true-positive and 2 false-positive cases; CXR demonstrated 100% sensitivity, 95.92% specificity, 98% AUC, 75% PPV, 100% NPV, and 96.34% diagnostic accuracy for pleural effusion (**Table 2**).

Cavity was detected on HRCT in 32 of 55 patients, while chest X-ray identified 8 true-positive and 2 false-positive cases. Chest X-ray demonstrated 25% sensitivity, 91.30% specificity, 0.58 AUC, 80% positive predictive value, 46.67% negative predictive value, and 52.73% diagnostic accuracy for detecting cavities (**Table 3**).

Miliary TB was detected on HRCT in 5 of 55 patients, with chest X-ray identifying 4 true-positive and 1 false-negative case. Chest X-ray demonstrated 80% sensitivity, 100% specificity, 0.90 AUC, 100% positive predictive value, 98.04% negative predictive value, and 98.18% diagnostic accuracy for detecting miliary TB (**Table 4**). Collapse was detected on HRCT in 3 of 55 patients, with chest X-ray identifying 2 true-positive & 1 false-negative case. Chest X-ray demonstrated 66.67% sensitivity, 100% specificity, 0.83 AUC, 100% positive predictive value,

98.11% negative predictive value, and 98.18% diagnostic accuracy for detecting collapse (**Table 5**). Among the 55 patients, fibrosis was observed in 4 (7.28%), while 51 (92.73%) showed no fibrosis. Endobronchial communication was present in 1 patient (1.82%), whereas 54 (98.19%) had no evidence of this finding. Mediastinal lymphadenopathy was identified in 24 patients (43.64%), while 31 patients (56.37%) showed no mediastinal lymphadenopathy (**Table 6**). The final diagnosis showed that primary tuberculosis was the most common diagnosis, accounting for 60.0% (33/55) of patients, followed by post-primary tuberculosis in 18.18% (10/55), tuberculous pleural effusion in 12.73% (7/55), and miliary tuberculosis in 9.09% (5/55). Regarding treatment outcomes, 80.0% (44/55) of patients had completed treatment, 10.91% (6/55) were still on treatment, and 9.09% (5/55) were lost to follow-up (**Table 6**).

Table 1: Distribution of HRCT Findings According to Lung Zone and Side

HRCT Finding	Right Upper Zone, n (%)	Right Middle Zone, n (%)	Right Lower Zone, n (%)	Left Upper Zone, n (%)	Left Lower Zone, n (%)	Right Pleural Effusion, n (%)	Left Pleural Effusion, n (%)
Consolidation	13 (23.64)	7 (12.73)	3 (5.46)	4 (7.28)	1 (1.82)	-	-
Centrilobular nodular opacities (tree-in-bud)	11 (20.00)	10 (18.19)	6 (10.91)	5 (9.10)	4 (7.28)	-	-
Cavity	6 (10.91)	1 (1.82)	2 (3.64)	3 (5.46)	1 (1.82)	-	-
Bronchiectasis	2 (3.64)	0 (0.00)	2 (3.64)	0 (0.00)	0 (0.00)	-	-
Collapse	2 (3.64)	0 (0.00)	0 (0.00)	2 (3.64)	0 (0.00)	-	-
Pleural effusion	-	-	-	-	-	5 (9.09)	3 (5.46)

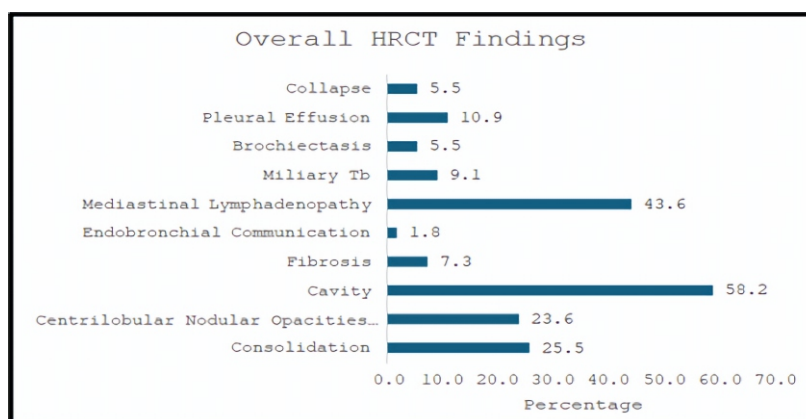


Figure 2: Overall HRCT Findings

Table 2: Diagnostic Performance of Chest X-ray for Detection of Pleural Effusion Compared with HRCT

Parameter	HRCT Pleural Effusion: Negative	HRCT Pleural Effusion: Positive	Total / Diagnostic Performance
Chest X-ray: Negative	47	0	47
Chest X-ray: Positive	2	6	8
Total	49	6	55
Sensitivity	-	-	100.00% (95% CI: 54.07 -100.00%)
Specificity	-	-	95.92% (95% CI: 86.02 -99.50%)
Area Under Curve (AUC)	-	-	0.980 (95% CI: 0.899 -0.999)
Positive Likelihood Ratio (LR+)	-	-	24.50 (95% CI: 6.31 -95.20)
Negative Likelihood Ratio (LR-)	-	-	0.000
Disease Prevalence	-	-	10.91% (95% CI: 4.11 -22.25%)
Positive Predictive Value (PPV)	-	-	75.00% (95% CI: 43.57 -92.10%)
Negative Predictive Value (NPV)	-	-	100.00%
Accuracy	-	-	96.36% (95% CI: 87.47 -99.56%)

Table 3: Diagnostic Performance of Chest X-ray for Detection of Cavity Compared with HRCT

Parameter	HRCT Cavity: Negative	HRCT Cavity: Positive	Total / Diagnostic Performance
Chest X-ray: Negative	21	24	45
Chest X-ray: Positive	2	8	10
Total	23	32	55
Sensitivity	-	-	25.00% (95% CI: 11.46 –43.41%)
Specificity	-	-	91.30% (95% CI: 71.96 –98.93%)
Area Under Curve (AUC)	-	-	0.582 (95% CI: 0.441 –0.713)
Positive Likelihood Ratio (LR+)	-	-	2.875 (95% CI: 0.672 –12.305)
Negative Likelihood Ratio (LR-)	-	-	0.821 (95% CI: 0.648 –1.041)
Disease Prevalence	-	-	58.18% (95% CI: 44.11 –71.35%)
Positive Predictive Value (PPV)	-	-	80.00% (95% CI: 48.31 –94.48%)
Negative Predictive Value (NPV)	-	-	46.67% (95% CI: 40.85 –52.57%)
Accuracy	-	-	52.73% (95% CI: 38.80 –66.35%)

Table 4: Diagnostic Performance of Chest X-ray for Detection of Miliary TB Compared with HRCT

Parameter	HRCT Miliary TB: Negative	HRCT Miliary TB: Positive	Total / Diagnostic Performance
Chest X-ray: Negative	50	1	51
Chest X-ray: Positive	0	4	4
Total	50	5	55
Sensitivity	-	-	80.00% (95% CI: 28.36 –99.50%)
Specificity	-	-	100.00% (95% CI: 92.89 –100.00%)
Area Under Curve (AUC)	-	-	0.900 (95% CI: 0.789 –0.964)
Positive Likelihood Ratio (LR+)	-	-	Not estimable
Negative Likelihood Ratio (LR-)	-	-	0.200 (95% CI: 0.035 –1.154)
Disease Prevalence	-	-	9.09% (95% CI: 3.02 –19.95%)
Positive Predictive Value (PPV)	-	-	100.00%
Negative Predictive Value (NPV)	-	-	98.04% (95% CI: 89.65 –99.66%)
Accuracy	-	-	98.18% (95% CI: 90.28 –99.95%)

Table 5: Diagnostic Performance of Chest X-ray for Detection of Collapse Compared with HRCT

Parameter	HRCT Collapse: Negative	HRCT Collapse: Positive	Total / Diagnostic Performance
Chest X-ray: Negative	52	1	53
Chest X-ray: Positive	0	2	2
Total	52	3	55
Sensitivity	-	-	66.67% (95% CI: 9.43 –99.16%)
Specificity	-	-	100.00% (95% CI: 93.15 –100.00%)
Area Under Curve (AUC)	-	-	0.833 (95% CI: 0.708 –0.920)
Positive Likelihood Ratio (LR+)	-	-	Not estimable
Negative Likelihood Ratio (LR-)	-	-	0.333 (95% CI: 0.067 –1.652)
Disease Prevalence	-	-	5.46% (95% CI: 1.14 –15.12%)
Positive Predictive Value (PPV)	-	-	100.00%
Negative Predictive Value (NPV)	-	-	98.11% (95% CI: 91.30 –99.61%)
Accuracy	-	-	98.18% (95% CI: 90.28 –99.95%)

Table 6: Distribution of Fibrosis, Endobronchial Communication, and Mediastinal Lymphadenopathy

HRCT Finding	Status	Frequency (n)	Percentage (%)
Fibrosis	No	51	92.73
	Yes	4	7.27
Endobronchial communication	No	54	98.18
	Yes	1	1.82
Mediastinal lymphadenopathy	No	31	56.36
	Yes	24	43.64
Total	—	55	100.00

Table 7: Final Diagnosis and Treatment Outcome

Category	Finding	Frequency (n)	Percentage (%)
Final Diagnosis	Miliary TB	5	9.09
	TB Pleural Effusion	7	12.73
	Post-primary TB	10	18.18
	Primary TB	33	60.00
	Lost to follow-up	5	9.09
Outcome	On treatment	6	10.91
	Treatment completed	44	80.00
Total	-	55	100.00

DISCUSSION

Tuberculosis (TB) remains a major global health problem, particularly in developing countries, and continues to contribute substantially to morbidity and mortality. Pediatric TB has considerable epidemiological importance because infection in children frequently represents recent transmission rather than reactivation of latent disease. Children therefore constitute a vulnerable population requiring early diagnosis and treatment to prevent progression and severe complications. Pulmonary tuberculosis (PTB) in children is predominantly a form of primary tuberculosis. Following inhalation and deposition of infected droplets in the alveoli, localized parenchymal inflammation develops, producing an area of air-space consolidation known as the Ghon focus. The infection subsequently spreads through the lymphatic pathways to regional hilar and mediastinal lymph nodes, producing lymphadenopathy. The combination of the primary parenchymal focus and regional lymph-node enlargement constitutes the Ranke complex [10].

In most children, mild parenchymal disease and lymphadenopathy may resolve spontaneously. However, enlarged lymph nodes may compress adjacent bronchi, resulting in bronchial narrowing, obstruction, air trapping, or emphysematous changes. With progression, lymph nodes may erode into the airways, producing bronchogenic spread and localized or lobar pneumonia. Although cavitation is more commonly associated with post-primary or adult-type TB, it may occasionally occur in primary pediatric disease. Therefore, the presence of cavitation is influenced more by the host immune status than by the duration since acquisition of infection. Santos TC, et. al; 2019, reported that CT was more effective than conventional radiography for detecting pediatric TB, supporting the complementary role of CT when CXR findings are equivocal. The major imaging manifestations include consolidation, nodules, cavitation, and lymphadenopathy. The present study was therefore undertaken to evaluate the radiological spectrum of suspected pediatric PTB and compare findings obtained on chest radiography and CT [11,12].

In the present study, the largest proportion of patients belonged to the 12–18-year age group (43.64%), whereas children aged 2–12 months constituted the smallest group (7.27%). Verma B, et. al; 2015, observed a predominance of older children, particularly those aged 10–15 years, in a population ranging from 3 months to 18 years. Muir S, et. al; 2023, reported a higher frequency of children aged 0–3 years, demonstrated variation in the age distribution of pediatric TB between study populations. Regarding sex distribution, males constituted 54.55% and females 45.45% of the present study population. This male predominance is comparable with the findings of Heuvelings CC et al.62, who reported 57% male participants, and Kaplan AE et al.61. Verma B, et. al; 2015 and Muir S, et. al; 2023, reported contrasting gender distributions [13,14].

Persistent cough was the most frequent clinical manifestation in the present study, occurring in 50.91% of patients, followed by

chronic fever (40%), weight loss (32.73%), haemoptysis (16.36%), dyspnoea (14.55%), and night sweats (12.73%). Less frequent manifestations included fatigue, respiratory distress, recurrent pneumonia, poor feeding, wheezing, failure to thrive, lymph-node swelling, pleuritic pain, chest pain, and breathlessness. These findings are consistent with previous reports emphasized cough, fever, weight loss, & constitutional symptoms as common presentations of pediatric PTB. Buonsenso D, et. al; 2021, reported that cough was the predominant respiratory symptom, while fever and weight loss were among the most frequent systemic manifestations [12].

On CXR, inhomogeneous opacities were the commonest finding (30.9%), followed by cavitation (18.2%), bulky hilum (18.2%), pleural effusion (14.5%), miliary TB (7.3%), and collapse (3.6%). HRCT demonstrated a broader spectrum and greater frequency of several abnormalities, including cavitation in 58.2%, mediastinal lymphadenopathy in 43.6%, consolidation in 25.5%, centrilobular nodular/tree-in-bud opacities in 23.6%, miliary TB in 9.1%, pleural effusion in 10.9%, fibrosis in 7.3%, bronchiectasis in 5.5%, collapse in 5.5%, and endobronchial communication in 1.8% [15,16].

Comparison of CXR with HRCT demonstrated particularly important differences in detection of cavitation. Cavities were identified in 18.2% on CXR compared with 58.2% on HRCT, with CXR showing a sensitivity of 25%, specificity of 91.30%, and accuracy of 52.73%. For pleural effusion, CXR demonstrated 14.5% compared with 10.9% on HRCT, with sensitivity of 100%, specificity of 95.92%, AUC of 0.98, and accuracy of 96.34%. CXR also showed good diagnostic performance for miliary TB and collapse, with sensitivities of 80% and 66.67%, respectively. Mediastinal lymphadenopathy was detected in 43.64% of patients, comparable to the 41.7% reported by Muir S, et. al; 2023, although higher prevalences were reported by Moreno-Ballester V, et. al; 2018 [14,17].

The final diagnosis comprised primary TB in 60% of patients, post-primary TB in 18.18%, TB pleural effusion in 12.73%, and miliary TB in 9.09%. Treatment outcomes were favorable overall, with 80% completing treatment, 10.91% remaining on treatment, and 9.09% being lost to follow-up. These findings supported the important complementary role of CT in pediatric PTB, particularly for demonstrating parenchymal lesions, cavitation, fibrosis, endobronchial communication, and mediastinal lymphadenopathy that may be inadequately characterized on conventional radiographs. CT should therefore be considered in selected children when CXR findings are inconclusive or complications are suspected, while avoiding unnecessary radiation exposure and routine CT use [14,17].

CONCLUSION

Infants and young children with pulmonary tuberculosis may demonstrate diverse radiographic abnormalities, particularly in the presence of typical clinical features & relevant exposure history. Chest radiography alone may be insufficient for diagnosis,

especially when findings are equivocal or complications are suspected. Although CT is more sensitive than conventional radiography, routine use is limited by its higher cost and restricted availability in tuberculosis-endemic, resource-limited settings. Nevertheless, CT is valuable in selected cases, providing better visualization of pulmonary parenchymal lesions, fibrosis, endobronchial communication, and tuberculous lymphadenopathy than chest radiography.

LIMITATIONS & FUTURE PERSPECTIVES

The study was limited by its single-centre design, relatively small sample size, and short duration, which may restrict generalizability. Future research could focus on multicenter studies with larger cohorts to validate findings, evaluate long-term outcomes, and explore innovative diagnostic & management strategies for appendicular perforation, improving patient prognosis and reducing complications.

CLINICAL SIGNIFICANCE

The clinical significance of this study lies in its potential to bridge the gap between research findings and practical healthcare applications. It emphasizes the importance of translating scientific observations into meaningful improvements in patient care, diagnosis, and treatment outcomes. By highlighting real world relevance, the study contributes to evidence based medical practice and supports informed clinical decision making. Ultimately, the findings aim to enhance patient quality of life, optimize therapeutic strategies, and promote better disease management in clinical settings.

ABBREVIATIONS

PTB: Pulmonary Tuberculosis

CXR: Chest Radiography

CT: Computed Tomography

HRCT: High-Resolution Computed Tomography

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AUTHOR CONTRIBUTIONS

All authors significantly contributed to the study conception and design, data acquisition, or data analysis and interpretation. They participated in drafting the manuscript or critically revising it for important intellectual content, consented to its submission to the current journal, provided final approval for the version to be published, and accepted responsibility for all aspects of the work. Additionally, all authors meet the authorship criteria outlined by the International Committee of Medical Journal Editors (ICMJE) guidelines.

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CONFLICT OF INTEREST

Authors declared that there is no conflict of interest.

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ETHICAL APPROVAL & CONSENT TO PARTICIPATE

All necessary consent & approval was obtained by authors.

CONSENT FOR PUBLICATION

All necessary consent for publication was obtained by authors.

DATA AVAILABILITY

All data generated and analyzed are included within this research article. The datasets utilized and/or analyzed in this study can be obtained from the corresponding author upon a reasonable request.

USE OF ARTIFICIAL INTELLIGENCE (AI) & LARGE LANGUAGE MODEL (LLM)

The authors confirm that no AI & LLM tools were used in the writing or editing of the manuscript, and no images were altered or manipulated using AI & LLM.

AUTHOR'S NOTE

This article serves as an important educational tool for the scientific community, offering insights that may inspire future research directions. However, they should not be relied upon independently when making treatment decisions or developing public health policies.

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