JHWCR JOURNAL OF HEALTH, WELLNESS AND COMMUNITY RESEARCH 3007-0570

DOI: https://doi.org/10.61919/tx44ha63

Original Article

Role of High-Resolution Computed Tomography (HRCT) In the Assessment of Chronic Pulmonary Tuberculosis

Nida[1], Ehsanullah[1], Hafiza Hijab Rehman[2], Kinza Waris[3], Eshal Shahzadi[4], Muhammad Sharjeel[5]

[1] Afro Asian Institute, Lahore, Pakistan
[2] Lecturer, Radiography and Imaging Technology, Afro Asian Institute, Lahore, Pakistan
[3] Al Shifa Institute of Health Sciences, Narowal, Pakistan
[4] Idrees Institute of Rehabilitation Sciences, Sialkot, Pakistan
[5] Sialkot Medical College, Sialkot, Pakista

***Corresponding author: Hafiza Hijab Rehman, sonepari135@gmail.com**

"Cite this Article" Received: 11 November 2025; **Accepted**: 04 February 2026; **Published**: 15 February 2026

Author Contributions: Concept: HHR, N; Design: HHR, E; Data Collection: N, E, KW, ES; Analysis: HHR, MS; Drafting: HHR, KW, ES, MS. **Ethical Approval**: Radiography and Imaging Technology, Afro Asian Institute, Lahore, Pakistan. **Informed Consent**: Written informed consent was obtained from all participants; **Conflict of Interest**: The authors declare no conflict of interest. **Funding**: No external funding; **Data Availability**: Available from the corresponding author on reasonable request; **Acknowledgments**: NA

ABSTRACT

Background: Pulmonary tuberculosis may produce persistent parenchymal and pleural abnormalities that require detailed imaging characterization. Objective: To describe the clinical and high-resolution computed tomography findings among patients with confirmed or clinically suspected chronic pulmonary tuberculosis and assess associations between selected symptoms and radiological features. Methods: This analytical cross-sectional study included 120 patients aged 25–45 years undergoing chest HRCT at the radiology departments of Lahore General Hospital and Services Hospital, Lahore, Pakistan. Participants were selected through non-probability convenience sampling. Clinical symptoms and HRCT findings were summarized using frequencies, percentages, mean, and standard deviation. Reported symptom–imaging associations were evaluated at a significance threshold of $p < 0.05$. Results: The mean age was 35.08 ± 6.05 years, and 75 participants (62.5%) were male. Fever was present in 66 (55.0%), cough in 64 (53.3%), and weight loss in 62 (51.7%). HRCT demonstrated pulmonary infiltrates in 96 (80.0%), cavitation in 66 (55.0%), nodules in 50 (41.7%), and pleural thickening in 44 (36.7%). Bilateral involvement occurred in 108 participants (90.0%). Cough was associated with cavitation ($p = 0.030$), and fever was associated with infiltrates ($p = 0.020$); weight loss was not significantly associated with cavitation ($p = 0.070$). Conclusion: HRCT identified frequent and extensive pulmonary abnormalities and may support anatomical characterization of chronic pulmonary tuberculosis when interpreted with clinical and microbiological findings. Keywords: Pulmonary Tuberculosis; High-Resolution Computed Tomography; Pulmonary Cavitation; Pulmonary Infiltrates; Clinical–Radiological Association.

INTRODUCTION

Pulmonary tuberculosis remains an important communicable respiratory disease and continues to cause substantial morbidity, particularly in countries with a high disease burden. The disease is primarily caused by Mycobacterium tuberculosis and most commonly affects the lungs, although extrapulmonary involvement may also occur. Pulmonary infection can produce a wide spectrum of clinical and structural abnormalities, ranging from localized parenchymal disease to cavitation, fibrosis, pleural involvement, bronchiectatic changes, and extensive bilateral lung damage. These abnormalities may persist during prolonged or recurrent disease and can contribute to chronic respiratory symptoms and permanent functional impairment (1,2).

The clinical presentation of pulmonary tuberculosis commonly includes persistent cough, fever, weight loss, malaise, and other constitutional symptoms. However, the severity of these symptoms does not always correspond directly to the anatomical extent of pulmonary involvement. Some patients may have

extensive radiological disease despite relatively nonspecific clinical manifestations, whereas others may present with prominent symptoms but limited structural abnormalities. Clinical assessment alone may therefore be insufficient for defining the location, distribution, and morphological pattern of pulmonary lesions.

Chest radiography remains widely used in the initial evaluation of pulmonary tuberculosis because it is accessible and relatively inexpensive. Nevertheless, radiographic appearances may be normal, subtle, overlapping, or nonspecific, particularly during the early stages of disease or when abnormalities are obscured by surrounding anatomical structures. Computed tomography provides greater anatomical detail than conventional radiography and is more sensitive for characterizing pulmonary parenchymal and pleural abnormalities. High-resolution computed tomography is particularly useful for demonstrating small nodules, cavities, areas of consolidation or infiltration, interstitial abnormalities, bronchiectasis, pleural thickening, and the distribution of disease within one or both lungs (2–4).

Previous computed tomography studies have demonstrated considerable variation in the radiological manifestations of pulmonary tuberculosis. Martini et al. reported consolidation, tree-in-bud nodularity, cavitation, scattered nodules, and pleural effusion among patients with active pulmonary tuberculosis, illustrating the heterogeneous appearance of the disease on chest CT (3). Cavitary lesions are clinically important because they may reflect substantial parenchymal destruction, communicate with the bronchial tree, and be associated with increased infectious burden. Computed tomography is more sensitive than chest radiography for detecting and characterizing such cavities and for identifying associated parenchymal abnormalities (4,5). Previous pulmonary tuberculosis may also be associated with persistent bronchiectatic and emphysematous changes, which can contribute to chronic respiratory impairment after the acute infection has resolved (6).

Despite the established value of HRCT for characterizing pulmonary abnormalities, locally available evidence regarding the relationship between common clinical symptoms and specific HRCT patterns remains limited. In particular, the extent to which cough, fever, and weight loss are associated with cavitation, pulmonary infiltrates, and other structural abnormalities has not been adequately described among patients undergoing HRCT evaluation in local tertiary-care hospitals. Clarifying these clinical–radiological relationships may assist clinicians in recognizing patients who are more likely to have extensive or complicated pulmonary involvement while ensuring that imaging findings are interpreted alongside clinical and microbiological assessment.

Therefore, this study aimed to describe the clinical and HRCT findings among patients with confirmed or clinically suspected chronic pulmonary tuberculosis and to determine the associations between selected clinical symptoms and radiological features, including cavitation and pulmonary infiltrates.

MATERIALS AND METHODS

An analytical cross-sectional study was conducted in the radiology departments of Lahore General Hospital and Services Hospital, Lahore, Pakistan, over a period of six months following approval of the study protocol. The study population consisted of patients referred to for HRCT examination of the chest because of confirmed or clinically suspected chronic pulmonary tuberculosis. A non-probability convenience sampling technique was used, and 120 eligible patients were enrolled during the study period.

Patients of either sex aged 25–45 years were eligible when they had confirmed or clinically suspected chronic pulmonary tuberculosis and were undergoing HRCT examination of the chest as part of their clinical assessment. Pregnant women, patients with known immunocompromising conditions such as HIV/AIDS, and individuals who did not consent to participate were excluded. Participation was voluntary, and clinical and imaging information was used for the study only after obtaining consent from the participant.

Demographic and clinical information was recorded for each participant. The demographic variables included age and sex. The principal clinical variables were cough, fever, and weight loss. Because more than one symptom could occur in the same participant, symptom patterns were recorded as cough alone, fever alone, weight loss alone, cough with fever, cough with weight loss, fever with weight loss, or the simultaneous presence of cough, fever, and weight loss. These categories were treated as mutually exclusive for the description of symptom combinations. For the assessment of associations with HRCT findings, the presence or absence of each individual symptom was considered separately (7-11).

All enrolled participants underwent HRCT examination of the chest in the participating radiology departments. Images were evaluated for pulmonary cavitation, infiltrates, nodules, pleural thickening, and the anatomical distribution of pulmonary involvement. Cavitation was identified as a gas-containing space within an area of pulmonary consolidation, infiltration, or nodular abnormality. Pulmonary infiltrates represented areas of abnormal increased parenchymal attenuation, while nodules were recorded as focal rounded pulmonary opacities (4-7). Pleural thickening was identified when abnormal thickening of the pleural surface was visible on HRCT. Disease distribution was classified as unilateral when abnormalities involved only one lung and bilateral when both lungs were affected. Because individual participants could demonstrate more than one radiological abnormality, cavitation, infiltrates, nodules, and pleural thickening were analysed as non-mutually exclusive HRCT findings. HRCT was used to characterize the extent and morphological pattern of pulmonary abnormalities rather than as a substitute for clinical or microbiological diagnosis (3–5). The overall radiological extent of disease was categorized as mild, moderate, or severe according to the extent of pulmonary involvement documented during HRCT interpretation. The same categories were used throughout data recording and analysis. Clinical and radiological observations were entered on a structured data-recording form and checked for completeness and internal consistency before analysis.

Continuous data were summarized using the mean, standard deviation, and observed range. Categorical variables were presented as frequencies and percentages. The prevalence of each clinical symptom was calculated by combining all mutually exclusive symptom categories in which that symptom was present. Accordingly, cough included cough alone and all combinations containing cough; fever included fever alone and all combinations containing fever; and weight loss included weight loss alone and all combinations containing weight loss. Associations between individual clinical symptoms and selected HRCT findings were evaluated using Pearson's chi-square test. Fisher's exact test was considered when expected cell frequencies were insufficient for chi-square analysis. All tests were two-sided, and a p-value of less than 0.05 was considered statistically significant (6-8).

Participant confidentiality was maintained by restricting the study dataset to information required for the research analysis. Patients who declined participation were not enrolled, and pregnant women were excluded to avoid unnecessary radiation exposure.

RESULTS

A total of 120 participants were included in the analysis. Their mean age was 35.08 ± 6.05 years, with an observed age range of 25–45 years. Male participants accounted for 75 (62.5%) of the sample, while 45 (37.5%) were female. The mutually exclusive symptom-pattern categories accounted for all 120 participants. Fever alone and weight loss alone were each reported in 21 participants (17.5%), while cough alone was reported in 19 (15.8%). Combined cough and fever occurred in 18 participants (15.0%), cough and weight loss in 14 (11.7%), fever and weight loss in 14 (11.7%), and the simultaneous presence of cough, fever, and weight loss in 13 (10.8%).

When the symptom-pattern categories were combined to calculate the overall prevalence of each individual symptom, fever was present in 66 participants (55.0%), cough in 64 (53.3%), and weight loss in 62 (51.7%). Thus, more than half of the participants experienced each of the three principal clinical symptoms. These derived prevalences provide a more accurate representation of the symptom burden

than the frequencies of the isolated symptom categories alone. Pulmonary infiltrates were the most frequently reported HRCT abnormality, occurring in 96 participants (80.0%). Cavitation was identified in 66 (55.0%), pulmonary nodules in 50 (41.7%), and pleural thickening in 44 (36.7%). Because these findings were non-mutually exclusive, individual participants could demonstrate multiple abnormalities on HRCT.

Bilateral pulmonary involvement was observed in 108 participants (90.0%), whereas unilateral involvement was present in 12 (10.0%). Disease severity was categorized as moderate in 66 participants (55.0%), severe in 45 (37.5%), and mild in 9 (7.5%). Consequently, 111 participants (92.5%) were classified as having either moderate or severe disease according to the severity categories used in the study. The reported analysis demonstrated an association between cough and cavitation ($p = 0.030$) and between fever and pulmonary infiltrates ($p = 0.020$). The association between weight loss and cavitation did not meet the predefined threshold for statistical significance ($p = 0.070$). Because the underlying cross-tabulated frequencies, effect estimates, confidence intervals, and test statistics were not available, the magnitude and precision of these associations could not be quantified from the reported aggregate results.

Table 1. Demographic characteristics of the study participants

Characteristic	Value
Total participants, n	120
Age, mean ± SD, years	35.08 ± 6.05
Age range, years	25–45
Male sex, n (%)	75 (62.5)
Female sex, n (%)	45 (37.5)

Abbreviation: SD, standard deviation.

Table 2. Distribution of mutually exclusive clinical symptom patterns

Symptom pattern	n (%)
Cough only	19 (15.8)
Fever only	21 (17.5)
Weight loss only	21 (17.5)
Cough and fever	18 (15.0)
Cough and weight loss	14 (11.7)
Fever and weight loss	14 (11.7)
Cough, fever, and weight loss	13 (10.8)
Total	120 (100.0)

Symptom-pattern categories were mutually exclusive. Percentages may differ slightly from 100% when calculated from rounded individual values.

Table 3. Overall prevalence of individual clinical symptoms derived from the reported symptom patterns

Clinical symptom	Present, n (%)	Absent, n (%)
Cough	64 (53.3)	56 (46.7)
Fever	66 (55.0)	54 (45.0)
Weight loss	62 (51.7)	58 (48.3)

The prevalence of each symptom was derived by combining all mutually exclusive symptom-pattern categories containing that symptom. Cough was present in the cough-only, cough-and-fever, cough-and-weight-loss, and three-symptom categories. Fever and weight loss were calculated using the same approach.

Table 4. High-resolution computed tomography findings among the study participants

HRCT finding	Present, n (%)	Absent, n (%)
Pulmonary infiltrates	96 (80.0)	24 (20.0)
Cavitation	66 (55.0)	54 (45.0)
Pulmonary nodules	50 (41.7)	70 (58.3)
Pleural thickening	44 (36.7)	76 (63.3)

Abbreviation: HRCT, high-resolution computed tomography. Findings were non-mutually exclusive; an individual participant could have more than one HRCT abnormality.

Table 5. Anatomical distribution and reported severity of pulmonary disease

Variable	n (%)
Anatomical distribution	
Bilateral involvement	108 (90.0)
Unilateral involvement	12 (10.0)
Reported severity category	
Mild	9 (7.5)
Moderate	66 (55.0)
Severe	45 (37.5)

The severity categories are presented as reported in the source data.

Table 6. Reported associations between clinical symptoms and HRCT findings

Clinical symptom	HRCT finding	p-value
Cough	Cavitation	0.030
Fever	Pulmonary infiltrates	0.020
Weight loss	Cavitation	0.070

Abbreviation: HRCT, high-resolution computed tomography. Statistical significance was defined as $p < 0.05$.

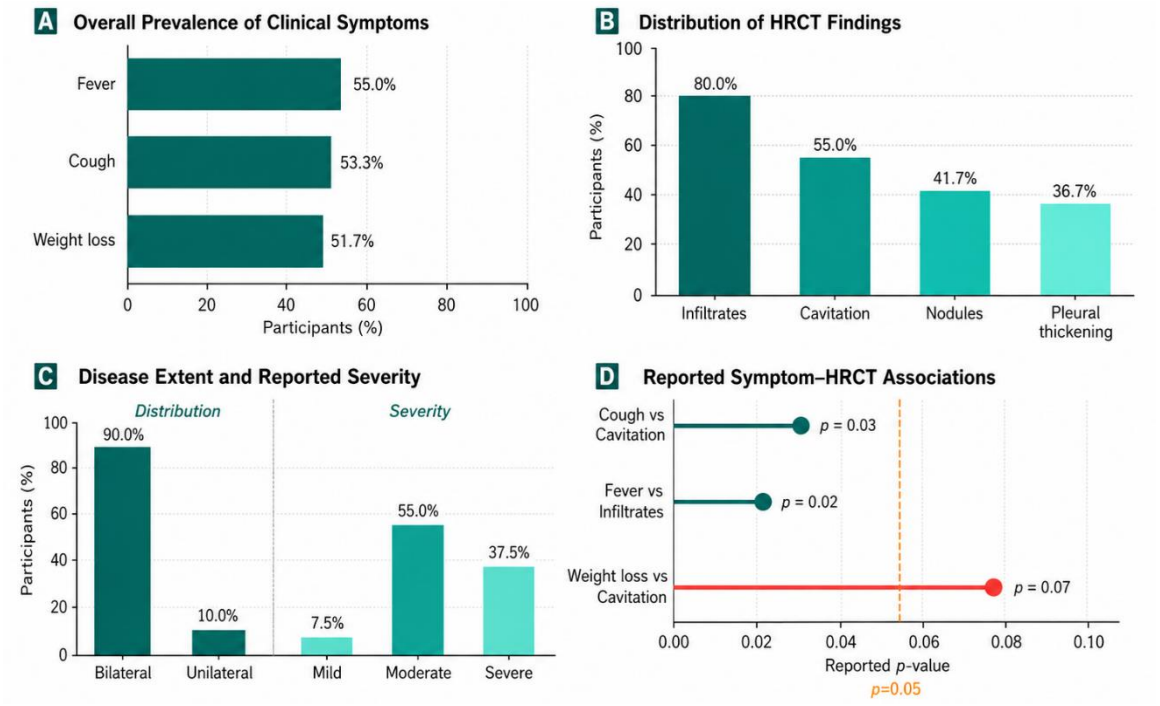

Figure 1 presents the clinical and HRCT profile of 120 patients with chronic pulmonary tuberculosis. Fever was the most prevalent symptom, affecting 55.0% of participants, followed by cough in 53.3% and weight loss in 51.7%. Pulmonary infiltrates were the most frequent HRCT finding, observed in 80.0% of patients, while cavitation, nodules, and pleural thickening were present in 55.0%, 41.7%, and 36.7%, respectively. Bilateral pulmonary involvement was identified in 90.0% of participants, compared with 10.0% showing unilateral disease. Regarding reported severity, 55.0% of cases were classified as moderate, 37.5% as severe, and 7.5% as mild. The reported association analysis showed statistically significant relationships between cough and cavitation (p = 0.03) and between fever and pulmonary infiltrates (p = 0.02), whereas the association between weight loss and cavitation was not statistically significant (p = 0.07).

DISCUSSION

This analytical cross-sectional study characterized the clinical and HRCT profile of 120 patients undergoing evaluation for confirmed or clinically suspected chronic pulmonary tuberculosis. The principal findings were the high prevalence of pulmonary infiltrates, cavitation, and bilateral lung involvement, together with frequent fever, cough, and weight loss. Pulmonary infiltrates were identified

in 80.0% of participants, cavitation in 55.0%, nodules in 41.7%, and pleural thickening in 36.7%. Bilateral abnormalities were present in 90.0% of the sample. The reported analysis also indicated associations between cough and cavitation and between fever and pulmonary infiltrates, whereas the association between weight loss and cavitation did not reach the predefined statistical threshold (11-12).

The predominance of male participants was consistent with the demographic pattern frequently observed in pulmonary tuberculosis populations. However, this finding should be interpreted within the context of the study's convenience sampling and restricted age range rather than as evidence that chronic pulmonary tuberculosis inherently occurs more frequently in men. Sex-specific occupational exposures, smoking, healthcare-seeking behaviour, and differences in access to diagnostic services may contribute to observed distributions, but these factors were not assessed in the present study and therefore cannot be used to explain the finding directly (13-16).

Fever, cough, and weight loss were each present in more than half of the participants when the mutually exclusive symptom combinations were combined appropriately. Fever was present in 55.0%, cough in 53.3%, and weight loss in 51.7%. These symptoms are compatible with the recognized clinical presentation of pulmonary tuberculosis, although none is sufficiently specific to establish the diagnosis independently. Clinical symptoms may indicate active inflammatory or systemic disease, but they provide limited information regarding the anatomical extent, distribution, or morphology of pulmonary lesions. Imaging must therefore be interpreted alongside clinical examination and microbiological investigations rather than as an isolated diagnostic standard (1,3, 17-20).

Pulmonary infiltrates were the most common HRCT abnormality in the present study. This finding supports the value of cross-sectional imaging for demonstrating parenchymal abnormalities that may be subtle, overlapping, or incompletely characterized on conventional chest radiography. Previous CT studies have described heterogeneous pulmonary patterns, including consolidation, tree-in-bud nodularity, cavitation, scattered nodules, and pleural abnormalities among patients with active pulmonary tuberculosis (3). The high frequency of infiltrates in the current sample may reflect ongoing parenchymal inflammation, extensive disease at the time of imaging, or referral of patients with clinically significant abnormalities for HRCT. However, because disease duration, treatment status, microbiological activity, and previous imaging findings were not available, infiltrates could not be classified reliably as active disease, residual change, or a combination of both (16).

Cavitation was identified in 55.0% of participants, a proportion higher than that reported in some previous CT-based descriptions of pulmonary tuberculosis. Martini et al. reported cavitation in approximately 41% of patients undergoing CT assessment for active pulmonary tuberculosis (3). Differences between studies may be related to patient selection, disease chronicity, treatment status, referral patterns, radiological definitions, or the prevalence of advanced pulmonary involvement. Cavitary lesions are clinically important because they represent structural destruction of pulmonary tissue and may communicate with the bronchial tree. Computed tomography provides greater anatomical detail than chest radiography for detecting cavities, evaluating cavity walls, and identifying associated parenchymal abnormalities (4,5). Nevertheless, the present study did not evaluate cavity size, number, wall thickness, lobar location, or microbiological burden, limiting more detailed interpretation.

Pulmonary nodules and pleural thickening were also common, affecting 41.7% and 36.7% of participants, respectively. Nodular abnormalities may reflect endobronchial or bronchogenic spread, while pleural thickening may represent previous or ongoing pleural involvement. These findings further demonstrate that pulmonary tuberculosis can produce multiple concurrent radiological abnormalities. Because the HRCT categories were non-mutually exclusive, the study reflects a composite structural disease profile rather than isolated lesion types. More detailed assessment of lesion distribution, including upper- and lower-lobe involvement, centrilobular nodules, tree-in-bud changes, bronchiectasis, fibrosis, and volume loss, would have strengthened the clinical characterization.

Bilateral pulmonary involvement was observed in 90.0% of participants. This finding suggests that abnormalities were extensive in the selected population, but bilateral involvement should not automatically be interpreted as disseminated tuberculosis or severe disease. The study included patients already referred for HRCT, which may have preferentially selected individuals with persistent symptoms, abnormal chest radiographs, complex disease, or suspected complications. Furthermore, the criteria used to classify disease as mild, moderate, or severe were not sufficiently documented. Although 92.5% of participants were categorized as having moderate or severe disease, the clinical meaning and reproducibility of these classifications remain uncertain without a defined anatomical scoring system.

The reported association between cough and cavitation was clinically plausible. Cavitary lesions may communicate with the airways and may be accompanied by bronchial irritation, drainage of necrotic material, or surrounding inflammatory changes that contribute to cough. Similarly, the association between fever and pulmonary infiltrates may reflect active parenchymal inflammation. These interpretations remain provisional because the study reported only p-values and did not provide cross-tabulated counts, prevalence ratios, odds ratios, confidence intervals, or adjusted analyses. The magnitude and precision of the associations therefore could not be determined, and potential confounding by disease duration, treatment status, smoking, microbiological activity, and overall disease extent could not be evaluated (16).

Weight loss was not statistically associated with cavitation at the conventional threshold. This finding may indicate that systemic manifestations do not correspond directly to a single localized radiological feature. Weight loss may be influenced by prolonged inflammation, appetite loss, socioeconomic conditions, nutritional status, treatment effects, and the overall burden of disease rather than by cavitation alone. The reported p-value of 0.070 should not be interpreted as proof of no relationship, particularly because the effect estimate and confidence interval were unavailable.

The study had several strengths. It included participants from two tertiary-care hospitals, evaluated multiple clinical and radiological features, and provided a descriptive overview of HRCT abnormalities in a local population. The reconstruction of symptom prevalence from mutually exclusive symptom combinations also demonstrated that fever, cough, and weight loss each affected more than half of the participants. The study additionally attempted to examine clinical–radiological associations rather than limiting the analysis to descriptive imaging frequencies.

Important limitations must also be considered. The cross-sectional design did not establish temporal or causal relationships. Convenience sampling and inclusion only of patients referred for HRCT increased the risk of selection bias and limited generalizability to all patients with pulmonary tuberculosis. The definition of chronic pulmonary tuberculosis and the diagnostic basis for confirmed and clinically suspected cases were not fully documented. Treatment status, previous tuberculosis, microbiological findings, drug resistance, smoking, comorbidities, and symptom duration were not analysed. HRCT acquisition parameters, reader experience, blinding, and interobserver reliability were also not reported. The absence of operational definitions for severity reduced the interpretability of the mild, moderate, and severe categories. Finally, the association analyses lacked cross-tabulated counts, effect estimates, confidence intervals, and adjustment for potential confounders.

Despite these limitations, the findings demonstrate that HRCT identified a broad range of pulmonary abnormalities in this selected clinical population, particularly infiltrates, cavities, bilateral involvement, nodules, and pleural thickening. HRCT may therefore contribute to the anatomical characterization of pulmonary tuberculosis and its structural complications when clinically indicated. It should, however, complement rather than replace microbiological testing, clinical assessment, and appropriate follow-up. Longitudinal studies using standardized disease definitions, microbiological confirmation, validated imaging scores, and adjusted statistical models are needed to determine how specific HRCT patterns relate to disease activity, treatment response, and long-term pulmonary impairment (8, 13).

CONCLUSION

Among patients undergoing HRCT evaluation for confirmed or clinically suspected chronic pulmonary tuberculosis, pulmonary infiltrates, cavitation, bilateral lung involvement, nodules, and pleural thickening were frequently observed. Fever, cough, and weight loss each occurred in more than half of the participants, while the reported analyses identified associations between cough and cavitation and between fever and pulmonary infiltrates. These findings indicate that HRCT can contribute to the characterization of the anatomical extent and morphological patterns of pulmonary abnormalities when used alongside clinical and microbiological assessment; however, the cross-sectional design and incomplete effect estimates preclude causal or diagnostic-accuracy conclusions.

REFERENCES

1. Lyon SM, Rossman MD. Pulmonary tuberculosis. Microbiol Spectr. 2017;5(1).
2. Lange C, Mori T. Advances in the diagnosis of tuberculosis. Respirology. 2010;15(2):220-40.
3. Martini K, Loubet A, Bankier A, Bouam S, Morand P, Cassagnes L, et al. Nodular reverse halo sign in active pulmonary tuberculosis: a rare CT feature? Diagn Interv Imaging. 2020;101(5):281-7.
4. Swensen SJ, Aughenbaugh GL, Brown LR. High-resolution computed tomography of the lung. Mayo Clin Proc. 1989;64(10):1284-94.
5. Cozzi D, Bartolucci M, Giannelli F, Cavigli E, Campolmi I, Rinaldi F, et al. Parenchymal cavitations in pulmonary tuberculosis: comparison between lung ultrasound, chest X-ray and computed tomography. Diagnostics (Basel). 2024;14(5):522.
6. Fan H, Wu F, Liu J, Zeng W, Zheng S, Tian H, et al. Pulmonary tuberculosis as a risk factor for chronic obstructive pulmonary disease: a systematic review and meta-analysis. Ann Transl Med. 2021;9(5):390.
7. Chen J, Byanju S, Zhang H, Zhu D, Liao M. CT-guided percutaneous core needle biopsy of pulmonary tuberculosis: diagnostic accuracy and complications. Radiol Infect Dis. 2018;5(2):69-75.
8. Deng Y, Li X, Xiang Y, Li H, Lu P, Yu W. Application of 18F-FDG PET/CT in the diagnosis of extrapulmonary tuberculosis. Radiol Infect Dis. 2018;5(4):165-70.
9. Ukil S, Reinhardt JM. Anatomy-guided lung lobe segmentation in X-ray CT images. IEEE Trans Med Imaging. 2009;28(2):202-14.
10. Desai S, Thapa P. Morphological variation of human lung fissures and lobes: an anatomical cadaveric study in North Karnataka, India. Indian J Health Sci Biomed Res. 2016;9(3):284.
11. Cereser L, Giovannini I, Caronia G, Zabotti A, De Vita S, Zuiani C, et al. Chest high-resolution computed tomography in primary Sjögren's syndrome: an up-to-date primer for rheumatologists. Clin Exp Rheumatol. 2022.
12. Chandna P, Dhiman A, Dhiman DS. HRCT imaging of pulmonary tuberculosis. Int J Med Sci. 2022.
13. Garg M, Bhatia H, Chandra T, Debi U, Sehgal I, Prabhakar N, et al. Imaging spectrum in chronic pulmonary aspergillosis. Am J Trop Med Hyg. 2022.
14. Himandri Harish W, Himanshu P, Pankaj M, Archana K, Sudhanshu Sunil T. Diagnosis of sputum smear-positive and sputum smear-negative pulmonary tuberculosis: the role of high-resolution computed tomography of the chest. J Evol Med Dent Sci. 2022:880-3.
15. Naseer M, Balooch S, Amin U, Amin M, Khan MU, Anwar M. Diagnostic accuracy of high-resolution computed tomography of the chest in diagnosing sputum smear-positive and sputum smear-negative pulmonary tuberculosis. Professional Med J. 2024.
16. Nel M, Franckling-Smith Z, Pillay T, Andronikou S, Zar H. Chest imaging for pulmonary TB: an update. Pathogens. 2022.
17. Rodriguez K, Ashby CL, Varela VR, Sharma A. High-resolution computed tomography of fibrotic interstitial lung disease. Semin Respir Crit Care Med. 2022.
18. Tasawar A, John A, Ali A, Bakhtawar K, Noor M. Evaluation of pulmonary tuberculosis using high-resolution computed tomography: a cross-sectional study. Pak J Health Sci. 2022:42-5.
19. Wetscherek M, Sadler T, Lee J, Karia S, Babar J. Active pulmonary tuberculosis: something old, something new, something borrowed, something blue. Insights Imaging. 2022.
20. S X. Review on importance of high-resolution computed tomography in chronic otitis media. Int J Sci Res. 2022;11(1):144-8.