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RESEARCH ARTICLE

The sensitivity of Chest CT for the diagnosis of COVID-19 pneumonia and imaging patterns as seen on Chest CT: a crossectional prospective study done in Addis Ababa, 2021

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Abstract

Background: Coronavirus disease 2019 (COVID-19) is a respiratory illness caused by a novel coronavirus known as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). While the RT-PCR test is considered the gold standard for diagnosis, chest imaging plays an important adjunct role in diagnosing and assessing the severity of the disease, as well as identifying complications. Distinguishing COVID-19 from other infectious processes can be challenging; thus, recognizing typical imaging patterns and degrees of involvement is crucial for guiding treatment.
Objective: This study aimed to assess the sensitivity of chest CT scans in comparison to the standard RT-PCR for diagnosing COVID-19.

Method: Hospital based cross-sectional study design was employed using information collected from various diagnostic and treatment centers between July 1, 2021 and October 1, 2021. The chest CT scans of patients were reviewed, and a structured questionnaire was completed using a Google form. The data were exported and analyzed using SPSS version 26.

Results: Chest CT analysis revealed that 95.9% of cases exhibited bilateral involvement, with 51.3% showing a peripheral distribution. Among the typical chest CT patterns, ground-glass opacities (GGO) were observed in 157 (83%) cases, consolidation in 152 (80.4%), and broncho vascular thickening in 68 (35.4%). The mean chest CT severity score was 13.6 ± 6.2, with 95 patients (49.2%) scoring above 18 (indicating severe disease). A positive correlation was found between the CT severity score and both age and diabetes, with a p-value < 0.01. There was a high probability of severe disease on chest CT among patients with diabetes mellitus (AOR = 1.6, 95% CI: 0.4-6.8).

Conclusion: This study demonstrated that chest CT has a high sensitivity (82.9%) for diagnosing COVID-19 pneumonia. The predominant imaging features included ground-glass opacity, consolidation, and bronchovascular thickening, with a notable bilateral, basal, and peripheral distribution. Additionally, the study revealed a positive correlation between the chest CT severity score and both age and diabetes comorbidity.

Keywords: Chest CT, COVID-19, RT-PCR

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1 Introduction

Background

Corona virus is an illness caused by corona virus designated sever acute respiratory syndrome SARS-CoV-2, primarily identified during an outbreak of respiratory illness in Wuhan city, Hubei province, China in December 2019 [1].

Coronaviruses are non-segmented, enveloped RNA viruses with a single-strand linear positive-sense RNA. Six types of coronaviruses have been identified that cause human disease; four of these cause mild respiratory symptoms, while the other two—Middle East Respiratory Syndrome (MERS-CoV) and Severe Acute Respiratory Syndrome (SARS-CoV-1)—have previously resulted in epidemics with high mortality rates (2). Respiratory illness is commonly associated clinical feature of SARS-CoV-2 due to abundant ACE2 receptor expression in the lung parenchyma, specifically on the acinar side of the lung epithelial cell within the alveolar space facilitating viral entry [2, 3].

Following the identification of the coronavirus as the cause of a cluster of pneumonia cases in Wuhan, it rapidly spread, resulting in an epidemic throughout China [4]. On January 30, 2020, the World Health Organization (WHO) declared a global public health emergency in response to the outbreak of COVID-19, and on March 11, 2020, the WHO classified the coronavirus outbreak as a global pandemic [5].

The primary mode of transmission of the virus is person-to-person, occurring mainly through respiratory droplets released during coughing, sneezing, or conversation. Environmental contamination also plays a role in viral transmission, with droplets accumulating on frequently touched surfaces, leading to subsequent spread to susceptible mucous membranes in the mouth, nose, and eyes [2, 3].

The clinical presentation of COVID-19 varies widely, with approximately 80% of cases experiencing mild to moderate symptoms, 14%–15% presenting with severe symptoms, and 5% classified as critical illness. The most common symptoms at presentation include fever, cough, and shortness of breath. Mild to moderate disease is generally characterized by constitutional symptoms and the potential development of mild pneumonia, while severe disease symptoms include dyspnea and hypoxia [2, 3].

The SARS-CoV-2 virus has the potential to cause complications across all organ systems. Acute respiratory distress syndrome (ARDS) is a major complication of severe COVID-19, affecting 20%–40% of patients with severe symptoms. Other complications may include cardiac issues such as arrhythmias (including atrial fibrillation), acute myocarditis, cardiomyopathy, and shock. Thromboembolic phenomena can also occur, including pulmonary embolism (PE), peripheral venous and arterial thrombosis, and acute stroke [2].

Reverse-transcription polymerase chain reaction (RT-PCR) tests are currently the gold standard for diagnosing COVID-19. These assays are performed on nasopharyngeal and/or oropharyngeal swabs [3]. However, false-negative results may occur due to various factors, including insufficient viral load, improper sample collection, and technical errors during the swabbing procedure [2, 6].

Chest imaging plays an adjunct role in cases where an initial RT-PCR test returns negative results but there is a persistent high clinical suspicion of disease, as well as in patients with worsening symptoms or in resource-constrained environments where RT-PCR testing may be limited. The American College of Radiology advises against using CT as a first-line diagnostic tool for COVID-19, recommending its use be reserved for symptomatic hospitalized patients with specific clinical indications, such as the assessment of complications [2].

Among pulmonary imaging modalities, chest radiography is less sensitive for detecting COVID-19 lung disease compared to CT, with a reported baseline sensitivity of 69% [2, 6]. Pulmonary ultrasound is another useful imaging modality for evaluating critically ill patients with COVID-19, as it can be performed at the bedside and allows for the detection of pneumonia and complications such as pneumothorax [2].

CT has played a crucial role in the diagnosis and management of patients with viral pneumonia, as evidenced by large-scale outbreaks of Severe Acute Respiratory Syndrome (SARS-CoV) and Middle East Respiratory Syndrome (MERS-CoV) [7]. The primary chest CT findings in patients with COVID-19 pneumonia include ground-glass opacities (GGO), crazy paving, consolidation, bronchovascular thickening, and traction bronchiectasis. Ground-glass and/or consolidative opacities are typically bilateral, peripheral, and basal in distribution, which are considered suggestive of the disease. Atypical findings include mediastinal lymphadenopathy, pleural effusions, pulmonary nodules, tree-in-bud patterns, pneumothorax, cavitation, the atoll sign, and pneumomediastinum [8].

While RT-PCR is the gold standard for definitive diagnosis, it has limitations regarding availability, sensitivity for detecting COVID-19, and extended waiting times for results. Additionally, inter-operator variability can affect sample quality, leading to false negatives [9]. CT has become a standard of care in diagnosing and assessing various respiratory conditions, such as interstitial lung disease and lung cancer, optimizing the management process. Although CT scans are not routinely used to diagnose ARDS, they can identify complications related to mechanical ventilation, including pneumonia, pneumothorax, and emphysema, which may not be evident on chest radiography [3].

Chest CT serves as a rapid and cost-effective alternative to RT-PCR, providing a highly specific diagnosis for COVID-19 when there is high clinical suspicion (9). In patients with high clinical suspicion and repeated negative RT-PCR tests, chest CT can facilitate early diagnosis, patient isolation, and contact tracing. A significant number of patients with typical imaging features have also been diagnosed incidentally when imaging is performed for other indications [6, 10].

Imaging is beneficial for differentiating patients with COVID-19 pneumonia from those with other infectious and non-infectious pulmonary pathologies presenting acutely [10]. The significance of this study lies in assessing the diagnostic capacity of chest imaging, particularly chest CT, in diagnosing COVID-19 pneumonia, by identifying its sensitivity compared to RT-PCR and outlining typical chest imaging patterns.

2 Methods and Materials

2.1 Operational Definitions

Clinically Suspicious Case: A patient presenting with acute upper or lower respiratory symptoms, with or without fever, or having close contact with a confirmed COVID-19 patient [9].

Suspicious Imaging Feature: A patient exhibiting chest CT features of consolidation or ground-glass opacity (GGO) with a peripheral, bilateral, and basal distribution [2].

Unrelated Illness: A disease condition not attributed to the infection or complications of COVID-19 [9].

CT Severity Score: A semi-quantitative CT severity scoring system was used to assess the involvement of the five lobes of the lungs. Each lobe's involvement is scored as follows:

- 0: no involvement
- 1: $< 5\%$ involvement
- 2: 5–25% involvement
- 3: 26–50% involvement
- 4: 51–75% involvement
- 5: $> 75\%$ involvement

The global CT score is the sum of each lobar score, resulting in a total score ranging from 0 to 25. A score of < 7 is considered mild, 8–17 is moderate, and > 18 is severe [11].

2.2 Study Area and Period

Imaging for the study participants was primarily conducted at two institutions: Pioneer Diagnostic Center and Wudassie Diagnostic Center. Pioneer Diagnostic Center is one of the largest imaging facilities in Addis Ababa, providing dedicated imaging services for patients with suspected and confirmed COVID-19 using a

128-slice CT scanner. Wudassie Diagnostic Center also offers imaging services for all referred patients, regardless of their clinical diagnosis.

Additional data were collected from Tikur Anbessa Specialized Hospital (TASH), the largest tertiary hospital in the country, with over 700 beds and multiple outpatient services. TASH has an isolation ward and ICU for COVID-19 patients and provides imaging services using two CT scan machines with 128 and 64-slice capabilities. The treatment centers are dedicated care units that offer inpatient medical services, including intensive care for patients with moderate to severe COVID-19 pneumonia requiring admission.

Patients admitted to the treatment centers and those scanned at the aforementioned institutions between July 1, 2021, and October 1, 2021, were enrolled in the study.

2.3 Study Design

A crossectional study was performed to collect data on patients with clinically suspected or confirmed COVID-19 who underwent chest CT imaging and patients imaged for unrelated illnesses with incidental findings suggestive of COVID-19 pneumonia

2.4 Population

2.5 Source Population

All patients with clinical suspicion or confirmed COVID-19 infection underwent chest CT scanning and patients scanned for unrelated illness with imaging suspicion during the study period.

2.6 Study Population

All patients with clinical suspicion or confirmed COVID-19 patients who underwent chest CT and patients with suspicious imaging features were scanned for unrelated illnesses and had RT PCR tests done during the study period.

2.7 Eligibility criteria

Inclusion criteria

- All patients with clinically suspected or confirmed COVID-19 infection underwent chest CT scan evaluation.

Exclusion criteria

- Patients with suspected COVID-19 pneumonia whose RT PCR test is unknown or lost
- Those patients underwent chest imaging but were not reviewed due to poor quality (artifacts or not completely inclusive of the whole chest)

2.8 Sampling Technique and Sample Size

A convenience sampling method was employed in this study. All patients with laboratory-confirmed or clinically suspected COVID-19 infections who underwent chest CT scanning and RT-PCR testing during the study period (from July 1, 2021, to October 1, 2021) were enrolled.

2.9 Data Collection Instruments, Techniques, and Data Collectors

Data were collected from over eight COVID-19 treatment centers in Addis Ababa, which varied in the number of inpatient beds and services. These included Millennium Hall Treatment Center, Eka Kotebe General Hospital, St. Peter Hospital, Bulbula COVID-19 dedicated hospital, Sint Paul, Zewditu Memorial, and Hallelujah hospital. Most of these treatment centers do not have dedicated CT scan facilities for imaging their patients; those requiring cross-sectional imaging are referred to diagnostic centers.

Chest CT scans of patients who met the inclusion criteria were reviewed using an open-source DICOM viewer. The initial cases were reviewed in collaboration with the principal investigator and an experienced senior radiologist specializing in cardiothoracic imaging to standardize data collection. Important patient data, including COVID-19 RT-PCR results, demographic information, and clinical conditions (such as patient presentation and any underlying illnesses), were collected from patient imaging requests and the national COVID registry.

The Principal Investigator collected the data using a structured questionnaire, which was then reviewed by two senior radiologists to minimize bias. The data were subsequently exported to SPSS for analysis.

2.10 Data Analysis

The data collected from the Google Form questionnaire were exported to SPSS version 26.0 for analysis, after checking for missing values. Various analytical methods, including tables and graphs, were used to present demographic data, clinical findings, and CT findings and patterns. Pearson correlation and binary logistic regression analyses were conducted to explore associations between demographic variables, clinical characteristics, and chest CT findings, as well as to assess associations with disease severity. A p-value of < 0.05 was considered statistically significant for testing associations between variables.

2.11 Ethical Considerations

Ethical clearance was obtained from the Review Board of the College of Health Sciences (IRB-CHS), allowing for data collection. To protect patient privacy, identifiers were used to maintain the anonymity of study subjects.

3 Results

3.1 Patient Characteristics

A total of 193 patients were included in the study, of which 116 (60.1%) were male and 77 (39.9%) were female. The age of the patients ranged from 23 to 85 years, with a mean age of 50 ± 14.2 years. Most of the patients (92, or 47.7%) were over the age of 51.

Among the 193 patients, 42 (21.8%) had one or more known comorbidities. Specifically, 26 (61.9%) had hypertension, 25 (59.5%) had diabetes mellitus, 4 had known HIV/AIDS, and 2 had a history of lung disease. Notably, a third of the patients with known comorbidities (14, or 33.3%) had both diabetes and hypertension (Table 1).

Table 1 Underlying comorbidities of the patient

Variable (n=42)		Number(percent)
Co-morbidity	DM	25(59.5)
	Hypertension	26(61.9)
	HIV/AIDS	4(9.5)
	Underlying lung disease	2(4.7)
	Cardiac disease	1(2.3)
	Malignancy	1(2.3)
	Renal disease	1(2.3)

Clinical presentations were documented for 84 (43.5%) of the study participants. Among those with a known presentation, only one patient was asymptomatic. Of the symptomatic patients, cough was the most common complaint, reported by 82 (76%) patients, followed by shortness of breath in 65 (60.7%), chest pain in 36 (33.6%), and fatigue in 26 (24.3%). The majority of symptomatic patients reported a duration of symptoms between 5 and 8 days, accounting for 46 (43%) of the cases (Table 2).

Table 2 Clinical presentation of patients

Variable(n=107)		Frequency (percent)
Patients presenting symptoms	Cough	82(76.6)
	SOB	65(60.7)
	Chest pain	36(33.6)
	Fatigue	26(24.3)
	Fever	20(18.7)
	Headache	14(13)
	Arthralgia/myalgia	4(3.7)
	Loss of taste	4(3.7)
	Sore throat	2(1.9)
Duration of symptoms	$<$ 4 days	19(17.7)
	5-8 days	46(43)
	9-14 days	15(14)
	$>$15 days	28(26.1)

Among the total number of patients included in this study, COVID-19 RT-PCR positivity was 93.8% (181 patients). Most of the patients who underwent chest CT evaluation had CT angiography (101 patients, or 52.3%), while 63 patients (32.6%) underwent non-contrast CT; the remainder had conventional post-contrast CT. Among those who had chest CT scans, 190 patients (98.4%) exhibited positive chest findings, and only 3 patients had unremarkable chest CT results. Considering chest CT findings with CORAD scores of 4 and 5 as suggestive of COVID-19 infection, 160 patients (82.9%) were diagnosed with COVID-19 pneumonia based on chest CT. Using RT-PCR results as the gold standard, the sensitivity and specificity of chest CT were found to be 82.9% and 16.7%, respectively.

3.2 Chest CT Findings, Distribution, and Severity

In this study, chest CT pattern distribution revealed that 95.9% of cases had bilateral lung involvement, 51.3% had a peripheral distribution, and 45.6% had a diffuse distribution. The disease process involved all lobes in approximately 90% of cases. The anterior-posterior distribution showed that 64.2% of cases had diffuse involvement, while 34.5% exhibited a predominant dorsal distribution.

The chest CT findings displayed both typical and atypical patterns for COVID-19 pneumonia, with a typical pattern observed in 189 patients (97.9%) and atypical features in 30 patients (15.5%). Among patients with typical chest CT patterns, 157 (83%) showed ground-glass opacities (GGO), 152 (80.4%) had consolidation, 68 (35.4%) presented with bronchovascular thickening, and subpleural curved fibrosis was seen in 67 patients (35.4%). In patients with overlapping atypical chest CT features, mediastinal lymphadenopathy was noted in 18 patients (60%), pleural effusion in 16 patients (53.3%), and non-specific nodular opacity in 3 patients (10%).

The imaging patterns among symptomatic patients varied according to the duration of symptoms. Among those presenting with symptoms lasting less than 4 days, consolidation was found in 18 patients (94.7%) and GGO in 15 patients (78.9%). Of the 44 patients who presented with symptoms lasting between 5 to 8 days, 38 (86.3%) had GGO, 34 (77%) had consolidation, 14 (31.8%) exhibited bronchovascular thickening, and 15 (34%) had curved peripheral fibrosis. Among patients who presented with symptoms lasting 9 to 14 days, 14 (93.3%) had consolidation, 13 (86.6%) had GGO, 8 (53.3%) showed bronchovascular thickening, and 5 had curved peripheral fibrosis. Of the 28 patients whose symptoms persisted for more than 15 days, 25 (89.3%) had consolidation, 24 (85.7%) had GGO, 14 (50%) had bronchovascular thickening, and 12 (42.8%) exhibited curved peripheral fibrosis (Table 3, Table 4, Figure 1).

Table 3 Imaging patterns of patients

Variable(n=193)		Number(percent)
Typical feature (189)	GGO	157(83)
	Consolidation	152(80.4)
	Broncho-vascular thickening	68(36)
	Peripheral curved fibrosis	67(35.4)
	Crazy paving	10(5.2)
	Traction bronchiectasis	15(7.9)
	Halo sign	14(7.4)
Atypical feature (30)	Mediastinal lymphadenopathy	18(60)
	Pleural effusion	16(53.3)
	Nodular opacities	3(10)

Table 4 Frequency of combined typical imaging feature

Variable(n=193)	Number(percent)
GGO and consolidation	120(62.1)
GGO and bronchovascular thickening	55(28.5)
Consolidation and bronchovascular thickening	55(28.5)
GGO, Consolidation and bronchovascular thickening	44(22.8)

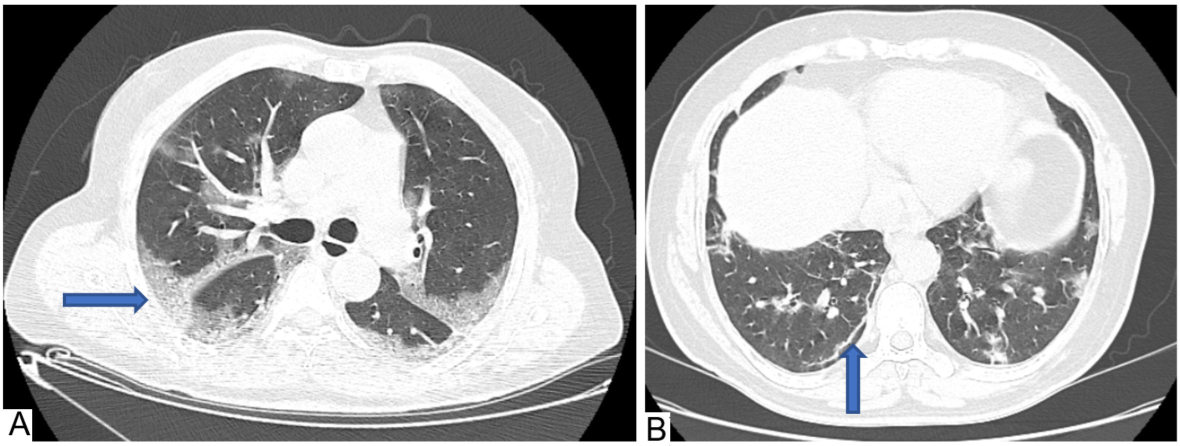

Figure 1 A) A 60 years old male patient with bilateral ground glass opacity(arrow) with peripheral and dorsal distribution B) A 51 years old male patient with positive COVID PCR test with a right basal lung peripheral curved fibrosis (arrow)

Among the 157 patients with ground-glass opacity (GGO), 85 (54.1%) exhibited a peripheral distribution and 68 (43.3%) displayed a diffuse distribution. Of the 152 patients with consolidation, 110 (72.4%) had a predominantly peripheral pattern, while 39 (25.6%) had a diffuse pattern.

Acute pulmonary embolism was identified in 8 patients. Among those with underlying lung diseases not attributed to COVID-19, lung fibrosis was observed in 11 patients, emphysema in 7, and cystic lung disease in 6 patients.

The mean (SD) chest CT severity score was 13.6 ± 6.2, with a median score of 14. A total of 95 patients (49.2%) had a severity score greater than 18 (Table 5).

Table 5 CT severity score grading (Francone *et al*, 2020)

CT severity	Frequency (Percent)
Mild (<7)	59(30.6%)
Moderate (8-17)	59(30.6%)
Severe (>18)	95(49.2%)

In this study, the association of variables was assessed using Pearson's correlation. The relationships between age, sex, comorbidities, symptoms, and the duration of symptoms were evaluated in relation to the CT severity score. The analysis revealed a positive correlation between the CT severity score and both age and diabetes mellitus, with a p-value of < 0.01. The bivariate logistic regression indicated that diabetic patients had a 1.6 times higher risk of developing severe COVID-19 pneumonia (Table 6, Table 7).

Table 6 Correlation of age and DM with chest CT severity score

	Variables	Mean	SD	1	2
1.	Age	50	14.2		
2.	DM			.413	
3.	CT severity score	13.6	6.2	.0001*	.003*

* P<0.01(2-tailed); N= 193, SD: Standard deviation

Table 7 Association of severe CT score with age of the patient and DM

	Severe CT score (>18) Frequency(percentage)	COR 95% CI	AOR 95% CI
40-49 years	18(41.9)	2.16[0.39-11.9]	1.6[0.1-25.7]
50-64 years	20(33.9)	1.54[0.28-8.3]	2.8[0.26-31.6]
64-84 years	9(32.1)	1.42[0.23-8.5]	2.5[0.2-32.6]
DM	11(78.6)	2.01[0.56-7.31]	1.6[0.4-6.8]

4 Discussions

This study aimed to explore the demographic characteristics, clinical presentations, and imaging patterns among patients with suspected and confirmed COVID-19 pneumonia. The findings indicate a slight male predominance, with a male-to-female ratio of 1.5:1. The mean age of patients was 50 ± 14.2 years, and nearly half (47.7%) were over the age of 51. While many studies do not document a significant gender predilection, the older age distribution aligns with findings from a study conducted in Tehran, Iran [12], which reported the highest incidence of the disease among individuals aged 50-59 years. Similarly, a study in China [13] found a median age of 47 years, with 47% of patients over the age of 51.

In our study, among participants with known comorbidities, 62% had hypertension and 59.5% had diabetes mellitus, representing the most common underlying conditions in COVID-19 patients. This is comparable to a study involving 2012 patients in Pakistan [14], which identified uncontrolled diabetes with hypertension (n = 56; 26.4%) and controlled diabetes (n = 22; 10.37%) as prevalent comorbidities.

Cough and SOB are frequently reported findings, occurring in 76% and 60.7% of participants, respectively. Fever as a presenting symptom was noted in only 18.75% of patients in this study. This symptom pattern is consistent with findings from a study in China [13] involving 1099 patients, which reported cough (67.8%) and fever (43.8%) as the most common symptoms. In contrast, an Italian study [15] indicated that fever was the predominant symptom in 97 (61%) of patients, followed by cough and dyspnea in 88 (56%) and 52 (33%) patients, respectively. The discrepancy may be due to treatment interventions, such as antipyretics, affecting symptom presentation in our cohort, most of whom were admitted to COVID-19 treatment centers.

RT-PCR is considered the gold standard for assessing the diagnostic sensitivity of imaging modalities, including chest CT scans. In our study, using CO-RAD scores of 4 and 5 as criteria for diagnosing COVID-19 pneumonia via CT, the overall positivity rate was 93.8%. The sensitivity and specificity of chest CT were found to be 82.9% and 16.7%, respectively, when compared to RT-PCR results. These figures are lower than those reported in studies from China and Italy. A study conducted in China [16] found chest CT sensitivity and specificity for COVID-19 infection to be 97% and 25%, respectively, while an Italian study [17] involving 773 patients reported sensitivity and specificity rates of 90.7% and 78.8%. A large meta-analysis of 1431 patients also indicated pooled sensitivity and specificity rates of 94.6% and 46.5%, respectively. Though these studies have methodological limitations that may have led to an overestimation of sensitivity [18], the lower sensitivity observed in our study may be attributed to selection bias; most patients had positive PCR results upon admission, and the majority of those imaged were confirmed cases undergoing evaluation for complications. The lower specificity in our study may also be due to the small number of RT-PCR negative cases that underwent chest CT imaging.

Our study revealed that the predominant chest CT findings were GGO and consolidation, observed in 83% and 80.4% of patients, respectively, followed by bronchovascular thickening (35.4%). These findings are consistent with multiple studies conducted in China [14, 18-20] and Italy [13], which reported multifocal ground-glass opacities and consolidations as the primary chest CT features in patients with COVID-19 pneumonia.

Our study examined the variation in imaging appearances among symptomatic patients based on the duration of their symptoms. Patients presenting with symptoms for less than 4 days predominantly exhibited consolidation (94.7%) and ground-glass opacity (GGO) (78.9%). Among those whose symptoms lasted 5 to 8 days, consolidation (86.3%) and GGO (77%) remained the predominant CT features, with bronchovascular thickening and curved peripheral fibrosis observed in 31.8% and 34% of cases, respectively. In patients with symptoms lasting 9 to 14 days, as well as those with symptoms exceeding 14 days, although consolidation and GGO remained the typical CT features, there was a higher prevalence of bronchovascular thickening and curved peripheral fibrosis. The predominance of consolidation and GGO, followed by the development of bronchovascular thickening, has also been described by Jin *et al.* [21].

The bilateral, peripheral distribution with multilobar involvement seen in our study is consistent with findings from multiple publications, including a review by Salehi *et al.*, which analyzed various publications and case reports involving a total of 919 patients [22].

Using a semi-quantitative CT severity scoring system [11], we found that lung pathologies predominantly affected the basal regions, with the right lower lobe involved in 186 patients (96.4%) and the left lower lobe in 183 patients (94.8%). The mean total CT severity score in our study was 13.6 $\pm$ 6.2. In a related study using the same scoring system, it was reported that pathological involvement was mostly in the inferior lobes, with the right lower lobe (RLL) affected in 122 patients (93.8%) and the left lower lobe (LLL) in 123 patients (94.6%). The mean (SD) CT severity score in that study was 12.3 $\pm$ 11.1.

In our study, the 25-point CT severity score showed a significant correlation with patient age and the presence of diabetes mellitus, suggesting that COVID-19 pneumonia is more severe in older patients and those with diabetes. Patients with diabetes had a 1.6 times higher risk of developing severe disease as indicated by chest CT.

Strengths and Limitations of the Study

A major strength of this study is its ability to identify typical imaging patterns of COVID-19 pneumonia, distinguishing them from other infectious processes affecting the lungs. Additionally, the study successfully implemented a severity score assessment and identified major risk factors. Most patients included were admitted to treatment centers, and chest CT was performed to assess complications such as pulmonary embolism and post-COVID fibrosis. Consequently, the majority of our patients were symptomatic, and since most were admitted with a positive PCR test and moderate to severe illness, this may have created a sampling bias in assessing both CT sensitivity and severity scores.

Moreover, we noted that the presenting symptoms of 107 (55.4%) patients and underlying comorbidities of 144 (74.6%) patients were not documented, which complicates the generalization of common presenting symptoms and comorbidities.

5 Conclusion and Recommendations

Most patients referred for chest CT evaluation from various treatment centers exhibited positive CT findings suggestive of COVID-19 pneumonia, characterized by predominant GGO, consolidation, and bronchovascular thickening. The pathologies demonstrated a notable dorsal and basal distribution. These imaging features are considered typical for COVID-19 pneumonia and are crucial for differentiating it from other causes of pneumonia and acute respiratory distress syndrome (ARDS).

Among those with known clinical information, many patients had diabetes and hypertension, with the primary complaints being cough, shortness of breath, and chest pain. The average CT severity score was moderate (13.6), and there was a significant correlation between older age and diabetes with the chest CT severity score, indicating that these factors directly influence patient clinical outcomes.

The study primarily involved hospitalized patients and did not include asymptomatic patients or those with mild symptoms, limiting the identification of CT imaging patterns, distributions, and severity scores. Future research should include a larger cohort of patients with complete clinical presentations and assess clinical outcomes in relation to imaging evaluations. It is also recommended to follow patients after COVID-19 pneumonia to observe the imaging patterns associated with post-COVID sequelae.

Abbreviations

ACE	Angiotensin-converting enzyme
ARDS	Acute respiratory distress syndrome
CDC	Center for disease control
CT	Computed Tomography
DM	Diabetes Mellitus
GGO	Ground glass opacity
MS Excel	Microsoft Excel
PACS	Picture archiving and communication system
PPV	Positive predictive value
RNA	Ribonucleic Acid
RT- PCR	Reverse-transcription polymerase chain reaction
SPSS	Statistical Package for the Social Sciences
TASH	Tikur Anbessa specialized hospital
US	Ultrasound
WHO	World Health Organization

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Competing Interests Declaration

None of the authors received any financial or non-financial benefits from the submitted work.

Ethical Approval

Ethical clearance was obtained from the Research and Ethics Committee of the Department of Radiology and the Institutional Review Board of the College of Health Sciences (IRB-CHS), granting permission to collect the data. To protect patient privacy, identifiers were used to maintain the anonymity of the study subjects.

Data Access

All authors of this manuscript had full access to all data (including statistical reports and tables) in the study and can take responsibility for the integrity of the data and the accuracy of the data analysis.

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