

# Sensitivity and Specificity of High-Resolution Computed Tomography in the Diagnosis of COVID-19 Infections

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## ABSTRACT

### Introduction:

The goal of this study is to find the sensitivity and specificity of High resolution computed tomography (HRCT) of the chest in diagnosing COVID-19 infection using Reverse Transcription Polymerase Chain Reaction (RT-PCR) as a gold standard.

### Methods:

All patients clinically suspected of having COVID 19 infection who had undergone both RT PCR test and HRCT chest were included in the study. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and diagnostic accuracy of HRCT chest in diagnosing COVID 19 infection were calculated considering RT-PCR as the gold standard test.

### Results:

A total of 100 patients were included in the study. The mean age was 55.68 years. HRCT chest showed 92.85 % sensitivity, 68.75 % specificity, 93.97 % PPV, 64.7 % NPV and 89 % diagnostic accuracy in the detection of COVID-19 infection.

### Conclusion:

HRCT scan of the chest shows high sensitivity and specificity for the diagnosis of COVID-19 pneumonia. It is a fast diagnostic test and also helps in grading the severity of pneumonia thus in further management.

### Keywords:

COVID-19; Reverse Transcription Polymerase Chain Reaction; Tomography, X-Ray Computed

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## INTRODUCTION

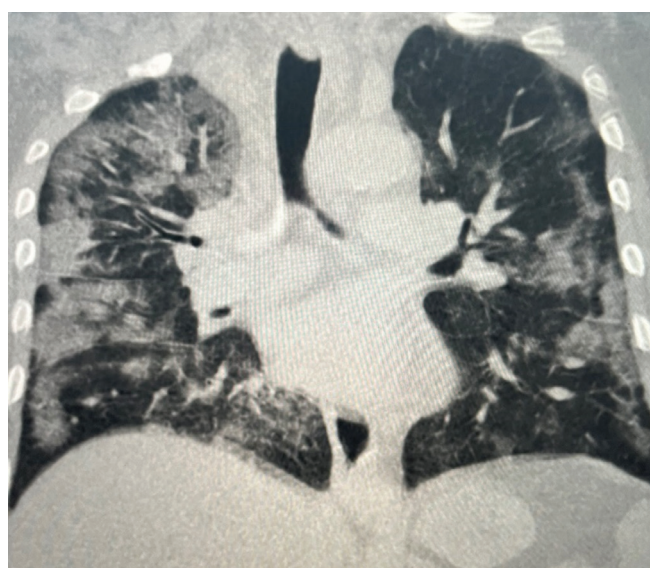
In December 2019, an outbreak of new coronavirus disease (COVID-19) was reported in Wuhan city of China. Coronavirus disease 2019 (COVID-19) is an acute infectious disease caused by a new strain of coronavirus known as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).<sup>1</sup> The disease was seen rapidly spreading in the world. On March 11, 2020, the World Health Organization (WHO) declared the novel coronavirus outbreak to be a pandemic.<sup>2,3,4</sup> The first wave was subsequently followed by the second wave in various parts of the world.

Diagnosing the disease at its early stage and isolating the patient is very important to prevent the further spread of COVID 19 infection. Though HRCT scan of the chest helps in the diagnosis of COVID 19 infection; RT PCR is considered a gold standard test by WHO. RT PCR has limited availability, takes a long time to report, and does not report the severity of the disease. It also has a high false-negative rate, requiring multiple tests to be performed. Apart from rapid diagnosis; HRCT chest also helps in grading the severity of the disease and thus in further management of COVID-19 infection. For this reason, there is an emphasis on evaluating HRCT chest as an imaging tool in a patient suspected of COVID 19 infection. This study is done to find the sensitivity and specificity of HRCT chest in detecting COVID-19 using RT-PCR as the gold standard.

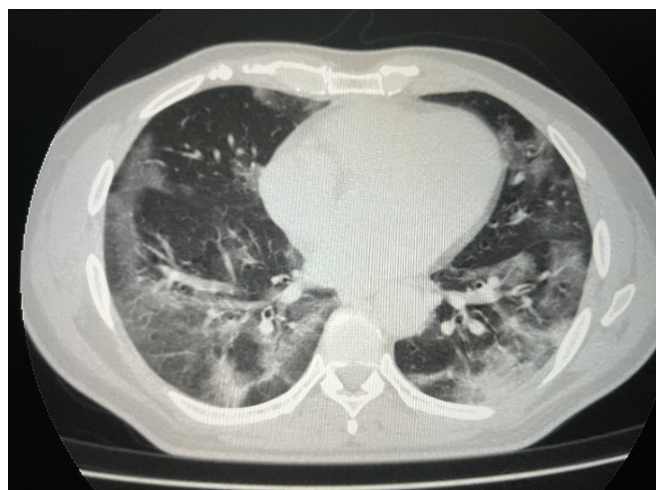
## METHODS

This was a cross-sectional observational study done in the Radiology Department of Manipal Teaching hospital, Fulbari, Pokhara. The study was conducted from 1<sup>st</sup> July 2021 to 31<sup>st</sup> August 2021. Ethical clearance was taken from the institutional review board of Manipal Teaching Hospital. Informed consent was taken from the patients before the study. All patients clinically suspected of having COVID 19 infection and sent for HRCT chest in the radiology department were included in the study. CT scan was done with the patient in the supine position by using a 128 slice CT (PHILIPS) scan machine. Axial sections with 3 mm slice thickness were obtained with a tube current of 250-300 mAs, and a tube voltage of 120 kV. All images were reconstructed with a 1mm slice thickness. Sagittal and coronal reformatted

images were subsequently obtained. Contrast material was not used. All CT scan images were analyzed and reviewed by radiologists. CT scan findings were classified according to COVID 19 reporting and data system (CO-RADS). The CO-RADS is a standardized reporting system for patients with suspected COVID-19 infection. CT findings were categorized as CO-RADS 1 to 6 as shown in Table 1. Patients categorized as CO-RADS 4 & 5 were considered positive and CO-RADS 1, 2, and 3 were considered negative. The COVID-19 Reporting and Data System (CO-RADS) was developed by the Dutch Association for Radiology with grades ranging from 1 to 6; with an increasing probability of disease according to the CT chest findings.<sup>5</sup> Typical CT findings of COVID 19 infection were multifocal ground-glass opacities and consolidation; predominantly at the periphery and basal distribution; vascular thickening, crazy paving pattern, and subpleural bands. Radiologists were not aware of the RT-PCR results. These patients were followed for their PCR reports. All the patients who did not agree to participate in the study and those whose PCR reports could not be followed were excluded from the study. The interval between HRCT chest and RT-PCR was five days or less. Data were analyzed using SPSS 21. A 2x2 table was constructed and sensitivity, specificity, PPV, NPV, and diagnostic accuracy of HRCT chest in diagnosing COVID-19 infection was calculated.



**Figure 1:** Coronal reformatted CT scan of the chest showing consolidation at the periphery of the bilateral lung



**Figure 2:** Axial CT scan of the chest showing consolidation and fibrosis at the periphery of the bilateral lung

**Table 1: CO-RADS classification**

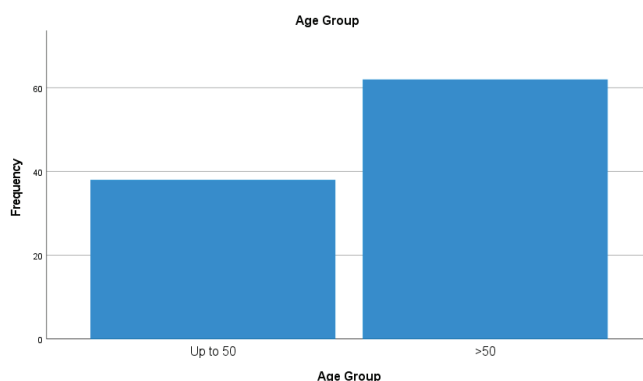
CO-RADS	Level of suspicion	CT findings
CO-RADS 1	No	Normal or non-infectious abnormalities
CO-RADS 2	Low	Abnormalities consistent with infections other than COVID 19 infection
CO-RADS 3	Intermediate	Unclear whether COVID 19 is present
CO-RADS 4	High	Suspicious of COVID 19 infection
CO-RADS 5	Very high	Typical of COVID 19 infection
CO-RADS 6	PCR +ve	

CO-RADS: Coronavirus disease 2019 (COVID-19) Reporting and Data System; PCR: Polymerase Chain Reaction

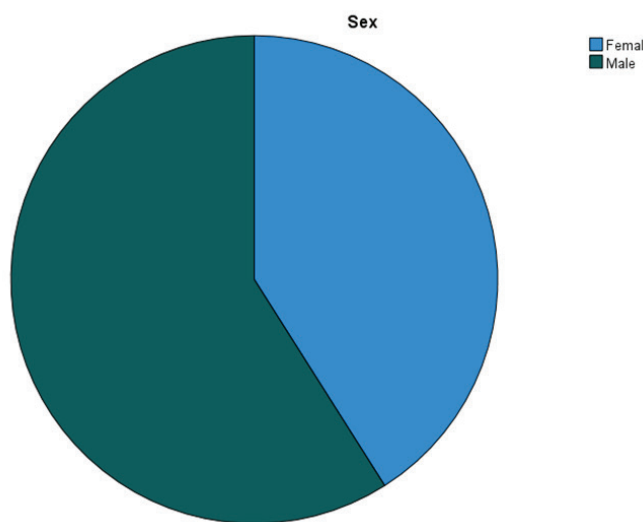
**RESULTS**

A total of 100 patients with suspected COVID-19 infection were enrolled in the study. The mean age was 55.68 years. More patients were found to be more than 50 years of age as shown in Figure 3. Males were 59% and females were 41%. Out of 100

patients; 83 patients were found to be positive for COVID-19 infection as per HRCT findings, while 84 patients were detected positive on RT-PCR. HRCT chest showed 92.85 % sensitivity, 68.75 % specificity, 93.97 % PPV, 64.7 % NPV and 89 % diagnostic accuracy in the detection of COVID-19 infection.



**Figure 3:** Age distribution



**Figure 4:** Sex distribution

**Table 2: HRCT and PCR findings**

HRCT	PCR		Total
	POSITIVE	NEGATIVE	
Positive	78	5	83
Negative	6	11	17
Total	84	16	100

HRCT: High resolution computed tomography; PCR: Polymerase Chain Reaction

## DISCUSSION

Early detection and isolation of patients with COVID 19 infection are very important to properly manage the patient and prevent the further spread of infection. RT-PCR is considered the gold standard test for the diagnosis of COVID 19 infection. We have done this study to find out the sensitivity and specificity of HRCT chest in diagnosing the COVID 19 infection. In present study; HRCT chest showed 92.85 % sensitivity, 68.75 % specificity, 93.97 % PPV, 64.7% NPV and 89 % diagnostic accuracy in diagnosing COVID-19 infection. Similar to our study; a meta-analysis by Kim et al. reported the pooled sensitivity of chest CT in diagnosing COVID-19 to be 94 %.<sup>6</sup> However, our specificity was higher than reported by Kim et al. (37 %). This variation may be because in our study we have included only CORADS 4 and 5 as positive; while some studies have included indeterminate findings (CORADS 3) also as positive results. Also, our study was done during the second wave, when the probability of disease was high. Ai T et al. found sensitivity, specificity, positive predictive value, and negative predictive value, the accuracy of chest CT in diagnosing COVID-19 infection to be 97%, 25%, 65%, 83%, and 68% respectively.<sup>7</sup> They found higher sensitivity than our results. A study conducted by Fang et al. found to have higher sensitivity than our study for the diagnosis of COVID-19 disease (97%).<sup>8</sup> Similarly, a study conducted by Caruso et al. also reported higher sensitivity than the present study in detecting COVID-19 cases.<sup>9</sup> They showed a sensitivity of 97%, specificity of 56%, and accuracy of 72%. Our study showed slightly lower sensitivity than the above-mentioned study. This discrepancy in findings may be due to the small sample size in our study and more patients may have presented early in hospital resulting in an early CT scan of the chest. Chung et al. reported that chest CT may be negative in patients with COVID-19 during the initial period.<sup>10</sup> Dangis et al. reported 93.6 % specificity, 86.7 % sensitivity, 90.3% negative predictive value, 91.1 % positive predictive value, and accuracy of 90.2%.<sup>11</sup> Systemic review and meta-analysis of HRCT chest accuracy in the diagnosis of COVID 19 infection reported the sensitivity and specificity of HRCT chest to be 87% and 43 % respectively for detecting patients

with COVID-19 infection.<sup>12</sup> These findings were comparable to our findings.

## CONCLUSION

High-resolution computed tomography (HRCT) of the chest has high sensitivity and diagnostic accuracy in diagnosing COVID 19 infection. It is a non-invasive imaging modality and helps to provide fast and accurate diagnosis in patients with COVID 19 infection. It also helps in grading the severity of COVID-19 pneumonia and thus further management. Patients usually present in the hospital after 3-5 days after the onset of symptoms. Hence, many patients with COVID 19 infection were found to have findings in HRCT of the chest. Our study suggests that HRCT chest should be considered for the diagnosis of COVID-19 infection in clinically suspected patients. This was a small sample size and single-center study. Therefore, more large-scale studies are recommended for further observations.

## CONFLICT OF INTEREST

None

## SOURCES OF FUNDING

None

## REFERENCES

1. Zhu N, Zhang D, Wang W, et al. A novel Coronavirus from patients with pneumonia in China, 2019. *N Engl J Med.* 2020;382(8):727–33. <http://dx.doi.org/10.1056/NEJMoa2001017>
2. Huang C, Wang Y, Li X, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet.* 2020;395(10223):497–506. [http://dx.doi.org/10.1016/S0140-6736\(20\)30183-5](http://dx.doi.org/10.1016/S0140-6736(20)30183-5)
3. ACR. ACR recommendations for the use of chest radiography and computed tomography (CT) for suspected COVID-19 infection. American College of Radiology [Internet]. 2020. [cited 2021 July 7]. <https://www.acr.org/Advocacy-and-Economics/ACR-Position-Statements/Recommendations-for-Chest-Radiography-and-CT-for-Suspected-COVID19-Infection>

4. Sverzellati N, Milanese G, Milone F, Balbi M, Ledda RE, Silva M. Integrated radiologic algorithm for COVID-19 pandemic. *J Thorac Imaging*. 2020;35(4):228–33. <http://dx.doi.org/10.1097/rti.0000000000000516>
5. Prokop M, van Everdingen W, van Rees Vellinga T, et al. CO-RADS: A categorical CT assessment scheme for patients suspected of having COVID-19-definition and evaluation. *Radiology*. 2020;296(2):E97–104. <http://dx.doi.org/10.1148/radiol.2020201473>
6. Kim H, Hong H, Yoon SH. Diagnostic performance of CT and reverse transcriptase polymerase chain reaction for Coronavirus disease 2019: A meta-analysis. *Radiology*. 2020;296(3):E145–55. <http://dx.doi.org/10.1148/radiol.2020201343>
7. Ai T, Yang Z, Hou H, et al. Correlation of chest CT and RT-PCR testing for Coronavirus disease 2019 (COVID-19) in China: A report of 1014 cases. *Radiology*. 2020;296(2):E32–40. <http://dx.doi.org/10.1148/radiol.2020200642>
8. Fang Y, Zhang H, Xie J, et al. Sensitivity of chest CT for COVID-19: Comparison to RT-PCR. *Radiology*. 2020;296(2):E115–7. <http://dx.doi.org/10.1148/radiol.2020200432>
9. Caruso D, Zerunian M, Polici M, et al. Chest CT features of COVID-19 in Rome, Italy. *Radiology*. 2020;296(2):E79–85. <http://dx.doi.org/10.1148/radiol.2020201237>
10. Hong J-M, Hu L-H, Zhong Q-S, et al. Epidemiological characteristics and clinical features of patients infected with the COVID-19 virus in Nanchang, Jiangxi, China. *Front Med (Lausanne)*. 2020;7:571069. <http://dx.doi.org/10.3389/fmed.2020.571069>
11. Dangis A, Gieraerts C, De Bruecker Y, et al. Accuracy and reproducibility of low-dose submillisievert chest CT for the diagnosis of COVID-19. *Radiol Cardiothorac Imaging*. 2020;2(2):e200196. <http://dx.doi.org/10.1148/ryct.2020200196>
12. Khatami F, Saatchi M, Zadeh SST, et al. A meta-analysis of accuracy and sensitivity of chest CT and RT-PCR in COVID-19 diagnosis. *Sci Rep*. 2020;10(1):22402. <http://dx.doi.org/10.1038/s41598-020-80061-2>