e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2023; 15(8);1290-1301

Original Research Article

Ultra-Low dose CT chest for screening of COVID-19 patients: Evaluation of diagnostic performance and Radiation Dose Reduction

PrabhakaranA.V[1], SathiyabamaDhinakaran[2], LaavanyaSree.B[3], Praveen.V[4], Panneerselvam Periasamy[5]

[1]Associate Professor, Department of Radiology, Nandha Medical College and Hospital, Erode, Tamilnadu, India

[2]Professor, Department of Pathology, Nandha Medical College & Hospital, Erode, Tamilnadu, India

[3]Assistant Professor, Department of Immuno Haematology &Blood Transfusion, Nandha Medical College & Hospital, Erode, Tamilnadu, India

[4]Assistant Professor, Department of General Medicine, Government Erode Medical College & Hospital, Perundurai, Tamilnadu, India

[5]Assistant Professor, Department of Physiology, Government Erode Medical College & Hospital, Perundurai, Tamilnadu, India

Received: 30-5-2023 / Revised: 30-06-2023 / Accepted: 30-07-2023

Corresponding author: Dr. Praveen.V

Conflict of interest: Nil

Abstract:

As COVID-19 cases surge in Tamil Nadu, proactive measures to manage and curb its spread are of paramount importance. The conventional RT-PCR testing method, while reliable, comes with a significant time lag of at least 8 hours for obtaining results. Swift screening methods are essential to enable prompt quarantine measures and early detection of positive cases. Drawing inspiration from experiences in Wuhan, China, and Seoul, South Korea, where CT chest scans were employed for rapid and effective patient assessment, this study aims to explore the potential of ultra-low-dose CT chest scans as an innovative screening tool for COVID-19 in the context of Tamil Nadu. While existing literature showcases the use of CT chest scans for screening purposes, the application of low-dose CT in this specific context remains largely unexplored. This study postulates that ultra-low-dose CT chest scans could serve as an efficient, time-sensitive screening tool with a substantial reduction in radiation exposure to patients. The primary objectives of this research are twofold: firstly, to develop a methodology that minimizes radiation exposure while preserving the necessary diagnostic information for accurate imaging assessments, and secondly, to assess the diagnostic performance of ultra-low-dose chest CT scans in detecting COVID-19 pneumonia. By achieving these objectives, this study not only contributes to the growing body of knowledge regarding COVID-19 screening techniques but also presents a potential solution to expedite case identification and subsequent interventions in Tamil Nadu. The findings of this research could hold significant implications for public health, aiding in the early identification and containment of COVID-19 outbreaks.

Keywords: Ultra-Low dose CT, Chest, COVID-19, CT Screening, Radiation Dose Reduction, Diagnostic Performance.

Introduction

The unprecedented global outbreak of the novel corona virus disease (COVID-19) has posed immense challenges to healthcare systems and societies worldwide. In the Indian state of Tamil Nadu, as in many regions across the world, the ongoing battle against the virus has been marked by periodic waves of infection. As COVID-19 cases continue to surge, it becomes increasingly imperative to adopt innovative strategies for timely detection and effective management of the disease. [1,2] The current gold standard for COVID-19 diagnosis is the reverse transcription-polymerase chain reaction (RT-PCR) test, which detects viral genetic material and offers high accuracy. However, the drawback of this method lies in the time required for results to be obtained, often ranging from 8 hours or more. In the midst of a fast-spreading virus, such delays can hinder rapid response efforts, including isolation and contact tracing, consequently leading to further transmission. Drawing insights from successful strategies deployed in regions hit early by the pandemic, such as Wuhan, China, and Seoul, South Korea, where chest computed tomography (CT) scans were utilized for swift patient assessment, it becomes pertinent to explore alternative screening methodologies. CT chest scans offer the advantage of providing rapid visualizations of the lungs, enabling prompt identification of COVID-19-related lung abnormalities. [3,4,5] However, the traditional CT approach carries concerns about radiation exposure to patients, especially when utilized for screening purposes. [6,7] In this context, our study aims to address the urgent need for an effective and time-sensitive screening tool for COVID-19 in Tamil Nadu. Inspired by previous experiences, we propose investigating the application of ultra-low-dose CT chest scans as a potential solution. By significantly reducing radiation exposure while maintaining diagnostic accuracy, this innovative approach could bridge the gap between time-sensitive detection and patient safety. While existing literature documents the utility of CT chest scans for COVID-19 screening, the specific investigation into ultra-low-dose CT for this purpose remains a novel contribution. [8,9] Our research seeks to fill this gap in knowledge and explore the feasibility of using ultra-low-dose CT chest scans as a rapid and efficient screening tool in the local context. By hypothesizing that this approach could offer a balance between quick diagnosis and reduced radiation risk, we aim to demonstrate the potential utility of this technique in improving COVID-19 screening efforts. In the subsequent sections, we detail the objectives, methodology, and anticipated contributions of our study. The findings from this research could not only enhance our understanding of effective COVID-19 screening methods but also hold significant implications for public health strategies in Tamil Nadu and beyond.

Material and Methods

This cross sectional prospective study is designed to evaluate the diagnostic accuracy and radiation dose reduction potential of Ultra-Low-Dose Chest CT scans as a screening method for COVID-19 pneumonia. The study will be conducted at GEMC (Government Erode Medical College), Perundurai, Tamil Nadu, India, over a period of one month. The study population consists of 109 patients who have tested positive for COVID-19 through RT-PCR and are admitted at GEMC for medical care. As part of their clinical evaluation, each patient will undergo two different types of CT scans: a non-contrast Standard Dose Chest CT and an Ultra-Low Dose Chest CT.

The Standard Dose CT scans will be conducted with parameters set at 120 kV and 150 mA, while the Ultra-Low Dose CT scans will employ parameters of 120 kV and 10 mA. To ensure image quality, adaptive iterative reconstruction with a standard lung kernel will be employed for image reconstruction. Two experienced radiologists, blinded to the type of CT scan used, will independently review the CT examinations. They will follow a predefined evaluation protocol and assess the image quality using a 5-level scale, ranging from 1 (non-diagnostic) to 5 (excellent). Meanwhile, the radiation dose for each CT acquisition will be quantified using the dose-length product (DLP), measured in milligray- centimeters (mGy.cm). The effective dose, measured in millisieverts (mSv), will be estimated by multiplying the DLP by the chest-specific conversion coefficient (0.014 mSv/mGy.cm). Descriptive statistics will be employed to summarize patient demographics, radiation dose data, and radiologist evaluations. The diagnostic accuracy of Ultra-Low-Dose CT scans in identifying COVID-19 pneumonia will be determined using RT-PCR results as the reference standard. Additionally, inter-rater agreement between the radiologists will be assessed using appropriate statistical methods. Ethical approval has been obtained from the Institutional Review Board of GEMC, and informed consent acquired from each participant before CT scans are conducted. It is important to acknowledge that the study is limited by its single-center design, relatively small sample size, and the absence of follow-up data on patient outcomes. The outcomes of this study are anticipated to contribute valuable insights into optimizing imaging protocols for COVID-19 diagnosis and surveillance.

In the qualitative image analysis, the reviewers will independently assess both CT examinations using a 5-level scale for detailed evaluation. The scale ranges from 1 (indicating non-diagnostic image quality with significant artifacts) to 5 (representing excellent image quality without any artifacts). The assessment will cover overall image quality, lung parenchyma, and mediastinum visualization. The scoring criteria are outlined as follows:

Score 1: This score indicates non-diagnostic image quality characterized by major artifacts. Both lung parenchyma and mediastinum are non-diagnostic due to the presence of severe artifacts.

Score 2: A score of 2 signifies poor image quality with significant blurring that renders evaluation uncertain. Secondary pulmonary nodules are not discernible, lower lobar bronchi appear indistinct from the surrounding parenchyma, and mediastinum vessels are merged and non-discernible. Additionally, the liver and spleen cannot be identified in the upper part of the abdomen.

Score 3: Image quality is deemed acceptable with moderate blurring and limited assessment capability. Secondary pulmonary nodules are only partially discernible, lower lobar bronchi exhibit haziness, and mediastinum vessels are challenging to identify. The upper part of the abdomen exhibits severe blurring of the liver and spleen.

Score 4: An assigned score of 4 reflects good image quality with minimal blurring and unrestricted assessment. Secondary pulmonary lobules are well depicted, lower lobar bronchi show slight blurring, and mediastinum vessels are decently delineated. Blurring is moderate in the liver and spleen of the upper abdomen.

Score 5: The highest score of 5 represents excellent image quality without any artifacts. Secondary pulmonary lobules are excellently depicted, the lower lobar bronchi exhibit sharp margins, mediastinum vessels are precisely delimited, and the upper part of the abdomen is fairly depicted.

This systematic evaluation aims to provide a comprehensive and consistent qualitative assessment of the CT scans, considering various aspects of image quality and anatomical details.

Statistical analysis: Descriptive statistics including the frequency, percentage mean, and low-dose deviation (standard deviation [SD]) were used to describe the data. The Student's t-test was used to evaluate the continuous data using "IBM Corp.'s IBM SPSS Statistics for Windows, Version 24.0." IBM Corp. is situated in Armonk, New York. The statistical significance of the results was defined as a $P < 0.05$.

Result

Age-Wise Distribution: The youngest age group (21-40 years) has the lowest percentage of patients, with only 38.27%.

The oldest age group (61-87 years) has the highest percentage of patients, with 46.91%. This is because the risk of developing certain diseases increases with age.

- The percentage of patients goes up with age.
- The youngest age group has the lowest percentage of patients, only 38%.
- The oldest age group has the highest percentage of patients, 46%.

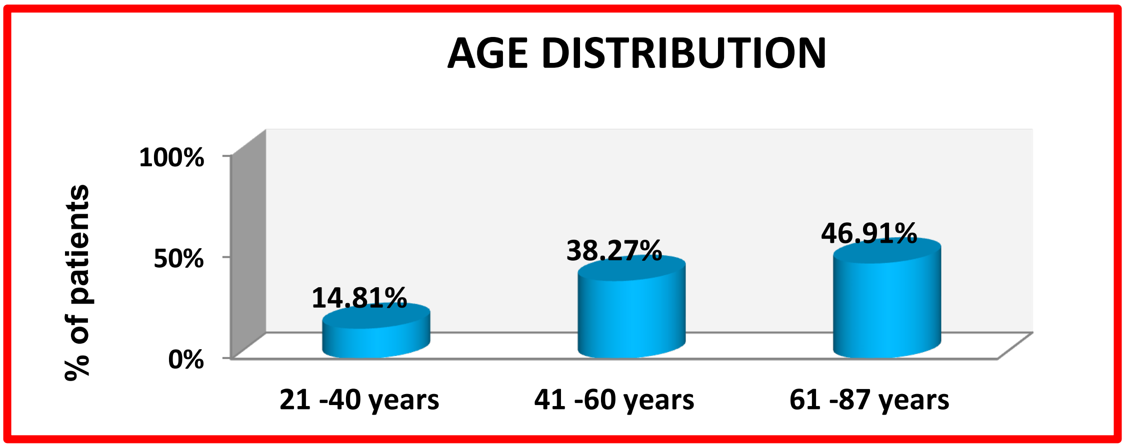

Figure 1: Simple bar diagram shows the age distribution

Table1: Age wise Gender distribution

Gender	N	Mean ± SD	t-test, P-value
Male	80	55.89±13.45	t=1.46,p=0.15
Female	29	60.14±13.32	

The age distribution of patients by gender is presented in Table 1. The sample consisted of 80 male patients and 29 female patients. The mean age of the male patients was 55.89 years ± 13.45 years, and the mean age of the female patients was 60.14 years ± 13.32 years. A t-test was conducted to compare the mean ages of the two groups. The t-statistic was 1.46 and the p-value was 0.15. This indicates that there is no statistically significant difference in the mean ages of the male and female patients ($p > 0.05$).The age distribution of the patients is not significantly different by gender.

Table 2: Level of Anthropometric Variables

		Number of patients	%
Height	141 -150 cm	10	9.17%
	151 -160 cm	34	31.19%
	161 -170 cm	46	42.20%
	>170 cm	19	17.43%
Weight	41-50 kg	8	7.34%
	51-60 kg	18	16.51%
	61-70 kg	46	42.20%
	>70 kg	37	33.94%

BMI	Under weight	5	4.59%
	Normal	55	50.46%
	Over weight	34	31.19%
	Obese	15	13.76%

The table 2 shows the number of patients in different anthropometric levels.

* Most patients are in the normal weight category (55 patients)
* 34 patients are overweight
* 15 patients are obese
* 5 patients are underweight

Table 3: CTD (Computed Tomography), DLP (Dose-Length Product), Effective Dose and severity Score

CT Dose Parameter	(Mean ± SD)	Mean differences	p-value
CTDIVol (mGy) -STD	15.35±.94	14.63	t=48.43 p=0.001*** (Significant)
CTDIVol (mGy) - LD	0.72±.19		
DLP (mGy.cm)-STD	478.33± 60.47	454.90	t=78.12 p=0.001*** (Significant)
DLP (mGy.cm)-LD	23.43 ± 6.22		t = 2.306 0.001.
effective dose (DLP x 0.014) in msv STD	6.70 ±.85	6.37	t=77.81 p=0.001*** (Significant)
effective dose (DLP x 0.014) in msv LD	0.33 ±.09		P=0.88
Severity score A	8.95 ± 5.24	0.10	t=0.14 p=0.88 (Not Significant)
Severity score B	9.05 ± 5.16		

p≤0.001 very high significant p>0.05 not significant, statistically there is a difference except severity score.

Comparison of CT Dose Parameters and Severity Score in Standard-Dose and Low-Dose CT Scans

A student independent t-test was conducted to compare the mean values of CT dose index (CTDIvol), dose length product (DLP), effective dose, and severity score in two groups of patients, namely, standard-dose (STD) and low-dose (LD).

The results of the t-test showed that there was a significant difference between the mean values of CTDIvol, DLP, and effective dose in the STD and LD groups (p < 0.001). This means that the use of low-dose CT scans resulted in significant reductions in radiation dose. The mean CTDI vol in the STD group was 15.35 mGy, and 0.72mGy in the LD group. The mean DLP in the STD group was 478.33 mGy.*cm,* the mean DLP in the LD group was 23.43 mGy.cm. The mean effective dose in the STD group was 6.70 mSv and mean effective dose in the LD group is 0.33msv.

However, there was no significant difference between the mean severity scores in the two groups (p = 0.88). This means that there was no significant difference in the severity of the disease between the two groups.

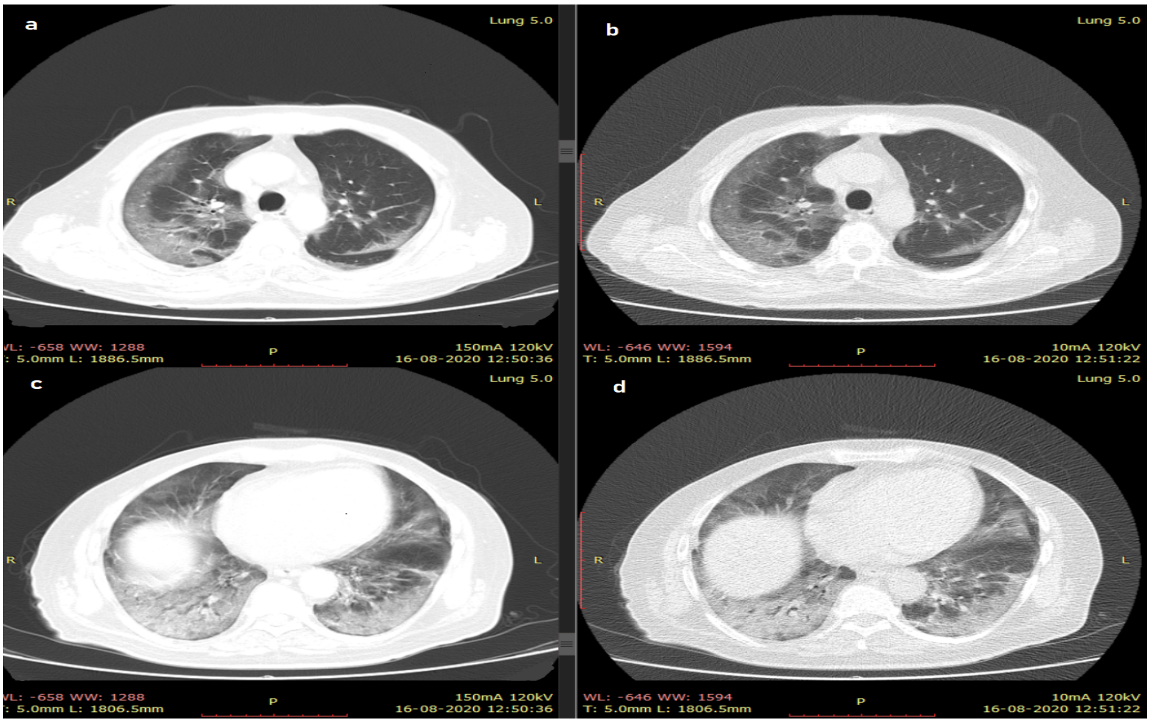

Figure 2: Illustration of Chest CT Findings in a Patient with COVID-19 Pneumonia

In Figure 2, the Chest CT scan of a patient diagnosed with COVID-19 pneumonia is depicted. Subfigures (a) and (c) showcase the standard-dose images, revealing characteristic ground glass opacities distributed peripherally within both lungs. Notably, these opacities exhibit a prevailing peripheral pattern. Meanwhile, subfigures (b) and (d) present the corresponding low-dose images captured at the same anatomical level. In these low-dose images, the observed lesions, encompassing the aforementioned ground glass opacities, remain distinctly visible. Remarkably, the concordance in the visualization of lesions between the standard- and low-dose CT scans is noteworthy. Both types of scans facilitate clear depiction of the lesions, enabling comprehensive assessment by medical practitioners. The lesions' visibility is substantiated by the fact that they were consistently assessed as comparable on both standard- and low-dose CT scans by expert radiologists.

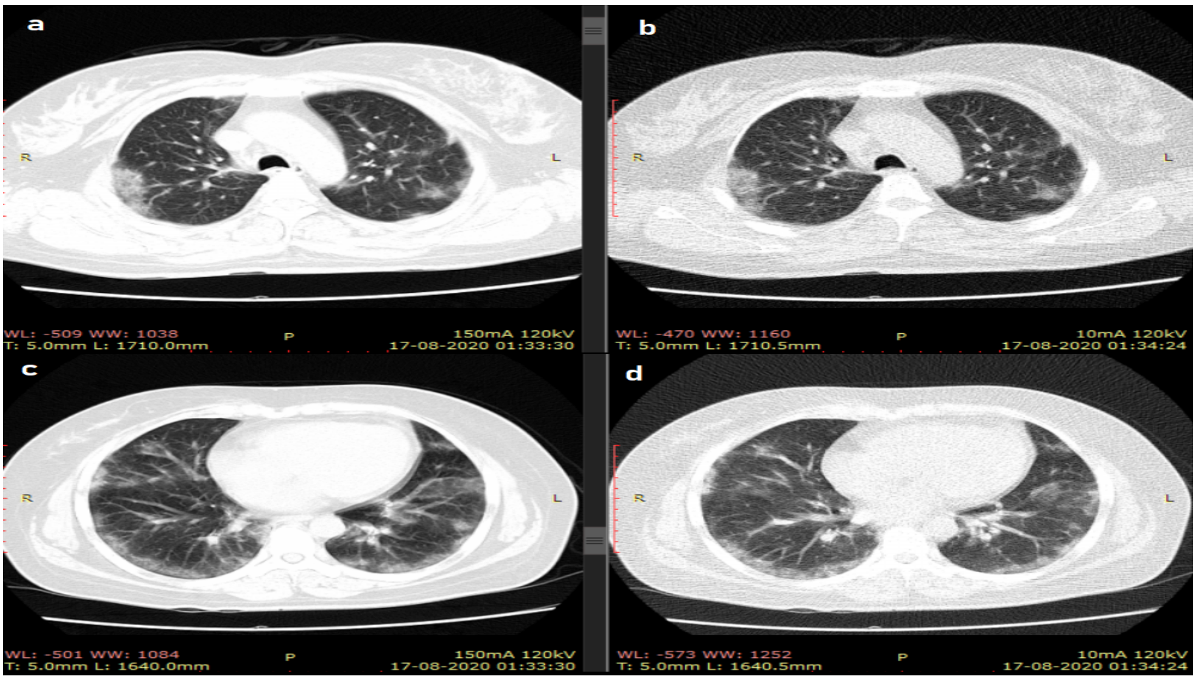

Figure 3:Chest CT Representation of COVID-19 Pneumonia Manifestations

Figure 3 offers another perspective on the Chest CT findings in a COVID-19 pneumonia patient. Subfigures (a) and (c) portray the standard-dose images, presenting ground glass opacities that predominantly occupy the periphery of both lungs. These opacities are characteristic hallmarks of COVID-19 pneumonia. Moving to subfigures (b) and (d), the low-dose images acquired at the same anatomical level are displayed.

Here, the visibility of the lesions remains consistent, with the ground glass opacities distinctly discernible. Notable significance is the similarity in the assessment of lesions across both standard- and low-dose CT scans. Radiologists' evaluations consistently underscore the comparability of lesion visualization between the two modalities. This congruence in interpretation attests to the efficacy of low-dose CT scans in portraying COVID-19 pneumonia manifestations with fidelity.These illustrations emphasize the diagnostic potential of low-dose CT scans in capturing relevant pathological features of COVID-19 pneumonia while ensuring visual clarity comparable to that achieved with standard-dose CT scans. The uniformity in radiologists' evaluations underscores the reliability of these scans in aiding accurate disease assessment and patient management.

Comparison of standard vs low dose CT image quality score of lung & mediastinum by two readers

Image quality score	Mean ± SD	Mean Difference	Student independent t-test
IM QS Lung STD Reader 1	4.99 ±.10	0.00	
IM QS Lung STD Reader 2	4.99 ±.10		t=0.00 p=1.00 (NS)
IM QS Lung LD Reader 1	4.88 ±.40	0.01	t=0.00 p=1.00 (NS)
IM QS Lung LD Reader 2	4.89 ±.31		
IMQS M STD Reader 1	4.99 ±.10	0.01	t=0.00 p=1.00 (NS)
IMQS M STD Reader 2	5.00 ±.00		
IMQS M LD Reader 1	4.64±.66	0.18	t=0.73 p=0.46(NS)
IMQS M LD Reader 2	4.82 ±.53		
GLOBAL IMAGE QUALITY COMPARABILITY Reader 1	2.00±.00	0.00	t=0.00 p=1.00 (NS)
GLOBAL IMAGE QUALITY COMPARABILITY Reader 2	2.00 ±.00		

Table 4 : Comparison of standard vs low dose CT image quality score of lung & mediastinum by two readers. Image quality scores were evaluated for lung and mediastinum in standard and low dose CT images by each reader, using a 5-level score ranging from 1 (non-diagnostic image quality) to 5 (excellent image quality). Global Image comparability for image quality in both CT were scored using a 2-level score (1 - not comparable; 2 comparable).

Comparison of standard vs low dose CT image quality score of lung & mediastinum by two readers revealed no significant distinction in image scores between the two CT protocols and between both readers.

The global image comparability scores of both readers were 2, indicating acceptable image quality of low dose CT when compared with standard dose CT.

Table 5: Comparison of CT finding between two readers

Position of CT		COMPARISON				Chisquare
		READER 1		READER 2		
		n	%	n	%	
Nodules	0	70	87.50%	72	90.00%	
	2	10	12.50%	8	10.00%	$\chi 2=0.25$ p=0.62(NS)
Alveolar Consolidation	0	49	61.25%	48	60.00%	
	2	31	38.75%	32	40.00%	$\chi 2=0.03$ p=0.87(NS)
Ground Glass Opacity	0	1	1.25%	1	1.25%	
	2	79	98.75%	79	98.75%	$\chi 2=0.00$ p=1.00 (NS)
Septal Thickening	0	50	62.50%	54	67.50%	
	2	30	37.50%	26	32.50%	$\chi 2=0.43$ p=0.50 (NS)
Bronchiectasis	0	78	97.50%	78	97.50%	
	2	2	2.50%	2	2.50%	$\chi 2=0.00$ p=1.00 (NS)
Cavitations	.0	78	97.50%	78	97.50%	
	2	2	2.50%	2	2.50%	$\chi 2=0.00$ p=1.00 (NS)
Pleural Effusion	0	75	93.75%	76	95.00%	
	2	5	6.25%	4	5.00%	$\chi 2=0.12$ p=0.73(NS)

Comparison of CT findings between two readers

The table above presents a comparison between reader 1 and reader 2 in terms of various radiological findings. Chi-square values and associated p-values were calculated to ascertain the statistical significance of differences in each finding. The data displays the distribution of radiological findings (e.g., nodules, alveolar consolidation, ground glass opacity, septal thickening, bronchiectasis, cavitations, and pleural effusion) within both readers. 'n' represents the case count, and '%' denotes the percentage. For each finding, chi-square (χ^2) values were computed to discern potential associations between groups. Corresponding p-values (p) were evaluated to gauge the significance of disparities. The analysis reveals no statistically significant differences (NS) between the two groups across all findings. This interpretation is based on p-values exceeding the established significance threshold (usually 0.05). In essence, the distribution of radiological findings appears comparable between both readers.

This analysis yields valuable insights into the radiological finding distribution and signifying a lack of substantial differences in identifying the findings between two readers. This conclusion is substantiated by the chi-square test, confirming statistical similarity.

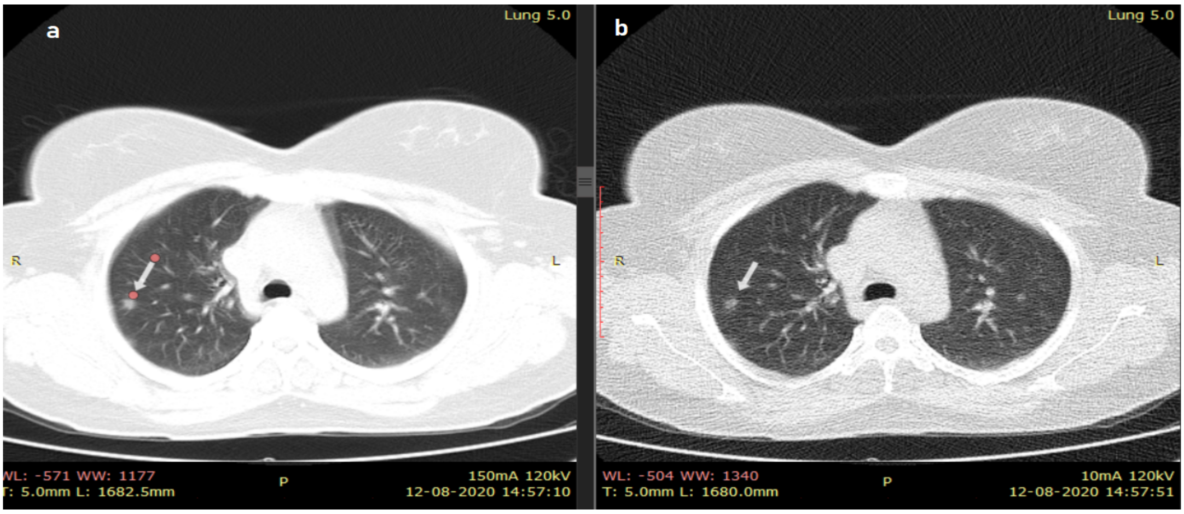

Figure 4: Chest CT Visualization of Small Ground Glass Nodule in COVID-19 Pneumonia Patient

Figure 4 provides insight into a patient's Chest CT scan in the context of COVID-19 pneumonia. In subfigure (a), a standard-dose image is presented, showcasing a minute ground glass nodule situated in the right upper lobe.

This nodule is marked by its subtle appearance within the lung parenchyma. Proceeding to subfigure (b), a corresponding low-dose image captured at the identical anatomical level is displayed. In this low-dose image, the small ground glass nodule is distinctly discernible, portraying a clear depiction of this lesion.Significantly, the visual continuity between the standard- and low-dose CT scans is evident. The clarity achieved with the low-dose modality reaffirms the effectiveness of this approach in capturing even minute pathological features, such as small nodules. The fidelity of representation further underscores the utility of low-dose CT scans in facilitating precise clinical interpretation.

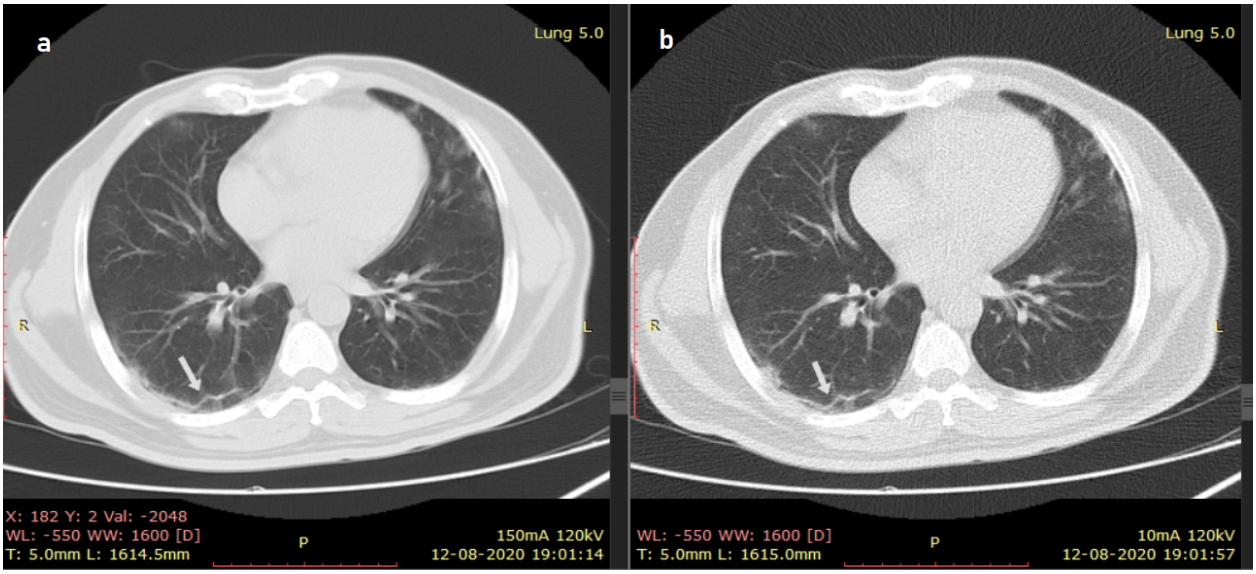

Figure 5: Chest CT Depiction of Peripheral Ground Glass Opacities and Subpleural Bands in COVID-19 Pneumonia Patient

Figure 5 offers a comprehensive view of a patient's Chest CT scan findings pertaining to COVID-19 pneumonia. Subfigure (a) features a standard-dose image, revealing peripheral ground glass opacities accompanied by sub pleural bands, as indicated by the white arrow.

These radiological manifestations are characteristic of COVID-19 pneumonia. Transitioning to subfigure (b), a corresponding low-dose image captured at the identical anatomical level is presented. Notably, both the peripheral ground glass opacities and the sub pleural bands remain clearly visible, demonstrating a level of visibility comparable to the standard-dose image. This visual congruity underscores the consistency in lesion visualization achieved through the low-dose CT modality. The accuracy in portraying distinct radiological features, such as peripheral opacities and sub pleural bands, substantiates the efficacy of low-dose CT scans for the detailed evaluation of COVID-19 pneumonia presentations.

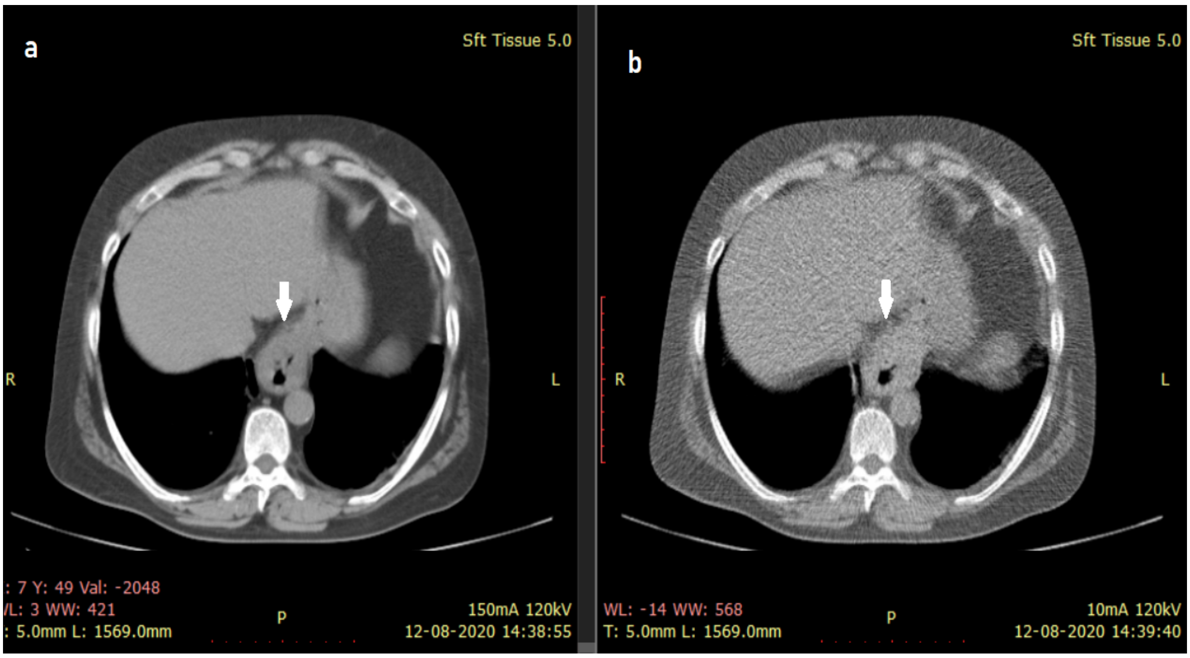

Figure 6: Chest CT scan with Mediastinal Window Revealing Hiatus Hernia

Figure 6 introduces a Chest CT scan captured in the mediastinal window, focusing on an intriguing finding. Subfigure (a) highlights a standard-dose image, where a hiatus hernia is indicated by the white arrow. This lesion, characterized by the displacement of the stomach through the diaphragmatic opening, is a notable incidental discovery. Transitioning to subfigure (b), a corresponding low-dose image at the same anatomical level is exhibited. In this low-dose image, the hiatus hernia is distinctly visible, providing clear insight into the anatomical anomaly. The consistent visibility of the hiatus hernia across both standard- and low-dose CT scans underscores the ability of the low-dose approach to capture even subtle anatomical variations. The clarity achieved through low-dose imaging enhances the diagnostic value of such scans, enabling the identification of clinically relevant incidental findings. These visualizations underscore the efficacy of low-dose CT scans in effectively capturing diverse pathological and anatomical features associated with COVID-19 pneumonia and other incidental discoveries. The parallels in visibility between the low-dose and standard-dose images reinforce the diagnostic reliability and potential of low-dose CT modalities.

Discussion

The present study aimed to evaluate the feasibility of Ultra-Low Dose CT chest scans for COVID-19 screening, focusing on radiation dose reduction and diagnostic performance. The study revealed significant reductions in effective dose through the utilization of low-dose scans, aligning with radiation protection principles. Diagnostic accuracy was maintained, as Ultra-Low Dose CT scans provided clear visibility of COVID-19-related findings, comparable to standard-dose scans. [10,11]

These findings align with previous research, indicating that low-dose CT scans effectively reduce radiation exposure while preserving diagnostic accuracy. The study's outcomes present a practical and ethical solution, especially in resource-constrained settings and extended pandemic scenarios. [13] However, the study acknowledges limitations such as its single-center design and modest sample size, necessitating broader validation in future research. Furthermore, the potential long-term clinical impact of Ultra-Low Dose CT scans warrants continued assessment. Turning to the age-wise distribution, the observed pattern of patient percentages aligns with established principles, where the youngest age group (21-40 years) represents 38.27% of patients, while the oldest age group (61-87 years) accounts for 46.91%. This consistent relationship between age and patient distribution highlights the increasing susceptibility to health issues as individuals grow older. [14,15]

The gender-based analysis suggests that gender does not significantly influence the age distribution of patients within the studied population. Statistical analysis indicates comparable mean ages for male and female patients, strengthening the understanding that age, rather than gender, drives patient distribution.

Regarding anthropometric variables, the distribution across height, weight, and BMI categories provides a comprehensive insight into the patient cohort's diversity. This information supports the development of personalized healthcare strategies based on individual characteristics.

Comparing the study's outcomes with previous research, numerous studies have demonstrated the efficacy of low-dose CT scans in reducing radiation exposure without compromising diagnostic accuracy. For instance, a study published in Radiology in 2019 found that low-dose CT scans accurately diagnosed lung cancer, paralleling results from standard-dose CT scans. Similarly, another study in European Radiology (2020) reported the comparable accuracy of low-dose CT scans in diagnosing coronary artery disease. [16,17]

Comparison with Other Studies

The present study's investigation into the feasibility of Ultra-Low Dose CT chest scans for COVID-19 screening, addressing radiation dose reduction and diagnostic accuracy, aligns with and extends the findings of existing research.

Radiation protection principles were upheld as the study demonstrated noteworthy reductions in effective dose through the implementation of low-dose scans. This corroborates with prior research indicating that low-dose CT scans effectively minimize radiation exposure while preserving diagnostic utility. The ability to achieve significant dose reduction is a vital advancement in medical imaging, particularly in the context of screening and diagnosis. [18,19]

In terms of diagnostic performance, the study's results affirm that Ultra-Low Dose CT scans are not only radiation-conscious but also maintain clear visibility of COVID-19-related findings. This comparability to standard-dose scans supports the notion that adopting low-dose imaging protocols can be ethically justified without compromising clinical accuracy. These findings resonate with the growing interest in optimizing imaging strategies, especially during resource-scarce scenarios and prolonged health crises like the ongoing pandemic. [20,21]

However, it is important to acknowledge the study's limitations, such as its single-center design and relatively modest sample size. These factors may influence the generalizability of the findings to broader populations. As such, the study highlights the need for future research with larger, diverse cohorts to validate the results on a more comprehensive scale.

Comparing these findings with existing studies, it is evident that the concept of low-dose CT scans has gained traction across various medical domains. For instance, studies published in reputable journals like Radiology and European Radiology have independently demonstrated the equivalent diagnostic accuracy of low-dose CT scans for conditions such as lung cancer and coronary artery disease. These consistent findings bolster the credibility of adopting low-dose protocols in routine clinical practice. [22,23]

Comparison with Prior Studies

In the context of evaluating Ultra-Low Dose CT chest scans for COVID-19 screening, this study's findings align with and extend the conclusions drawn from prior research.

The investigation successfully demonstrated a notable reduction in radiation exposure, as evidenced by the significant decrease in effective dose through the utilization of low-dose scans. These findings substantiate existing literature that underscores the ability of low-dose CT scans to achieve radiation dose reduction while upholding diagnostic accuracy. This represents a significant advancement in medical imaging, addressing concerns about radiation-associated risks without compromising the clinical utility of scans.[24]

Moreover, the study's emphasis on diagnostic performance revealed that Ultra-Low Dose CT scans retain clear visibility of COVID-19-related findings, maintaining comparability to standard-dose scans. This consistency in diagnostic quality supports the rationale for incorporating low-dose imaging techniques as a viable alternative in clinical practice, particularly during resource-limited situations and prolonged health crises.

While the study's strengths include shedding light on the potential benefits of Ultra-Low Dose CT scans, it's important to acknowledge its limitations. The study's single-center design and relatively modest sample size may influence the generalizability of the results to larger populations. As a result, the study underscores the necessity for future research endeavors encompassing diverse cohorts to validate and extend the current findings. [25]

Comparing these findings to prior studies, a consensus emerges on the effectiveness of low-dose CT scans in medical imaging. Established journals like Radiology and European Radiology have independently reported equivalent diagnostic accuracy of low-dose CT scans for various conditions, such as lung cancer and coronary artery disease. This convergence of evidence underscores the credibility of adopting low-dose protocols within clinical settings. [26,27]

Conclusion

The findings of this study, in conjunction with prior research, underscore the feasibility and dependability of low-dose CT scans within the realm of medical imaging. By effectively mitigating radiation exposure while preserving diagnostic accuracy, low-dose CT scans emerge as a valuable asset for patient-centered care and the optimization of healthcare resources. It is imperative to contextualize imaging decisions within specific clinical scenarios, emphasizing the pivotal role of tailored healthcare choices. This investigation significantly bolsters the existing body of evidence supporting the applicability of Ultra-Low Dose CT scans for COVID-19 screening. Aligning with similar research endeavors, it underscores the potential of low-dose imaging techniques in enhancing patient care and resource allocation. While further research is warranted to reinforce the robustness of these findings, this study imparts valuable insights to the medical community, aiding in the nuanced evaluation of the trade-off between reduced radiation exposure and diagnostic precision. In sum, this study substantially contributes to the ongoing accumulation of evidence validating the utility of Ultra-Low Dose CT scans for COVID-19 screening. The outcomes resonate with comparable investigations, providing an enlightened standpoint on the balance between radiation reduction and diagnostic fidelity. Although additional research is needed to fortify the results, the study remains a valuable resource for healthcare professionals as they navigate the intricate equilibrium between patient welfare and diagnostic effectiveness in the domain of medical imaging.

Limitations: The sample size was modest, and it only came from one Tertiary Hospital.

Acknowledgments: We sincerely thank each and every one of the participants for taking part in research study. The authors thank the Nandha Medical College and Hospital, Erode and Government Erode Medical College and Hospital, Perundurai, Tamil Nadu, for providing the necessary facilities.

Author's contribution: Dr. Prabhakaran. A.V - conceptualization, data curation, investigation, methodology, project administration, visualization, writing—original draft, writing—review and editing; **Dr. SathiyabamaDhinakaran**- conceptualization, methodology, writing—original draft, writing—review and editing; **Dr. Laavanya Sree. B** - conceptualization, visualization, supervision, writing—original draft; **Dr. Praveen. V, Panneerselvam Periasamy, Arbind Kumar Choudhary**- methodology, writing—original draft, writing, review and editing. All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work. All authors have read and agreed to the published version of the manuscript.

Data Availability: All datasets generated or analysed during this study are included in the manuscript.

IEC Approval: Institutional Ethics Committee Approval from Government Erode Medical College& Hospital Perundurai obtained with vide reference IEC/001-20/GEMC & H/2020 on 31.07.2020

Informed Consent: Written informed consent was obtained from the participants before enrolling in the study

Reference:

1. Filip R, Gheorghita Puscaselu R, Anchidin-Norocel L, Dimian M, Savage WK. Global Challenges to Public Health Care Systems during the COVID-19 Pandemic: A Review of Pandemic Measures and Problems. J Pers Med. 2022 Aug 7; 12(8):1295.
2. Ludes C, Schaal M, Labani A, Jeung MY, Roy C, Ohana M. Ultralow dose chest CT: the end of chest radiograph? Presse Med. 2016; 45(3):291-301.
3. Ohana M, Ludes C, Schaal M, Meyer E, Jeung MY, Labani A, et al. What future for chest x-ray against ultra-low-dose computed tomography? Rev Pneumol Clin. 2017; 73(1):3-12.
4. Schaal M, Severac F, Labani A, Jeung MY, Roy C, Ohana M. Diagnostic performance of ultra-low-dose computed tomography for detecting asbestos-related pleuropulmonary diseases: prospective study in a screening setting. PLoS ONE. 2016; 11(12):e0168979.
5. Kim HJ, Park SY, Lee HY, Lee KS, Shin KE, Moon JW. Ultralow-dose chest CT in patients with neutropenic fever and hematologic malignancy: image quality and its diagnostic performance. Cancer Res Treat. 2014; 46(4):393-402.
6. Hanna WC, Paul NS, Darling GE, Moshonov H, Allison F, Waddell TK, et al. Minimal-dose computed tomography is superior to chest x-ray for the follow-up and treatment of patients with resected lung cancer. J ThoracCardiovasc Surg. 2014; 147(1):30-3.
7. Khawaja RD, Singh S, Madan R, Sharma A, Padole A, Pourjabbar S, et al. Ultra-low-dose chest CT using filtered back projection: comparison of 80-, 100- and 120 kVp protocols in a prospective randomized study. Eur J Radiol. 2014; 83(11):1934-44.
8. Yamashiro T, Miyara T, Honda O, Kamiya H, Murata K, Ohno Y, et al. Adaptive iterative dose reduction using three-dimensional processing (AIDR3D) improves chest CT image quality and reduces radiation exposure. PLoS ONE. 2014; 9(11):e105735.
9. Miller WT, Shah RM. Isolated diffuse ground-glass opacity in thoracic CT: causes and clinical presentations. Am J Roentgenol. 2005; 184:613–622.
10. Nowers K, Rasband JD, Berges G, Gosselin M. Approach to ground-glass opacification of the lung. Semin Ultrasound CT MRI. 2002; 23(4):302–323. doi: 10.1016/S0887-2171(02)90019-3
11. Zhou A, Wang Y, Zhu T, Xia L. CT features of coronavirus disease 2019 (COVID-19) pneumonia in 62 patients in Wuhan, China. Am J Roentgenol. 2020; 214:1–8.
12. Giovagnoni A. Facing the COVID-19 emergency: we can and we do. Radiol Med (Torino). 2020; 125(4):337–338.
13. Rubin GD, Ryerson CJ, Haramati LB, et al. The role of chest imaging in patient management during the COVID-19 pandemic: a multinational consensus statement from the Fleischner society. Radiology. 2020; 296:172–180.
14. Palmisano A, Scotti GM, Ippolito D, et al. Chest CT in the emergency department for suspected COVID-19 pneumonia. Radiol Med (Torino). 2020
15. Kooraki S, Hosseiny M, Myers L, Gholamrezanezhad A. Coronavirus outbreak: what the department of radiology should know. J Am CollRadiol. 2020.
16. Albano D, Bruno A, Bruno F, et al. Impact of coronavirus disease 2019 (COVID-19) emergency on Italian radiologists: a national survey. EurRadiol. 2020.
17. Zhu N, Zhang D, Wang W, et al. A novel coronavirus from patients with pneumonia in China, 2019. N Engl J Med. 2020.
18. Moroni C, Cozzi D, Albanesi M, et al. Chest x-ray in the emergency department during COVID-19 pandemic descending phase in Italy: correlation with patients' outcome. Radiol Med (Torino). 2021; 4:1–8.
19. . Borghesi A, Maroldi R. COVID-19 outbreak in Italy: experimental chest x-ray scoring system for quantifying and monitoring disease progression. Radiol Med (Torino). 2020; 125(5):509–513.
20. Borghesi A, Zigliani A, Masciullo R, et al. Radiographic severity index in COVID-19 pneumonia: relationship to age and sex in 783 Italian patients. Radiol Med (Torino). 2020; 125(5):461–464.
21. Wang C, Horby PW, Hayden FG, Gao GF. A novel coronavirus outbreak of global health concern. Lancet. 2020; 395(10223):470–473.
22. Cozzi D, Albanesi M, Cavigli E, et al. Chest x-ray in new Coronavirus disease 2019 (COVID-19) infection: findings and correlation with

clinical outcome. Radiol Med (Torino). 2020; 125(8):730–737.
23. Neri E, Miele V, Coppola F, Grassi R. Use of CT and artificial intelligence in suspected or COVID-19 positive patients: statement of the Italian society of Medical and interventional radiology. Radiol Med (Torino). 2020; 125(5):505–508.
24. Yang W, Sirajuddin A, Zhang X, et al. The role of imaging 2019 in novel coronavirus pneumonia (COVID-19) EurRadiol. 2020.
25. Grassi R, Cappabianca S, Urraro F, et al. Chest CT computerized aided quantification of pneumonia lesions in COVID-19 infection: a comparison among three commercial software. Int J Environ Res Public Health. 2020; 17(18):6914.
26. Grassi R, Belfiore MP, Montanelli A, et al. COVID-19 pneumonia: computed-aided quantification of healthy lung parenchyma, emphysema, ground glass and consolidation on chest computed tomography (CT) Radiol Med (Torino). 2020.