ADDIS ABABA UNIVERSITY

COLLEGE OF MEDICINE AND HEALTH SCIENCES

SCHOOL OF GRADUATE STUDIES

DEPARTMENT OF RADIOLOGY

A CROSSECTIONAL STUDY ON ASSESSMENT OF CHEST RADIOGRAPHIC AND CHEST CT PATTERNS IN COVID-19 PATIENTS IN TIKUR ANBESSA HOSPITAL

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Abstract

Introduction: An outbreak of corona virus disease 2019(COVID-19) infection began in December 2019 in Wuhan the capital of central China's Hubei province (2). On 11 March 2020, the WHO
officially characterized the global COVID-19 outbreak as a pandemic (5). In Ethiopia, the first case of COVID-19 was reported on 13 March 2020 in Addis Ababa (3). COVID-19 primarily affects the lung parenchyma and it has high rate of human to human transmission (5). Thoracic radiology evaluation is often key to the evaluation of patients suspected of COVID-19 infection (2). Chest radiograph has lower sensitivity for the detection of COVID-19 lung abnormalities when compared to chest CT which is shown to have

reported CT sensitivity of 98% (7). Disease severity and timing of imaging appear to impact on the rates of normal baseline imaging.

Objective: The aim of this study is to describe the correlation between chest radiographic and chest CT patterns in patients with RT- PCR confirmed COVID-19 infection at Tikur Anbessa hospital.

Method: A retrospective study on RT-PCR confirmed COVID-19 patients who were seen at Tikur Anbessa specialized hospital and had chest x-ray and chest CT. The chest x-ray and chest CT will be reviewed by experienced consultant radiologists and imaging data will be filled separately and images which had differences in the findings will be reviewed again with the consultant radiologists together.

Results: This study included 62 COVID-19 patients seen at Tikur Anbessa hospital among which 32() were male aand 29() were female. Patient age ranged from 18 – 86 with mean age of 49 years. Majority of the patients 56(90.3%) were symptomatic most of them 40(70.2%) presented with shortness of breath and 36(63.2%) presented with fever. Most of the patients 39(62.9%) have history of known underlying illness. Among the 62 patients 50(80.6%) of the chest x rays and all the 62 CT images were abnormal. The predominant chest infiltrate was GOO seen in 22(44%) of chest x rays and 29(46.8%) of the chest CT images followed by combination of GGO and consolidation seen in 22(35.5%) chest x rays and 22(35.5%) of the chest CT images. Findings were bilateral in 44(88%) of chest x rays and 61(98.4%) of the chest CT images. Peripheral location was the predominant finding in both chest X ray and chest CT images accounting for 36(72%) of the chest X-rays and 49(79%) of the chest CT images. A combination of lower and middle lung involvement is the most common chest radiographic and chest CT location accounting for 25(50%) of the chest x rays and 21(33.9%) of the chest CT images. The abnormalities were predominantly multifocal accounting for 37(74%) of the chest X-rays and 43(69.4%) of the chest CT images.

Conclusion: The predominant chest radiological finding was multi focal ground glass opacity which is bilaterally and peripherally distributed in the lower and middle lungs on both chest X ray and chest CT followed by a combination of ground glass and consolidation.

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Abbreviations

COVID-19**:** Corona Virus Disease 2019

MERS-CoV**:** Middle East respiratory syndrome corona virus

SARS-CoV**:** severe acute respiratory syndrome Corona Virus

SARS-COV-2**:** Severe Acute Respiratory Syndrome Corona Virus-2

RT-PCR**:** Reverse Transcriptase Polymerase Chain Reaction

CXR**:** Chest Radiograph/X-ray

CT**:** Computed Tomography

GGO**:** Ground Glass Opacity

IRB**:** Institutional Review Board

HTN: Hypertension

DM: Diabetes mellitus

1. Introduction

1.1. Back ground

In December 2019, a large outbreak of a novel coronavirus infection occurred in Wuhan, Hubei Province, China (1). In humans, coronaviruses are among the spectrum of viruses that cause the common cold as well as more severe respiratory diseases specifically, severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS), which have mortality rates of 10% and 37%, respectively (1). Although the virus likely has a zoonotic origin related to the city's Huanan Seafood Market, widespread human to-human transmission has resulted in 73 451 cases in 26 countries, with 1875 deaths as of February 18, 2020 (2).

Coronaviruses are enveloped, positive single-stranded large RNA viruses that infect humans, but also a wide range of animals (4). Four subfamilies, namely alpha-, beta-, gamma- and delta coronaviruses exist. SARS-CoV-2 which belongs to B lineage of beta coronavirus apparently succeeded in making its transition from animals to humans on the Huanan seafood market in Wuhan, China (5).

SARS-CoV-2 virus primarily affects the respiratory system, although other organ systems are also involved. Lower respiratory tract infection related symptoms including fever, dry cough and dyspnoea were reported in the initial case series from Wuhan, China. In addition, headache, dizziness, generalized weakness, vomiting and diarrhoea were observed (5)

It affects all ages of the population and the median age of infection is around 50 years. However, clinical manifestations differ with age in general, older men (>60 years old) with co-morbidities are more likely to develop severe respiratory disease that requires hospitalization (6).

On 13 march 2020 the first COVID-19 infected person in Ethiopia was confirmed (3).

In COVID-19 diagnosis, real-time reverse transcription polymerase chain reaction (RT-PCR) of viral nucleic acid is regarded as the reference standard; however, recent studies addressed the importance of chest computed tomography (CT) examination in COVID-19 patients with false negative RT-PCR results, and reported the CT sensitivity as 98% (7)

The most common radiographic features in confirmed COVID-19 patients are peripheral rounded ground glass opacity, consolidation and pulmonary nodules. Distribution of the lung changes were more common in lower zones and bilateral (8). The chest x ray findings in these patients frequently showed bilateral lower zone consolidation which peaked at 10-12 days from onset (9).

Triage of patients with COVID-19 is based on clinical and laboratory parameters, whereas chest imaging might be required for second-level triage in specific cases, namely the chest radiography is offered as a first step and supplementary CT in more severe cases or in the case of discrepancies between clinical and radiographic characteristics(9)

According to Fleischner society, a multinational consensus statement, imaging is indicated for patients with COVID-19 with evidence of worsening of respiratory status and for patients with moderate to severe features of COVID-19 regardless of the COVID-19 test result. Imaging is not indicated for patients with mild features of COVID-19 unless they are at risk for disease progression and it is not indicated as a screening test for COVID-19 in asymptomatic individuals (10).

1.2. Statement of the problem

COVID-19 is global problem, affect all humanity. It primarily affects lung parenchyma and it has high rate of human to human transmission with number of confirmed cases are increasing exponentially.

Although chest radiograph is not considered to be sensitive for the detection of lung CT has higher sensitivity reaching about 97% especially in detecting early disease and most studies regarding the characteristics pattern of imaging findings have focused predominantly on the use of CT imaging.

Chest X-ray is relatively inexpensive and widely available diagnostic modality and can aid in assessing the severity of illness and also guide in management in set ups like ours where resources are limited.

This research will give good input as the prevalence of COVID-19 is increasing and is currently a global concern, it's important to be familiarized with the imaging spectrum of the disease and to recognise COVID -19 features on chest X-ray and chest CT.

1.3. Literature Review

In this retrospective study, chest CT scans from 121 symptomatic patients infected with coronavirus disease 2019 (COVID-19) from four centres in China from January 18, 2020, to February 2, 2020, were reviewed for common CT findings in relationship to the time between symptom onset and the initial CT scan (ie, early, 0–2 days [36 patients]; intermediate, 3–5 days [33 patients]; late, 6–12 days [25 patients]). The hallmarks of COVID-19 infection on images were bilateral and peripheral ground-glass and consolidative pulmonary opacities. Notably, 20 of the 36 patients (56%) imaged in the early phase had a normal CT scan. With a longer time after the onset of symptoms, CT findings were more frequent, including consolidation, bilateral and peripheral disease, greater total lung involvement, linear opacities, crazy-paving pattern, and the reverse halo sign. Bilateral lung involvement was observed in 10 of the 36 early patients (28%), 25 of the 33 intermediate patients (76%), and 22 of the 25 late patients (88%) (2).

In a retrospective study done in Italy on the main chest radiological features of COVID-19 from March1 to March 31 in a total of 482 patients, from which 234 had positive RT-PCR result, of this 153 were male and 81 were female with mean age of 66. Only 13 (5.6%) chest X-ray were normal, 135 patients (57.7%) had consolidation, 147 (62.8%) had GGO, 55 (23.5%) had lung nodules and 156 (66.6%) had reticulo-nodular opacities. Patients with consolidation and GGO co-existent in the same radiograph were 35.5%. Peripheral (57.7%) and lower zone distribution 58.5% were the most common predominance. Bilateral involvement was the most frequent than unilateral one accounting for about 69.2%. The other associated abnormalities were vascular congestion

(39.3%), cardiomegaly (29.9%) and pleural effusion (16.6%). Baseline chest X-ray sensitivity in this study is about 68.1% (11) .

In A systematic review of the published literature on radiologic features of COVID-19 infection was conducted in Shenzhen and Hong Kong, the predominant imaging pattern was of ground-glass opacification with occasional consolidation in the peripheries. Patients demonstrated evolution of the ground-glass opacities into consolidation and subsequent resolution of the airspace changes. Ground-glass and consolidative opacities visible on CT are sometimes undetectable on chest radiography, suggesting that CT is a more sensitive imaging modality for investigation. Pleural effusions and lymphadenopathy were absent in all cases (12).

In a retrospective case series, chest CT scans of 21 symptomatic patients from China infected with the 2019 novel coronavirus (2019-nCoV) were reviewed, with emphasis on identifying and characterizing the most common findings. Typical CT findings included bilateral pulmonary parenchymal ground-glass and consolidative pulmonary opacities, sometimes with a rounded morphology and a peripheral lung distribution. Notably, lung cavitation, discrete pulmonary nodules, pleural effusions, and lymphadenopathy were absent. Follow-up imaging in a subset of patients during the study time window often demonstrated mild or moderate progression of disease, as manifested by increasing extent and density of lung opacities (13).

In a retrospective study of 64 COVID-19 patients done in Hong Kong, consolidation was the most common finding accounting 47% followed by GGO (33%). CXR abnormalities had a peripheral (41%) and lower zone distribution (50%) with bilateral involvement accounting 50%. Pleural effusion was uncommon accounting for only 3% of the findings. 20 patients (31%) had normal baseline CXR, 26 (41%) patients had mild findings, and more extensive involvement was seen in others who had severity scores ranging from 3-6. CXR severity scores changed over time and peak severity was reached at 10-12 days. Of the 20 patients who had normal baseline CXR, 7 developed abnormalities on follow up radiograph (14).

In another study done in Italy chest x-ray of 240 symptomatic patients with SARS-COV-2 infection confirmed by RT-PCR was retrospectively evaluated. Out of 240 only 180 (75%) showed abnormality on chest x-ray. Of this 180 patients GGO was observed in 124 (68.8%), reticular opacity in 113 (62.7%) and consolidation in 71 (39.4%). Consolidation

was significantly less frequent. Upper, middle and lower fields were involved in 36.7%, 79.4% and 87.8% respectively. The lesions were peripheral in 49.4%, central in 11.1% or both in 39.4% (15).

In a retrospective analysis done in china on 51 patients at Enze medical center Enze Hospital fifty of the 51 patients (98%) had evidence of abnormal CT findings compatible with viral pneumonia at baseline; one patient had a normal CT scan. Of the 50 patients with abnormal CT scans, 36 (72%) had typical CT manifestations peripheral and subpleural ground-glass opacities, often in the lower lobes (16).

2. Objectives

2.1. General Objective

To assess the chest radiographic and chest CT patterns in patients with confirmed COVID-19 infection at Tikur Anbessa Hospital.

2.2. Specific Objective

- To assess the chest radiographic patterns of COVID-19 patients.
- To assess the common chest CT patterns of COVID-19 patients
- To assess the sociodemographic distribution of COVID-19.

3. Methodology

3.1. Study area and period

This study was conducted at Tikur Anbessa specialized hospital from data collected from patients tested positive with RT-PCR for covid-19. Tikur Anbessa specialized hospital is

under Addis Ababa University and it is the biggest teaching hospital in Ethiopia. Even though it is not a dedicated covid-19 treating center there are a lot of patients who visited the hospital and ultimately tested positive for covid-19.

The study was conducted on patients who visited Tikur Anbessa hospital and tested positive from September 2020 to September 2021.

3.2. Study design

This study is an institution based retrospective cross sectional study done on chest radiographic and chest CT images of all COVID-19 positive patients who visited Tikur Anbessa specialized hospital and underwent imaging in the specified period of time.

3.3. Population

3.3.1. Source population

All COVID-19 RT-PCR confirmed patients in Tikur Anbessa specialized hospital between September 2020 and September 2021.

3.3.2. Study population

All RT-PCR COVID-19 confirmed patients who had chest x-ray and chest CT in Tikur Anbessa specialized hospital between September 2020 and September 2021.

3.4. Inclusion and exclusion criteria

3.4.1. Inclusion criteria

All covid-19 positive (confirmed by RT-PCR) patients who underwent chest radiography and chest CT during the study period**.**

3.4.2. Exclusion criteria

Patients whose images were not found

Patients with incomplete imaging/whose images are not adequate for interpretation.

Patients with incomplete medical record.

3.5. Sampling technique and sample size

All COVID-19 confirmed patients who fulfil the inclusion criteria and have chest radiographic and chest CT imaging at Tikur Anbessa specialized hospital during the stated study period were included in the study.

3.6. Data collection technique

Data was collected by the principal investigator using a structured questionnaire developed from patient medic al records. Important patient data including the demographic data and the clinical conditions of the patient including the patient presentation and any underlying illnesswas collected from patient medical records. The chest radiographs were reviewed by the principal investigator and chest CT were reviewed by consultant radiologists from the cardiothoracic imaging unit and imaging data was filled on the questionnaire prepared.

Data collection was conducted after receiving ethical clearance to conduct this study from the ethical review committee of TASH. The Principal Investigator collected the data.

Data Analysis

The data collection instruments were coded and data was checked for completion and entered using Epi-data version 3.1 software. The data was fed to the statistical software SPSS version 25. After being further evaluated by the software for possible errors the data was processed by the same software. All statistical analysis was performed using SPSS (Version 25).

Dissemination of the results

After completion the results of the study will be submitted to the department of radiology and will be presented on seminars arranged by the research committee. It will also be distributed to medical journals for possible publication.

Ethical consideration

Before beginning data collection, permission to undertake the study will be obtained from Ethical Review Committee of Radiology department to access the medical records of the

patients. There will be no mentioning of patients name in data collection format and patient's card will be returned to card room as soon as data collection format is filled.

3.7. Study variables

3.7.1. Independent Variables

- ✓ Age
- ✓ Sex
- ✓ Underlying illness

3.7.2. Dependent Variable

- ✓ Clinical symptom
- ✓ Chest X-ray assessment
- ✓ Chest CT assessment
- ✓ Type of infiltration
- ✓ Location of infiltrates
- ✓ Focality
- ✓ Laterality
- ✓ Centrality

3.8. Data processing and analysis

The data was checked for clarity and completeness. Data was analysed using nonparametric statistical methods with the help of SPSS software package. Then summarization and comparison of data was done.

3.9. Data quality control

In order to evaluate the clarity of the questionnaire, validity of the instruments and after the pre-test, the findings and observations obtained was used to modify the questionnaire and the data collection process accordingly.

3.10. Operational Definitions

- **Linear (interstitial) opacities:** described as horizontal white lines or reticular changes (14).
- **Ground glass opacities:** described when lung markings are partially obscured by increased whiteness (14).
- **Consolidation:** described when the lung markings are completely lost due to whiteness (14).

3.11. Dissemination of results

Results of the study will be submitted to the department of radiology of TASH as part of dissertation requirement for the postgraduate certificate program and will be presented on a seminar prepared by the research committee for all staff and residents in the department. It will also be submitted for medical journals for possible publication.

3.12. Ethical considerations

In order to respect patient's bill of right, regulation of the hospital where the study was conducted, ethical considerations was taken in to account. Any piece of information was kept confidential by keeping anonymity of the study subjects. Written ethical clearance letters was obtained from the IRB and other relevant authorities.

4. Results

4.1. Patient demography

The study included 62 patients; among which 33(53.2%) were males, and 29(46.8%) were females. The mean age was 49 years with age range of 18 to 86 years old.

Figure 1. Pie chart for sex distribution.

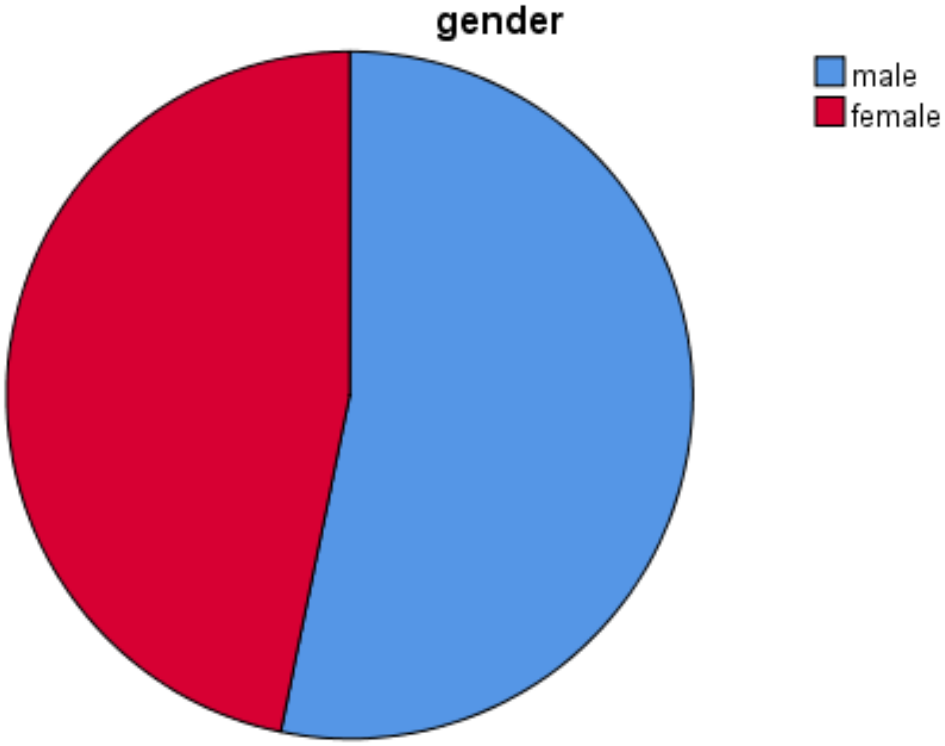
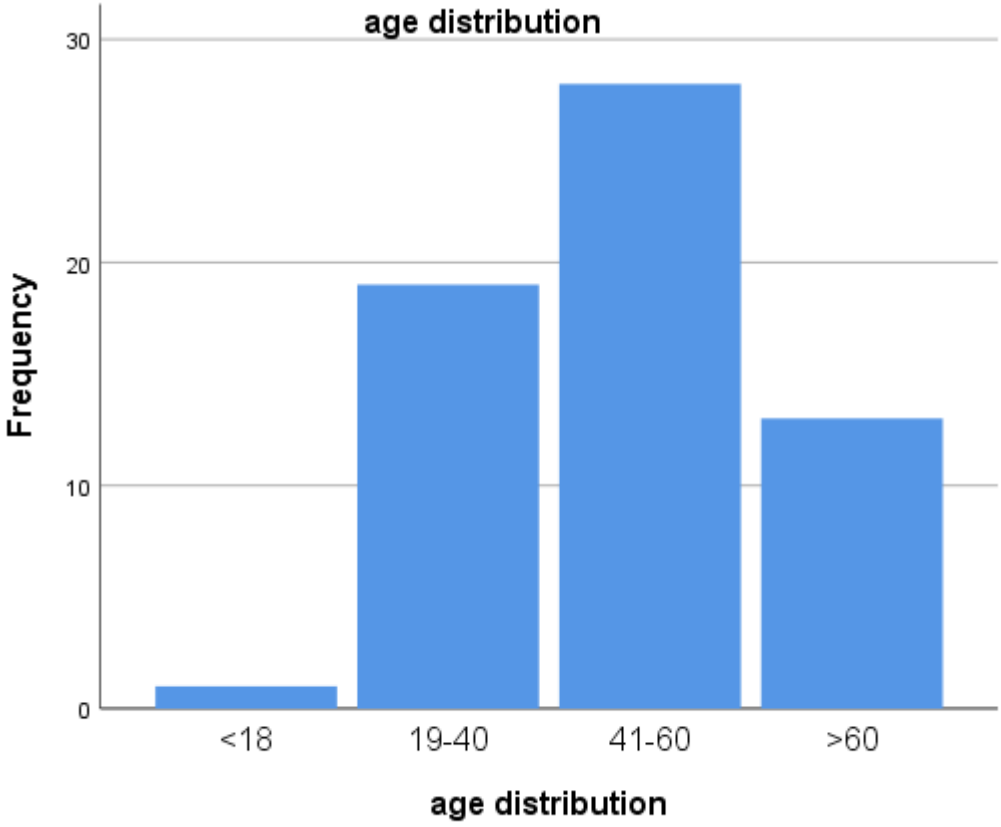


Figure 2. Bar chart fo age distribution.



4.2. Clinical category

Among the total of 62 patients 56(90.3%) of the patients were symptomatic and 6 patients (9.7%) were asymptomatic. Among the symptomatic 56 patients 40(70.2%) presented with shortness of breath, 36(63.2%) presented with cough. Fever was present in 11(19.3%) of patients and 14(24.6%) patients complained on fatigue.

	Frequency	Percent
Symptomatic	56	90.3
Asymptomatic	6	9.7
Total	62	100.0

Table 1. Clinical category

Clinical presentation	N	Percent
Cough	36	63.2%
Fever	11	19.3%
shortness of breath	40	70.2%
Headache	7	12.3%
Fatigue	14	24.6%
loss of taste	5	8.8%
Arthralgia	2	3.5%
chest pain	4	7.0%
sore throat	4	7.0%
Others	1	1.8%
Total	124	217.5%

Table 2. Clinical presentation.

4.3. Underlying illness

Among the 62 patients 39(62.9%) have underlying illness while 23(37.1%) do not. Among the 39 patients 15(39.5%) have history of known malignancy, 10(26.3%) have hypertension, 7 %(18.4%) have diabetes mellitus while 6(15.8%) have underlying lung disease.

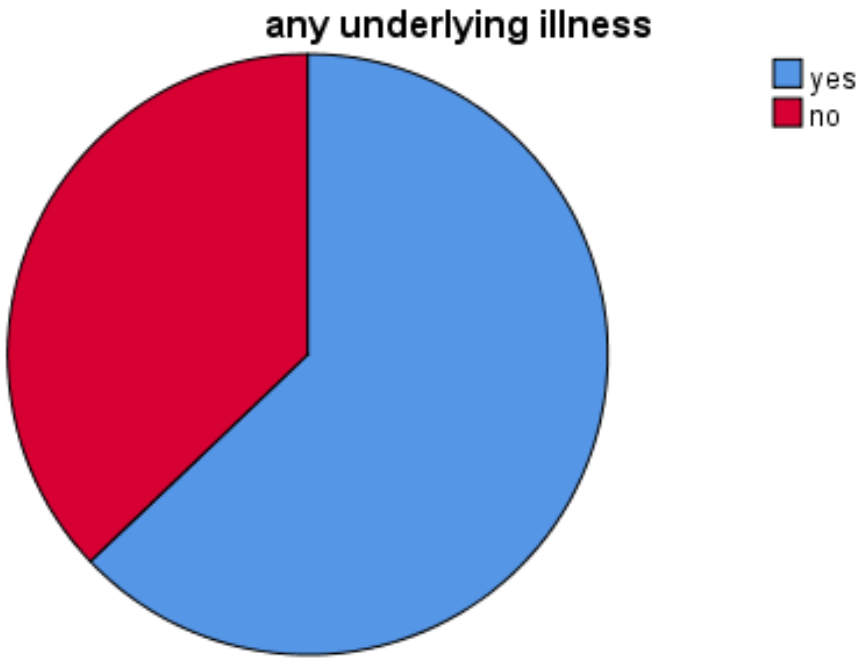


Figure 3. Pie chart for underlying illness.

Underlying illness	N	Percent
DM	7	18.4%
underlying lung disease	6	15.8%
Hypertension	10	26.3%
HIV/AIDS	1	2.6%
known malignancy	15	39.5%
other underlying illness	3	7.9%
Total	42	110.5%

Table 3. Underlying illness.

4.4, chest x ray and chest CT assessment

Among the 62 patients 50(80.6%) of the chest x rays were abnormal while 12(19.4%) were normal. All the 62 CT images were abnormal.

Chest x ray assessment

	Frequency	Percent
Normal	12	19.4
Abnormal	50	80.6
Total	62	100.0

Table 4. Chest x ray assessment

Chest CT assessment

	Frequency	Percent
abnormal	62	100
Total	62	100.0

Table 5. Chest CT assessment.

4.4.1. Chest X ray features

Among the 50 patients who have abnormal chest X ray 22(44%) showed ground glass opacity, 12(24%) showed ground glass and consolidation while 7(14%) showed consolidation.

Type of infiltrate on X ray	N	Percent
GGO	22	44.0%
consolidation	7	14.0%
GGO and consolidation	12	24.0%
GGO and interstitial	5	10.0%
interstitial infiltrate	3	6.0%
other infiltrates	3	6.0%
Total	52	104.0%

Table 6. Type of infiltrate on chest x ray

4.4.2. Chest CT features.

Among the 62 abnormal chest CT images 29(46.8%) showed GGO, 22(35.5%) showed GGO and consolidation, 13(21%) showed crazy paving pattern while 15(24.2%) showed other associated findings most of which were related to the underlying illness and includes, pleural effusion, pulmonary artery enlargement, atelectasis, pulmonary nodules, mediastinal lymphadenopathy, pulmonary emphysema and bronchiectasis.

Type of chest CT infiltrates	N	Percent
GGO	29	46.8%
consolidation	8	12.9%
GGO and consolidation	22	35.5%
crazy paving	13	21.0%
Interstitial infiltrates	9	14.5%
other infiltrates	15	24.2%
Total	96	154.8%

Table 7. Table for chest CT characteristics.

4.4.3. Symmetry of involvement

Among the 50 abnormal chest X ray images 44(88%) showed bilateral involvement of the lungs while only 6(12%) showed unilateral involvement. Among the 62 abnormal chest CT images 61(98.4%) showed bilateral involvement while only 1(1.6%) showed unilateral involvement.

		Frequency	Percent
Valid	Unilateral	6	12.0
	Bilateral	44	88.0
	Total	50	100.0
Missing	System	12	
Total		62	

Table 8. Symmetry of involvement on chest x ray

	Frequency	Percent
Unilateral	1	1.6
Bilateral	61	98.4
Total	62	100.0

Table 9. Symmetry of involvement on chest CT

4.4.4. Location of chest X ray and chest CT infiltrates

A combination of lower and middle lung involvement is the most common chest radiographic and chest CT location accounting for 25(50%) of the chest x rays and 21(33.9%) of the chest

CT images. The second most commonly involved location is the lower lung accounting for 13(26%) of the chest radiographs and 18(29%) of the chest CT images. All lung fields were

involved in 5(10%) of chest radiographs and 15(24.2%) of the chest CT images. Upper lobe involvement was the least common.

Involved lung zone on X ray	N	Percent
lower lung zone	13	26.0%
middle lung zone	3	6.0%
lower and middle lung zone	25	50.0%

all lung zones	5	10.0%
upper lung zone	2	4.0%
other	3	6.0%
Total	51	102.0%

Table 10. Table for lung zones involved on x ray

Lobar distribution on CT	N	Percent
lower lobe	18	29.0%
lower and middle lobe	21	33.9%
all lobes	15	24.2%
upper lobe	3	4.8%
other	8	12.9%
Total	65	104.8%

Table 11. Table for lung lobes involved on CT

Peripheral location was the predominant finding in both chest X ray and chest CT images accounting for 36(72%) of the chest X-rays and 49(79%) of the chest CT images. The next

common involvement was both central and peripheral location accounting for 12(24%) of the chest x rays and 12(19.4%) of the chest CT images.

Centrality on X ray

		Frequency	Percent
Valid	Central	2	4.0
	Peripheral	36	72.0
	Both	12	24.0
	Total	50	100.0
Missing	System	12	
Total		62	

Table 12. Table for centrality on chest x ray

Centrality on CT

	Frequency	Percent

Central	1	1.6
Peripheral	49	79.0
Both	12	19.4
Total	62	100.0

Table 13. Table for centrality on chest CT.

Most of the abnormalities were multifocal accounting for 37(74%) of the chest X-rays and 43(69.4%) of the chest CT images. The next common abnormality was diffuse involvement accounting for 8(16%) of the chest x rays and 18(29%) of the chest CT images. The least common findings was focal findings accounting for 5(10%) of the chest x rays and only 1(1.6%) of the chest CT images.

		Frequency	Percent
Valid	Focal	5	10.0
	Multifocal	37	74.0
	Diffuse	8	16.0
	Total	50	100.0
Missing	System	12	
Total		62	

Table 14. Table for Focality of infiltrates on chest x ray

Focality on CT	Frequency	Percent
Focal	1	1.6
Multifocal	43	69.4
Diffuse	18	29.0
Total	62	100.0

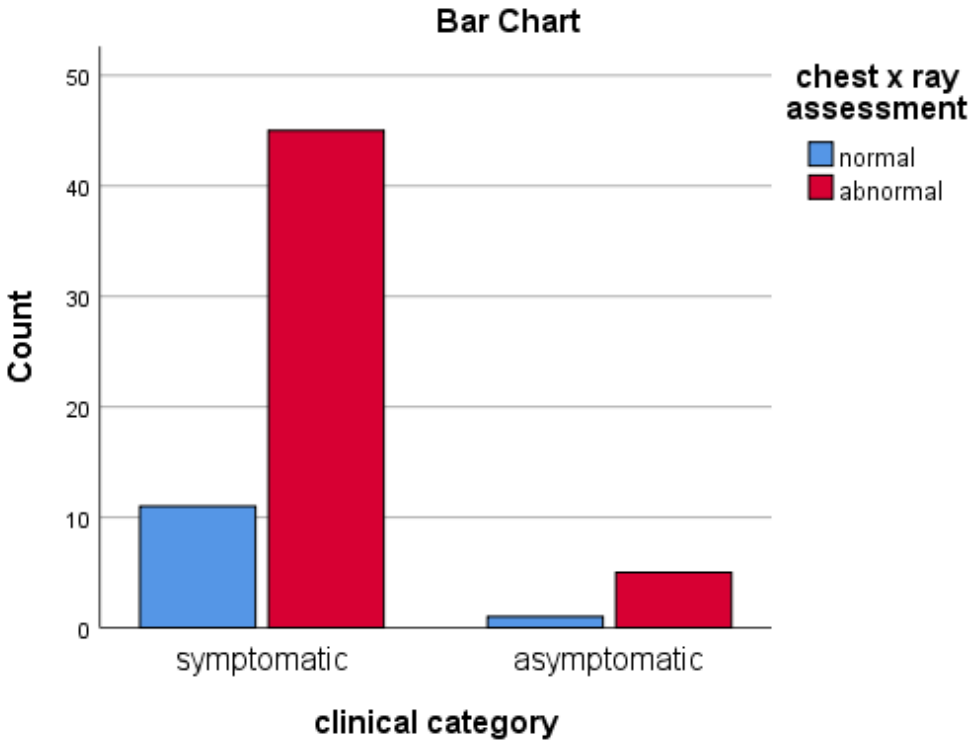
Table 15; Table for Focality of infiltrates on chest CT.

4.5. Cross tabulations

4.5.1. Clinical category with chest x ray

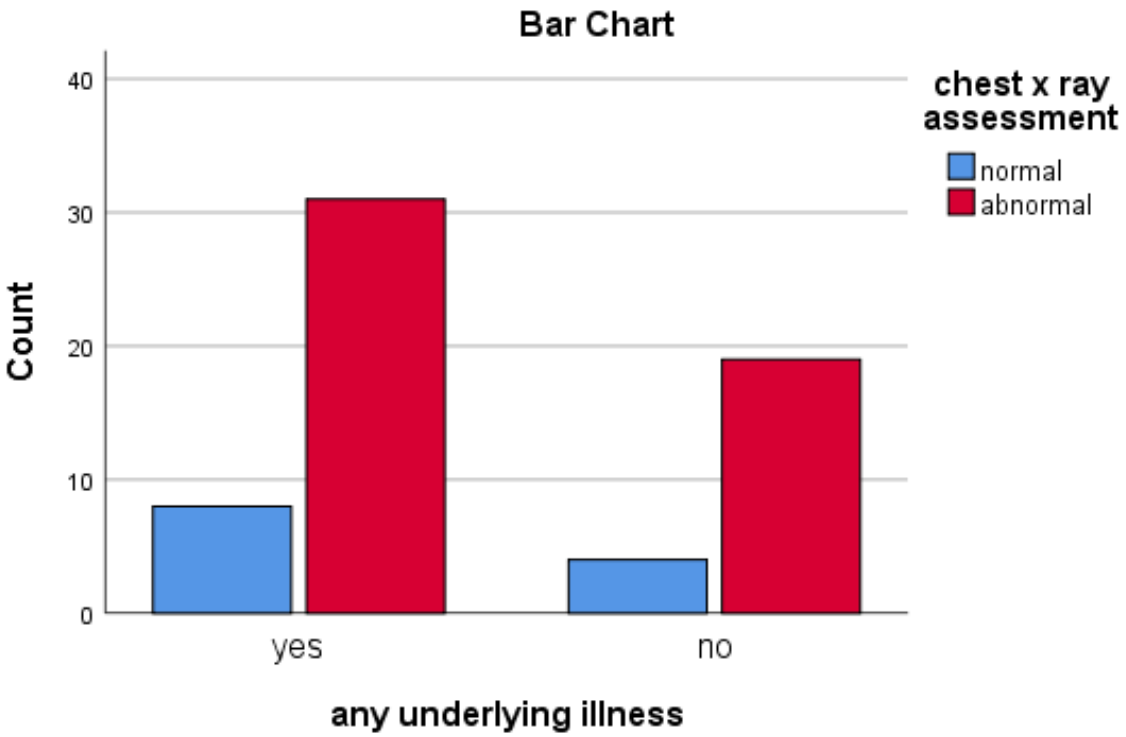
Among the 56 symptomatic patients 45(80%) and 55(98.2%) had abnormal chest X rays and chest CT s respectively.

Figure 4. Bar chart for clinical category with CRX assessment



4.5.2. Underlying illness with chest x ray

Among the 39 patients who had underlying illness 31(79.5%) had abnormal chest x ray and all the 39 had abnormal chest CT images. There is a positive but weak correlation between underlying illness and chest X ray assessment with pearson correlation coefficient of .038.



Correlations

		any underlying illness	chest x ray assessment
any underlying illness	Pearson Correlation	1	.038
	Sig. (2-tailed)		.768
	N	62	62
chest x ray assessment	Pearson Correlation	.038	1
	Sig. (2-tailed)	.768	
	N	62	62

Figure 5. Bar chart for underlying illness with CXR assessment

5. Discussion

This research describes the common chest radiographic and chest CT findings among 62 COVID-19 patients seen at Tikur Anbessa hospital. Majority of the patients 56(90.3%) were symptomatic

most of them 40(70.2%) presented with shortness of breath and 36(63.2%) presented with fever. Most of the patients 39(62.9%) have history of known underlying illness. Among the 62

patients 50(80.6%) of the chest x rays and all the 62 CT images were abnormal. The predominant chest radiological finding was multi focal ground glass opacity which is bilaterally and

peripherally distributed in the lower and middle lungs on both chest X ray and chest CT followed by a combination of ground glass and consolidation.

In this research the majority of the chest x rays (80.6%) were abnormal. This is consistent with a study done in Italy on chest x-ray of 240 patients with SARS-COV-2 infection confirmed by

RT- PCR which showed 180 (75%) abnormality on chest x-ray (14). The predominant abnormality was ground glass opacity which is consistent with our study.

In a retrospective case series, on chest CT scans of 21 symptomatic patients from China infected with the 2019 novel coronavirus typical CT findings included bilateral pulmonary parenchymal

ground-glass and consolidative pulmonary opacities with peripheral location which in consistence with our study.

In a retrospective study done in China on chest CT scan of 51 COVID-19 proven cases 50(98%) showed abnormality characteristic of COVID-19 pneumonia which is similar with our study.

The location of the radiographic findings were predominantly bilateral and peripheral involving the lower and middle lungs. This is similar with all the literatures reviewed.

5. Conclusion and recommendation.

The predominant radiographic finding in this study was ground glass opacity accounting for 22/62 (44%) of the findings followed by combination of ground

glass and consolidation accounting for 12/64 (24%) of the cases. Similarly the commonest chest CT finding was ground glass opacity which was seen in 29/62(46.8%) followed by ground glass with consolidation occurring in 22/62(35.5%). The distribution of the findings was bilateral and peripheral predominantly. The findings were multifocal and the lower and middle lungs were involved mostly.

The significant majority of the chest radiographs showed abnormalities characteristic for Cocid-19 pneumonia so we recommend the use of chest radiograph in the initial assessment or follow up of COVID-19 patients our country where resources are limited if imaging is indicated.

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Questionnaire

Research title: Correlation between chest Radiographic and chest CT patterns in COVID-19 Patients

Demographic Data

Code:---------- Age:---------- Sex: Male ☐ Female ☐

Clinical Cathegory :- Symptomatic ☐ Assymptomatic ☐

If symptomatic; **Clinical presentation**; Cough ☐ Fever ☐ SOB ☐ Headache ☐ loss of taste or smell ☐

Arthralgia/Myalgia ☐ Fatigue ☐ chest pain ☐ Sore throat ☐ others

Any underlying illness; Yes ☐ **No** ☐

If yes; DM ☐ underlying lung disease ☐ Cardiac illness ☐ Hypertension ☐ HIV/AIDS ☐

Known Malignancy ☐ Renal disease ☐ others __

CXR assessment :- Normal ☐ Abnormal ☐

Chest CT assessment: Normal ☐ Abnormal ☐

Type of infiltrate :- Chest x ray; Ground glass ☐ Consolidation Interstitial ☐ Other ☐

Chest CT; Ground glass ☐ Consolidation ☐ Crazy paving ☐ Interstitial ☐ Other ☐

Symmetry of involvement; Chest X ray; Unilateral ☐ Bilateral ☐

Chest CT; Unilateral ☐ Bilateral ☐

☐

Location of findings :- Lobar distribution; Chest X ray; Lower ☐ Middle ☐ Upper ☐ Other ☐

Chest X CT; Lower ☐ Middle ☐ Upper ☐ Other ☐

Centrality; Chest x ray; Central ☐ Peripheral ☐ Both ☐

Chest X CT; Central ☐ Peripheral ☐ Both ☐

Focality of findings:- Chest X ray; Focal ☐ Multifocal ☐ Diffuse ☐

Chest X CT; Focal ☐ Multifocal ☐ Diffuse ☐