

# PREVALENCE AND PATTERN OF ABNORMAL FINDINGS IN CHEST COMPUTED AXIAL TOMOGRAMS: A RETROSPECTIVE STUDY FROM A TERTIARY HEALTH FACILITY.

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## ABSTRACT

**Background:** A high-resolution chest CT (computed axial tomography) scan is a non-invasive cross sectional imaging modality, which makes use of ionizing radiation (X rays) and computer technology to visualize structures in the chest and chest wall. This radiological imaging modality is invaluable in the diagnosis of chest pathologies as it accurately demonstrates disease processes that may appear non-specific on chest radiographs.

**Aim/objective:** To determine the prevalence of abnormal chest CT findings and describe the radiological patterns for example consolidation/ collapse, pulmonary masses, bony pathologies in adult patients undergoing routine or diagnostic imaging. Secondly, paucity of data in our environment has also necessitated this study.

**Materials and Methods:** The subjects studied were patients referred to the department of Radiology, Rivers State University Teaching Hospital (RSUTH), Port Harcourt for chest CT scan. The socio-demographic factors like age and sex were taken. A total number of 199 patients were recruited into the study.

**Results:** This study has an age range of <30years to  $\geq 70$ years, with a mean age of  $52.58 \pm 12.25$ . The 40-49years age group were more frequent, with more males participating in the study. 75.4% were abnormal CT scans. More patients presented with mediastinal shift 35.7%. The mean ages for the presence of radiological features among study population is  $50.86 \pm 12.20$  and  $56.94 \pm 11.01$  for the least and most common features respectively for intrapulmonary mass and mediastinal shift. While the mean ages for the absence of radiological features for the least and most common are  $50.16 \pm 12.27$  and  $53.26 \pm 12.24$  respectively for the aforementioned radiological features. More females had mediastinal shift 59.2%, while males had 40.8%.

**Conclusion:** The study confirms that most of the patients that were recruited had abnormal chest CT scans and the examination is invaluable in the management of chest pathologies.

**Key words** Chest computed axial tomography, Prevalence, Pattern, Abnormal findings

## INTRODUCTION

Computed tomography of the chest has proven to be invaluable in the detection of various diseases or pathological conditions of the chest. Abnormal findings on chest CT, means there is a chest pathology and that includes infections, tumors, interstitial lung diseases, chronic obstructive air way diseases (e.g emphysema), fractures as seen in trauma. Chest CT scans may be useful in detecting lung lesions that are not readily visible on chest X-rays, especially with the advent of high-resolution CT scans. This could be done with or without intravenous (IV) contrast, however a standard CT chest is done with IV contrast.

Multidetector chest CT is very useful in trauma patients with risk of aortic, mediastinal and spinal injuries some of which may appear normal on chest radiographs<sup>1,2</sup>. CT chest scan is also the best modality in suspected cases of pulmonary lacerations/ hemorrhage, pleural space abnormalities such as effusion, pneumothorax, parenchymal lesions like tuberculosis, alveola lesions which appear as ground glass opacities, diaphragmatic injuries etc<sup>3</sup>. Thin slice chest CT scans are sensitive for detection of lung cancers (which includes staging and pattern of disease), pulmonary nodules and whether or not there is pleural and chest wall invasion<sup>4,5</sup>.

Chest CT angiography (CTA) is a specialized procedure basically for investigating vascular pathologies such as pulmonary embolism, though non vascular lesions like lymphadenopathy and pulmonary septic emboli<sup>6</sup>, with its attendant features like cavitation, feeding vessel, wedge shape peripheral lesions may be found<sup>7</sup>.

High resolution CT has been reported to be very useful in the management of patients with parenchymal lung diseases such as aspergillosis, which is fatal disease if left unattended to. The presence of the halo sign is a good prognostic sign for the patient. Interstitial lung diseases, pleural tuberculosis which could coexist with lung parenchymal tuberculosis (TB) are also better evaluated on high resolution CT scans.

Complications of Pulmonary tuberculosis such as pleural effusion, broncho- pleural fistula and chest wall involvement are also better evaluated on HRCT scan<sup>9</sup>. Chronic obstructive airway diseases as well as bronchial tree obstruction by tumors are also better evaluated with a HRCT chest scan.

## MATERIALS AND METHODS

This is a two-year retrospective study. Data were those of patients sent to the Radiology department of RSUTH, Port Harcourt between September 2023 to September 2025. It is located in the South- South area of Nigeria. Only patients with a request for a chest CT for various chest conditions were recruited into this study. Those who withdrew their request forms were excluded. Subjects that had images of diagnostic value in both pre and post contrast Computed Tomograms were evaluated. The age, sex and indication for the CT scan were gotten from the request forms. History of possible allergy(ies) were enquired about, since it is a contrast-based examination.

### Technique

Images were obtained using low dose GE Revolution CT multi slice scanner, with a slice thickness of 0.625mm. Pathological findings were analyzed based on the various indications seen on request forms and they include mediastinal shift, consolidation, intrapulmonary mass, pleural based mass, pneumothorax, lung collapse and bronchial dilatation.

The patient lies supine on the CT machine gantry and the scanogram is acquired. Pre-contrast images were then acquired from the thoracic inlet to the upper abdomen (lowest hemi diaphragm) in a breath holding technique. The post contrast images were acquired after a low osmolar contrast medium (Iohexol) was given to the patient intravenously using an automatic injection pump at the rate of 3-5ml per second. Reformatted sagittal and coronal images were generated for reporting.

A data collection sheet was used to record patients' information gotten from the referral form and this include the biodata, presenting complaints and the provisional diagnosis as seen by the referring clinician.

## Analysis

Data obtained from patient's record were entered into Microsoft Excel and subsequently exported to IBM SPSS version 25.0 for statistical analysis. Descriptive statistics were used to summarize socio- demographic variables, including age and sex and presented as frequencies, percentages, means, standard deviations, medians and ranges as appropriate. The prevalence of abnormal CT chest findings was depicted using pie charts, while bar charts illustrated the distribution of key radiological features. Radiological features were compared by sex using the goodness of fit Chi square, while mean ages between patients with and without radiological features were compared using an independent t-test. Statistical significance was set at  $p < 0.05$ .

## RESULTS

**Table 1 Sociodemographic characteristics of patients in the study population**

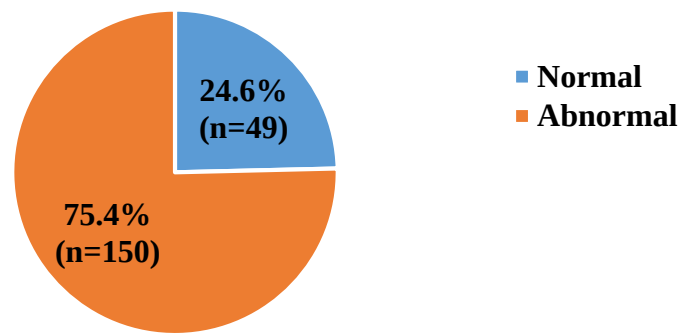
| Variables (N=199)  | Frequency | Percentage |
|--------------------|-----------|------------|
| <b>Age (years)</b> |           |            |
| <30years           | 6         | 3.0        |
| 30 – 39years       | 21        | 10.6       |
| 40 – 49years       | 58        | 29.1       |
| 50 – 59years       | 46        | 23.1       |
| 60 – 69years       | 50        | 25.1       |
| ≥70years           | 18        | 9.0        |
| <b>Sex</b>         |           |            |
| Female             | 94        | 47.2       |
| Male               | 105       | 52.8       |

**Table 1**, describes the characteristics of the study population. The vast majority were males (52.8%) while females wee (47.2%) with the most frequent age group been 40-49years.

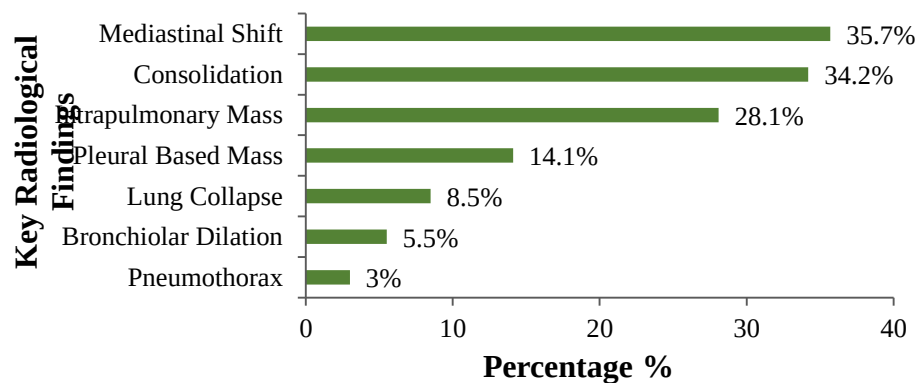
**Table 2 Indications for Chest CT Scan**

| Indications  | Frequency  | Percentage   |
|--------------|------------|--------------|
| Routine      | 5          | 2.5          |
| Not Routine  | 194        | 97.5         |
| <b>Total</b> | <b>199</b> | <b>100.0</b> |

**Table 2** showed Most of the patients were non- routine (97.5%). Only 2.5% of the scans were for routine purposes.



**Figure 1** is a pie chart showing that 75.4% of the patients had abnormal chest CT scans. 24.6% of the patients had normal CT chest.



**Figure 2** is a bar chart showing the various pathologies seen in the study population, it shows that mediastinal shift (35.7%) is the most frequent abnormality, followed by consolidation (34.2%), intrapulmonary mass (28.1%), pleural based mass (14.1%), lung collapse (8.5%), bronchiolar dilatation (5.5%) and pneumothorax (3%).

**Table 3 Comparison of radiological features by sex**

| Radiological features | N  | Sex           |                 | Chi Square <sup>a</sup> | p-value |
|-----------------------|----|---------------|-----------------|-------------------------|---------|
|                       |    | Male<br>n (%) | Female<br>n (%) |                         |         |
| Mediastinal shift     | 71 | 29 (40.8)     | 42 (59.2)       | 2.3803                  | 0.1229  |
| Consolidation         | 68 | 37 (54.4)     | 31 (45.6)       | 0.5294                  | 0.4669  |
| Intrapulmonary mass   | 56 | 30 (53.6)     | 26 (46.4)       | 0.2857                  | 0.5930  |
| Pleural based mass    | 28 | 11 (39.3)     | 17 (60.7)       | 1.2857                  | 0.2568  |
| Lung collapse         | 17 | 7 (41.2)      | 10 (58.8)       | 0.5294                  | 0.4669  |
| Bronchiolar dilation  | 11 | 9 (81.8)      | 2 (18.2)        | 4.4545                  | 0.0348* |
| Pneumothorax          | 6  | 4 (66.7)      | 2 (33.3)        | 0.6667                  | 0.4142  |

<sup>a</sup>Goodness of fit Chi square

\*Statistically Significant

**Table 3** shows comparison of radiological features by sex, the females had more of mediastinal shift (59.2%) and pleural based mass (60.7%), the other radiological features were male dominated. In general, mediastinal shift is the commonest radiological feature as seen in the table, while the least is pneumothorax.

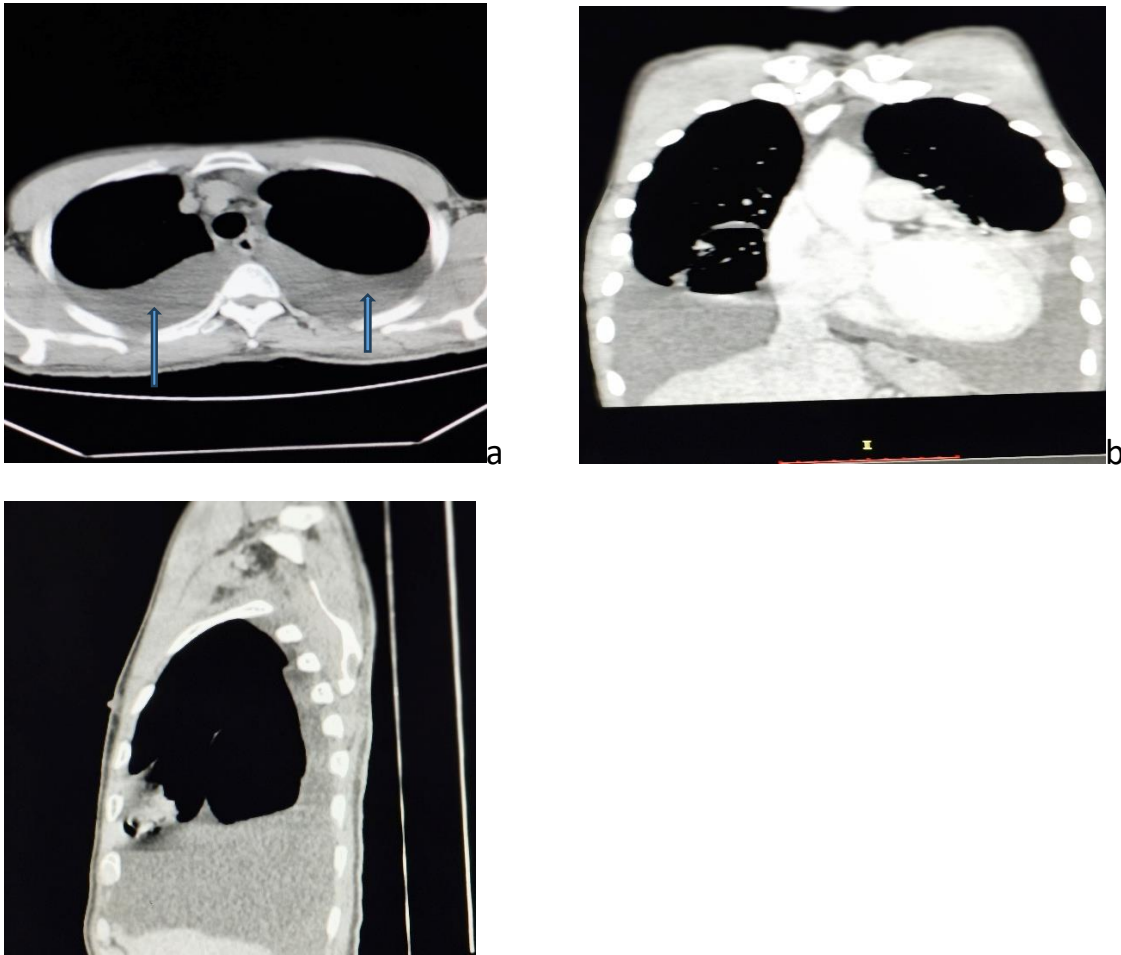
**Table 4 Comparison of mean ages between presence and absence of radiological features among patients in the study**

| Radiological features | Present           | Absent            | t     | p-value |
|-----------------------|-------------------|-------------------|-------|---------|
|                       | Mean age $\pm$ SD | Mean age $\pm$ SD |       |         |
| Mediastinal shift     | 56.94 $\pm$ 11.01 | 50.16 $\pm$ 12.27 | 3.871 | 0.0001* |
| Consolidation         | 54.10 $\pm$ 10.85 | 51.79 $\pm$ 12.88 | 1.263 | 0.208   |
| Intrapulmonary mass   | 50.86 $\pm$ 12.20 | 53.26 $\pm$ 12.24 | 1.246 | 0.214   |
| Pleural based mass    | 53.14 $\pm$ 12.07 | 52.49 $\pm$ 12.31 | 0.260 | 0.795   |
| Lung collapse         | 52.94 $\pm$ 11.45 | 52.55 $\pm$ 12.35 | 0.126 | 0.900   |
| Bronchiolar dilation  | 52.91 $\pm$ 10.04 | 52.56 $\pm$ 12.39 | 0.091 | 0.928   |
| Pneumothorax          | 51.83 $\pm$ 19.53 | 52.61 $\pm$ 12.03 | 0.152 | 0.879   |

\*Statistically Significant

**Table 4** shows comparison of mean ages between presence and absence of radiological features among the study population. Mediastinal shift is seen to be the most present and least absent with a mean value of 56.94 $\pm$ 11.01 and 50.16 $\pm$ 12.27 respectively. Consolidation is the second most present and least absent with a mean value of 54.10 $\pm$ 10.85 and 51.79 $\pm$ 12.88 respectively.

## Images:



**Figure 1a, b and c are axial, coronal and sagittal reformatted contrast enhanced computed tomography in the mediastinal window showing bilateral pleural fluid collections(slim blue arrows).**



**Figure 1a, b and c are axial, sagittal and coronal reformatted contrast enhanced computed tomography in the lung window showing consolidation in the middle lobe of the right lung(broad orange arrow)).**



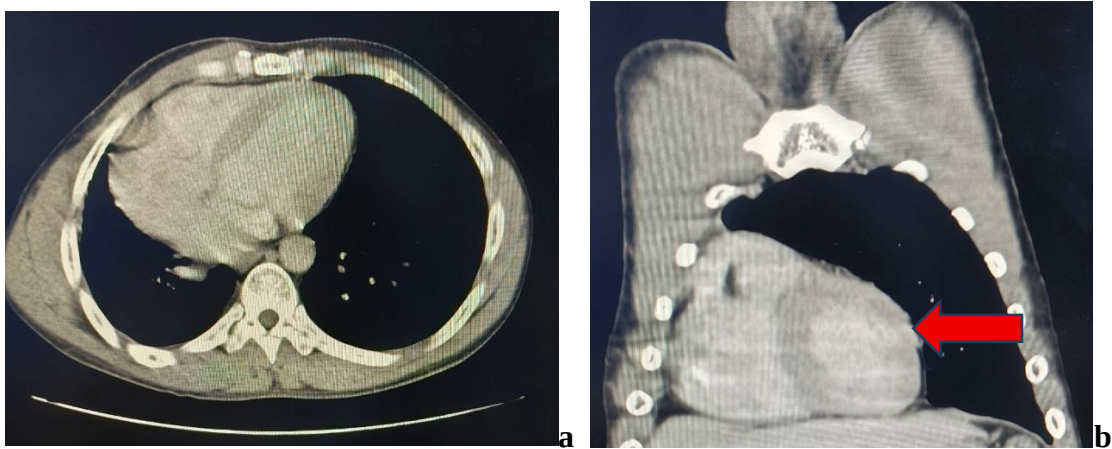


Figure 2a and b are axial and coronal reformatted contrast enhanced computed tomogram mediastinal window showing mediastinal shift to the right(The heart is on the right-broad red arrow).

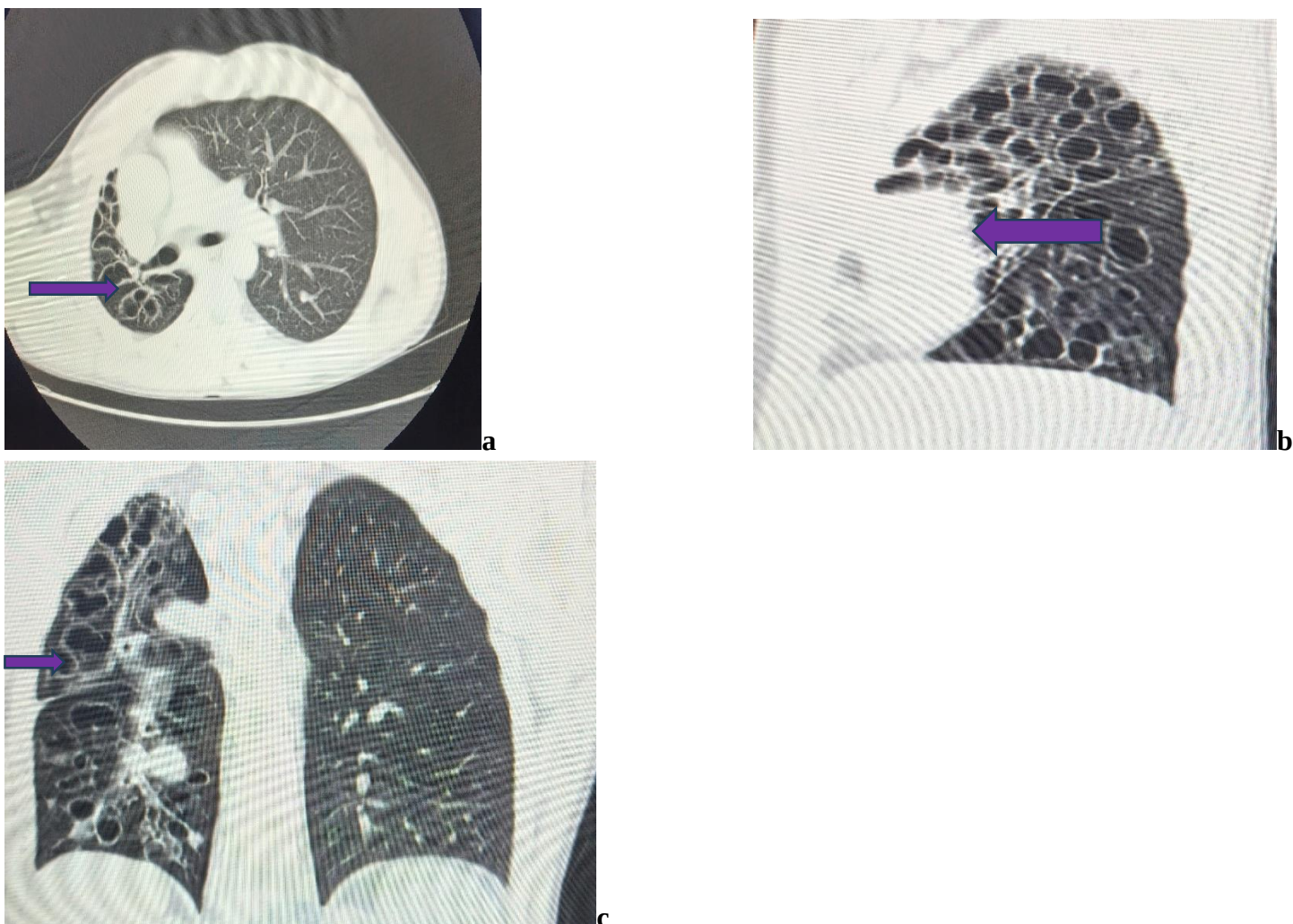


Figure 3a, b and c are axial, sagittal and coronal reformatted views of the lung window images showing multiple thin-walled cystic lesions in the right lung field(broad purple arrows).



## DISCUSSION

CT is a veritable tool in the diagnosis and management of chest pathologies this is because of its high sensitivity and its good soft tissue contrast as well as evaluation of bony details when compared to conventional radiography. Aside diagnosis, chest CT scan is very useful for the follow up of patients who have had pulmonary mass, interstitial lung diseases as well as monitoring of interventional procedures.

In our study only adult patients were recruited, the most common abnormality was mediastinal shift, which represents 35.7% of the study population. The other radiological abnormalities in order of decreasing frequency are as follows: Consolidation 34.2%, Intrapulmonary mass 29.1%, Pleural based mass 14.1%, Lung collapse 8.5%, Bronchiolar dilatation 5.5% and Pneumothorax 3%. A study done by Bonnermaison B. et al<sup>11</sup>, showed no evidence of mediastinal shift, this is same for the study done by Adenike. T. Adeniji-Sofoluwe et al<sup>12</sup>, in addition the latter had children as part of their subjects. In contrast to the case study, the former had more of pulmonary nodules 76%, while the latter had more of consolidative changes in the lung parenchyma 77.4%. In the study by Wahidi et al<sup>13</sup>, Austin et al<sup>14</sup> and Bonnermaison et al<sup>11</sup>, these studies showed the prevalence of pulmonary nodules as been the highest while the case study recorded no pulmonary nodule as a radiological finding. Pleural base mass, Intrapulmonary mass, lung collapse and bronchiolar dilatation are common radiological findings in the case study and in the study by Adeniji- Sofoluwe et al<sup>12</sup>. However, the aforementioned findings are more common in the study by Adeniji- Sofoluwe, probably because of better access to chest CT scan facility as reported by Gould et al<sup>15</sup>. Abnormalities like interstitial lung diseases, emphysematous and pulmonary cystic lesions were not recorded in our study, may be such ailments are less prevalent in our environment.

Only seven radiological features were reported and analyzed in our study, in contrast to the studies done by Adeniji- Sofoluwe et al<sup>12</sup>, Bonnermaison B. et al<sup>11</sup>, etc. The reason may be that fewer physicians /clinicians had a knowledge of the use of CT chest in the evaluation of patients with chest conditions or been a retrospective study some referrals or records of patients might have been lost.

In the case study, only three of the abnormal features were more common amongst females (mediastinal shift, lung collapse and pleural based mass), while in the studies by Adeniji-Sofoluwe and Bonnermaison, the males dominated in all the abnormal findings, even though the studies all show male dominance amongst the recruited subjects.

The patients that were sent for routine/ follow up chest CT in our study were 2.5%, this may be due to ignorance on the part of the physician as regards the use of CT in the monitoring of disease outcome or even patient's non-compliance to medical care. It could also be due to inaccessibility to a CT scan machine.

Pulmonary tuberculosis is prevalent in our environment, as Nigeria ranks 10<sup>th</sup> amongst high TB burdened countries in the world, which was estimated to be about 300,000 cases in 2010<sup>15</sup>, most of whom are immunocompromised.

In our study, pulmonary TB was not a major presenting complaint, this is probably because the managing physicians are not referring suspected cases of TB for chest CT scan. They rather depend on plain radiographic imaging, laboratory tests and or anti TB drug trial therapy in our environment. Active pulmonary TB is better differentiated more accurately from chronic TB using chest CT<sup>16</sup>.

Chest CT is also very important in the proper characterization of non-specific findings on plain chest radiograph, disease localization as well as follow up of patients when needed<sup>17</sup>

Also, there were no indications for computed tomography angiography (CTA), probably because there were no vascular lesions as presenting complaints or chest CTA are underutilized in our environment.

24.6% of participants had normal chest CT findings, which is at variance with a study done by Lee. K. et al<sup>18</sup>, they had 82% of the chest CT been normal. However, in the latter they had very few subjects and they classified their findings as normal, abnormal non-urgent and abnormal urgent.

The current study has provided baseline data on prevalent chest CT abnormalities in our environment.

**CONCLUSION:** Chest Computed tomography is invaluable in the diagnosis and management of chest pathologies, because of its sensitivity. Chest CT is under-utilized in developing countries especially in our environment, this may be due to the cost of the examination as well as availability and accessibility of the machine to patients who really need it.

In our study, the least frequent age group were adults below 30years, this may not be a true representation of chest pathology in this age group, so we advocate the use of a chest CT scan for screening of patients in this age.

We recommend that chest physicians be educated on the role and advantage of chest CT in the management of their patients with chest pathology.

**LIMITATION:** This is a retrospective study, and so some patients' data might have been missed during record keeping. Information about the patients is also limited to what was in the referral form.

**STUDY LIMITATION:** The study design is retrospective.

**FUNDING:** No funding sources.

**CONFLICT OF INTEREST:** None declared.

**ETHICAL APPROVAL:** Not required for this study.

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