

## Original Article

### Chest x-ray findings of paediatric patients seen at a Teaching Hospital in North-western Nigeria

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#### Abstract

**Introduction:** Plain radiography is the first line of radiological examination used for the evaluation of paediatric chest, and also a rapid imaging technique that allows lung abnormality to be identified. X-ray is used to diagnose conditions of the thoracic cavity, including airways, ribs, lungs, heart, and diaphragm. Chest x-ray has a high sensitivity for pulmonary tuberculosis and thus is a valuable tool to identify a differential diagnosis for a patient. **Methodology:** Two hundred and eleven paediatric chest x-ray reports were studied between February 2017 to September 2018. Data were collected retrospectively from the hospital archives using a data capture sheet. **Results:** Two hundred and eleven radiographs were assessed and the age of patients whose radiographs participated in the study ranged from 0-15 years. Also, a greater number of male patients 133(63.03%) participated in the study than female patients 78(36.97%). Among all the radiographs used in this study, the most common age group for this study ranged from 0-3 years. Results from the study also revealed that bronchopneumonia was the most common finding totaling 105(49.76%) followed by radiographs which are normal findings 77(36.49), pulmonary tuberculosis, 19(9.00%), congestive heart failure 4(1.90%), pleural effusion 3(1.42%), enlarged adenoid 2(0.95%) and dextrocardia 1(0.47%). **Conclusion:** This study report bronchopneumonia was the most common paediatric radiographic finding in a chest x-ray. Plain radiography is an effective tool to examine various respiratory and cardiac pathologies and is the first line of investigation for chest pathologies.

**Keywords:** *Bronchopneumonia, Chest x-ray, Paediatric*

#### Introduction

Plain radiography is the first line of radiological examination used for the evaluation of pediatric chest, and a rapid imaging technique that allows lung abnormality to be identified. X-ray is used to diagnose conditions of the thoracic cavity, including airways, ribs, lungs, heart, and diaphragm. Chest x-ray has a high sensitivity for pulmonary tuberculosis and thus is a valuable tool used to identify it as a differential diagnosis for a patient.<sup>1</sup> Computed tomography is currently the “gold standard” for the assessment of lung morphology and is so far the

most reliable imaging modality for monitoring lung disease.<sup>2</sup>

Radiological examinations are extremely valuable as investigation (diagnostic) tools in the paediatric population,<sup>3</sup> but it comes with many different challenges that will alter the quality of images which may lead to wrong diagnoses compared to that of an adult. The paediatric examination involves medical imaging of neonates, infants, and children. It comes with many challenges to the radiographer whose obligations are to produce quality images for correct

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diagnosis irrespective of the challenges.<sup>2</sup>

Chest radiography is frequently performed as a diagnostic examination, particularly in paediatric patients with respiratory and cardiac diseases, and can also be done for medical checkups and planning patients for surgery.<sup>3</sup> Techniques of a paediatric examination must require adequate skill and knowledge in handling pediatrics to obtain images of diagnostic quality. "It requires considerations as ionizing radiation is used".<sup>4</sup> One of the challenges in pediatric chest plain radiography is to gain trust and cooperation before and through the duration of the examination, which can be proved to be difficult in pediatric that may be ill and have pain. This is significant to acquire quality images and prevent a repeat of patient exposure. With a quality examination, accurate interpretation of images acquired, also provides intricate anatomy and can detect pathologies in the image. The rationale behind this study is that many faulty examinations of paediatric chest radiography may associate with inappropriate radiological techniques and improvement of image quality benefits not only the patient infected by diseases but also those suffering from pulmonary disease. In terms of detection and treatment of pulmonary pathology, poor imaging quality may be more harmful to the patients than having the patients not diagnosed through an x-ray procedure. Paediatric chest radiographs with poor image quality can cause misdiagnosis or require repeat examination, wasting economical resources and unnecessary radiation. Conversely, providing a high-quality image of a chest radiograph benefits anyone who will be examined by x-ray images which is an important task for the radiographer.<sup>4</sup>

Chest X-ray is a primary imaging study to confirm the diagnosis of pneumonia using a well-centered, appropriately, penetrated, anterior-posterior chest radiography in paediatrics. Although other views may be warranted to clarify anatomical relationships and air-fluid levels. Chest radiography in the determination of pneumonia needs radiographer and radiologist to pay attention to the following: costophrenic angle, pleural space, and surface, diaphragmatic margin, cardiothymic silhouette, pulmonary vasculature, right major fissures, air bronchogram overlying the cardiac shadow, lung expansion and pattern of aeration.<sup>5</sup>

An understanding of the infant chest radiography

requires a review of how embryology, anatomy, physiology, pathology, immunology, and the physics of fluid mechanics influence its appearance, this knowledge is critical in the interpretation of the infant chest radiograph. Going with the embryological and anatomical descriptions, it is believed that all generations of airways have developed by the time the fetus reaches the 16th week of gestational age. There are about 22 generations of airways depending on how the last generation is counted and where the count is performed. Near the lungs hila, there may be as few as 10 generations of airways before the gas-exchange unite-the respiratory bronchioles and alveolar sac are reached in the lungs periphery. There may be as many as 25 generations of airways before the gas-exchange units are reached. As the child grows and becomes an adult the airways grow in length and diameter but not in number. The alveoli, the gas exchange units, develop after the airways. They start proliferating about 29 weeks of gestational age. By the 40th week of gestation, there are approximately 20 million alveoli in the newborn lung. Although the precise number is debated. The mature lungs contain approximately 300 million alveoli. That number is reached at about 8 years of age. The alveoli then increase in size, and then the lining gets progressively thinner.<sup>6</sup>

Chest radiography is often necessary as a preliminary study and is the most commonly requested study for a child complaining of chest pain. Its availability, low cost, and lower radiation exposure compared with some other imaging modalities make it a preliminary procedure of choice for thoracic pathologies and other conditions that affect indirectly the chest. Chest radiography is 42-72% accurate in predicting the etiology of a case of pneumonia.<sup>7</sup> In a study of 168 children with pneumonia, 2 radiologists who independently evaluated all chest radiographs were unable to distinguish whether the agent involved was bacterial, viral, or unidentified.<sup>8</sup> Chest radiography is indicated in an infant or toddler who presents with fever and any of the following conditions. Tachypnea, nasal flaring, retractions, grunting, rales, decreased breath sounds, and respiratory distress; while in older children and adolescents, the diagnosis of pneumonia is often based on clinical presentation. Chest radiography is a commonly requested examination for both in-patients and out-

patients that have varieties of intra and extra-thoracic complaints. The intra-thoracic complaint can include pathologies affecting the lungs and their accessory structures, mediastinal pathologies, cardiopathies, and so many other conditions which are predominantly associated with adults.<sup>9</sup>

Immunopathological, growing children are exposed to many infectious organisms and need to develop immunity to them. The average adult inhales more than 9000 liters of air per day, the infant, much less. A multitude of organisms enters the airways along with this inspired air. The organisms that infect the respiratory tract in infancy are usually viral. The most severe diseases in the lower respiratory tract are caused by Para influenza viruses and the respiratory syncytial virus.<sup>10</sup> These are also among the most common organisms to infect the infant respiratory system. Adult has some immunity to most of these organisms because they were exposed to them as children and developed immunity against them. Although adults may be infected and transmit these viruses to others, they usually become no more than mildly ill. Infants have not yet developed immunity against so many diseases. Thoracic diseases are common chemical problems in children and often require the use of imaging to diagnose and aid in the treatment of the problem.<sup>11</sup>

In so many related studies such as Radiologia Brasileira; normal findings on chest x-rays of neonates. The purpose of this study is to describe the normal findings of newborn chest radiography. It is deduced from this study that a change in fetal circulation contributes to an increase in cardiac size, skin folds and variation in thymic silhouette may simulate disease.<sup>12</sup>

Quality assurance (QA) is a systemic measurement comparison with a standard, monitoring of the process, and associated feedback loop that confers error prevention.<sup>13</sup> Therefore, quality assurance in chest radiograph is a system designed to continuously improve the quality of the chest at a health facility and can be achieved through organization efforts by all staff members in taking chest radiographs. It comprises quality control, quality assessment, and quality improvement. Quality control includes all quality control efforts routinely performed. Even though a study on adult chest x-ray findings was conducted in this study

area,<sup>14</sup> there is no evidence-based research documented on pediatric chest radiograph findings to the best of our knowledge and hence the need for this study which aimed at revealing the findings and age/sex distribution of the findings on the radiographs.

## Materials and method

### Ethical consideration

The ethical clearance to conduct this study was obtained from the ethical clearance committee of the Usmanu Danfodiyo University Teaching Hospital (UDUTH), Sokoto with clearance certificate number UDUTH/HREC/2019/No. 855

### Study design and study area

This was a retrospective cross-sectional study conducted in the Department of Radiology UDUTH Sokoto, which covers paediatric chest radiographs done from February 2017 to September 2019. The study lasted for three months. The study area is a tertiary teaching hospital commissioned in 1989 and it's a referral hospital/regional center for Neurosurgery. The department of Radiology had sixteen consultants and eighteen resident doctors at the time of this study.

### Inclusion and exclusion criteria

All existing reported documents of paediatric chest radiographs in the Radiology department of UDUTH were included while unreported documents were excluded from the study.

### Sample size

The sample size was determined using Taro Yamane's formula<sup>15</sup>

$$n = \frac{N}{1 + Ne^2}$$

Where

n = sample size

N = target population

1 = constant

E = acceptable level of error.

$$n = \frac{448}{1 + 448(0.05)^2} = \frac{448}{1 + 1.21} = \frac{448}{2.21} = 211$$

$$n = 211$$

### Method/Instrument of data collection

Existing/reported documents of paediatric chest radiographs were retrieved from the archive of the Radiology Department Using a data capture sheet as

an instrument for data collection.

### Data analysis

Microsoft Excel version 2010 was used and data

were reported using descriptive statistics (mean, frequencies, and percentages).

### Details of the equipment used in the study center.

**Table 1:** Summary of departmental operating details

Parameters	Center details
Generator type	3 phases
Beam limiting device	Light beam diaphragm
Type of tube	Rotating anode x-ray tube
Unit name	Silhouette VR
Maximum kv	150kvp
Model	Ms-18s
Machine age	10years
Filtration(total)	1.5mm inherent+1mm added=2.5mm
Focal spot	1.0/0.5mm Al eq
Film type	AGFA
Screen(s)	Rare earth/calcium tungstate
Processing method	Manual/automatic
QA program	Beam alignment test/film reject analysis
Fine focus	0.6
Broad focus	1.2

### Results

Out of the 211 radiographs included in the study, 133 (63.03%) were for male patients while 78 (36.97%) were for females. Age distribution of patients as shown in table 2 revealed that the age range of 1 month to 1 year have the highest number of radiographs with 54 (25.59%) while the age range of 0 to 1 month had the lowest with only 3 radiographs (1.42%). Table 3 shows the findings of the radiographs evaluated. Out of the 211 paediatrics chest radiographs, bronchopneumonia was the most common finding in 105 radiographs (49.76%) followed by normal 77 (36.49%), pulmonary tuberculosis 19 (9%), congestive heart failure 4 (1.9%), pleural effusion 3 (1.42%), enlarged adenoid 2 (0.95%) and Dextrocardia being the least finding with 1 radiograph (0.47%).

**Table 2:** Age distribution of the patients

Age range	Number(N)	Percentages(%)
Neonate (0-1month)	3	1.422
Infant (1month-1 year)	54	25.592
Toddler (1-3 years)	45	21.330
Pre-school (3-6 years)	29	13.744
School (6-12 years)	43	20.380
Adolescent (12-15 years)	36	17.100

**Table 3:** Findings on radiographs evaluated

Findings	Frequency	Percentage (%)
Bronchopneumonia	105	49.76
Normal	77	36.49
Pulmonary tuberculosis	19	9.00
Pleural effusion	3	1.42
Dextrocardia	1	0.47
Enlarge adenoid.	2	0.95
Congestive heart failure	4	1.90
	<b>211</b>	<b>100</b>

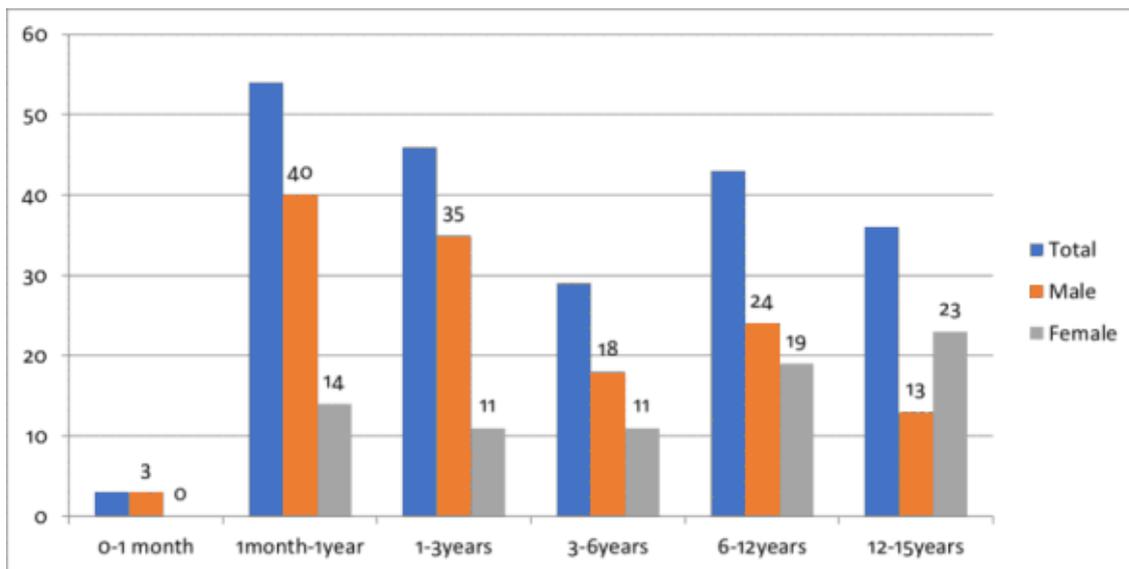


Fig 1: Bar chart shows sex distribution of paediatrics chest x-ray findings to the age groups.

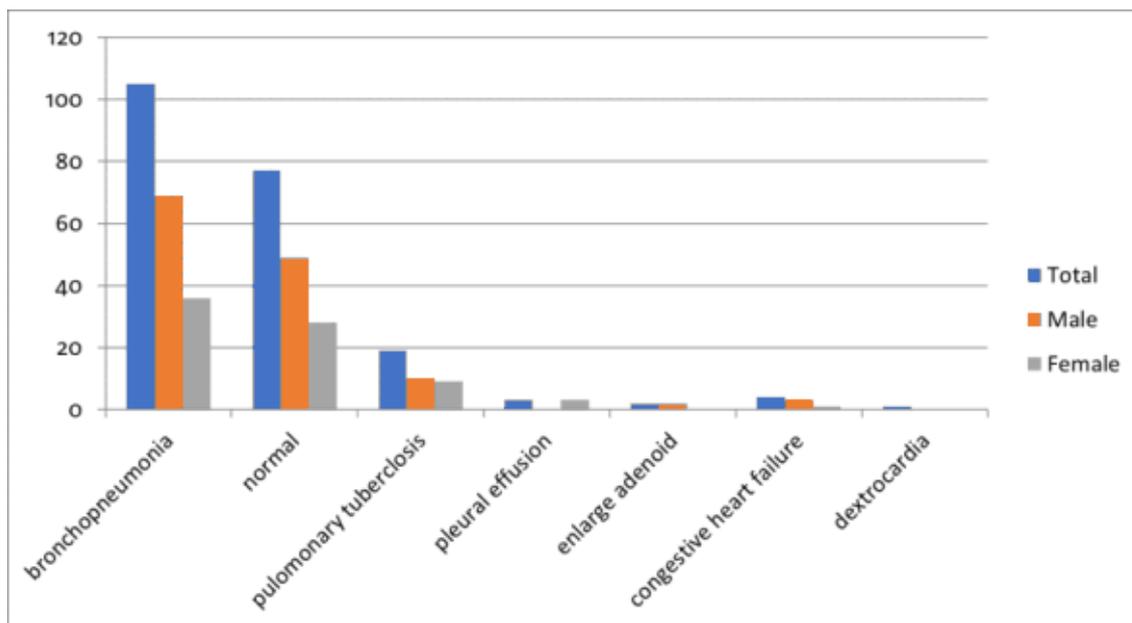


Fig 2: The bar chart shows the sex distribution of paediatric chest X-rays to the radiographic findings.

**Discussion**

All the chest radiographs in this study consist of patients whose age ranges from 0 to 15 years and all the radiographs assessed to have a diagnostic report with complete patient information. Out of the total number of 211 radiographs studied, radiographs of male patients are found to be higher than that of females which is similar to the studies conducted by Ching et al.<sup>16</sup> by Srinisa et al.,<sup>17</sup> and Stephen et al.<sup>18</sup> Findings from this study revealed that the most common finding was bronchopneumonia with

49.76% which is in line with the study conducted in Bangalore.<sup>19</sup> A similar study conducted in Malaysia,<sup>20</sup> on the topic of common pathological findings in paediatrics chest radiographs, concluded that bronchopneumonia is the most common finding with 38.24% which is similar to the findings in this study though with a higher percentage. The age group 1 month to 1 year was found to have the highest number of radiographs followed by 1 to 3 years in this study, which is contrary to studies

conducted in Nepal<sup>21</sup> which reported 6 months to 2 years as the most common age group, followed by 2 to 5 years. Moreover, in the study conducted in Georgia, USA,<sup>22</sup> reported 1 to 5 years as the most common age group. This variation may be due to differences in geographical locations.

Our study elucidates bronchopneumonia is predominantly present with reticulonodular opacities which tend to be a patchy appearance with peribronchial thickening and poorly defined air space opacity which is similar to the study we cited earlier conducted by Aderson, *et al.* which also *elucidate* these radiographic features.

### Conclusion

Bronchopneumonia was the most commonest pathology of all the paediatrics chest radiographs studied with the highest number found among males. The highest number of radiographs evaluated in this study was among the age group of one month to one year. Plain radiography is an effective tool to examine various respiratory and cardiac pathologies and is the first line of investigation for chest pathologies.

### Limitations

Several pediatric chest radiographs have met the requirement for inclusion, but the reports were missing.

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