COMMON PATHOLOGICAL FINDINGS IN PAEDIATRIC CHEST RADIOGRAPHS IN NNAMDI AZIKIWE UNIVERSITY TEACHING HOSPITAL, NNEWI

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Abstract

The study examined common pathological findings in paediatric chest radiographs in Nnamdi Azikiwe University Teaching Hospital, Nnewi. A descriptive cross-sectional study was adopted for the study. The work targeted all paediatric patients who underwent chest x-ray investigation in the radiology department of Nnamdi Azikiwe University in the year 2017. A purposive sampling method was adopted in sampling participants for the study. The research was done using records that met the inclusion criteria dating the year 2017. A total of 100 patient records, below fourteen years of age that met the criteria for inclusion were used after scrutinizing records of patients. Data obtained were analyzed using descriptive statistics of mean, frequency and standard deviation. Results showed that At Nnamdi Azikiwe University Teaching Hospital (NAUTH), out of 100 paediatric patients recorded who had plain chest x-ray examinations, 63%(n=52) patients presented with normal radiographic findings while 37%(n=48) presented with pathological findings. It also revealed that the common pathological findings are bronchopneumonia 15%(n=19), foreign body 4%(n=8), pulmonary tuberculosis 4%(n=5), interstitial lung disease 4%(n=8), pneumonic consolidation 3%(n=3), congestive cardiac failure 4%(n=4), pleural effusion 2%(n=1), then the normal findings of this study include normal study 63%(n=52). Bronchopneumonia has the highest frequency of occurrence at 15%, where male patients were more affected than females. The age group range of range of 0-3 years is more susceptible to most diseases apart from normal findings, this may be related to this age's physiological immune status (congenital or non-congenital) or social behaviour. It was recommended among others that Chest X-rays should also be seconded with 2-D echocardiography or ultrasound for most cases of congenital cardiopathies.

Keywords: *Pathological Findings, Paediatrics, Chest Radiographs.*

Introduction

Paediatrics is the field of medicine concerned with the health of infants, children, and adolescents; their growth and development; and their opportunity to achieve their full potential as adults (William,2018). Growing children are exposed to many infectious organisms and need to develop immunity. The average adult inhales more than 9000 litres of air per day, the infant, much less (Wikipedia, 2021). A multitude of organisms enter 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. These are also among the most common organisms to infect the infant's 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 (Donna et al., 2012). Viruses are common pathogens associated with respiratory symptoms in children (Chen et al.,2005). Morbidity associated with viral pneumonia is particularly high in children. (Roiha et al., 2008). Distinguishing viral from bacterial pneumonia helps initiate appropriate care (using antiviral vs. antibacterial agents) in a timely fashion. In this regard, imaging examinations such as chest X-rays can provide useful information to supplement laboratory findings.

A chest X-ray examination is a very common, non-invasive radiology test that produces an image of the chest and the internal organs. To produce a chest X-ray examination, the chest is briefly exposed to radiation from an X-ray machine and an image is produced on a film or into a digital computer. Chest X-ray is also referred to as a chest radiograph, chest roentgenogram, or CXR. Depending on its density, each organ within the chest cavity absorbs varying degrees of radiation, producing different shadows on the film. Chest X-ray images are black and white with only the brightness or darkness defining the various structures. For example, bones of the chest wall (ribs and vertebrae) may absorb more of the radiation and thus, appear whiter on the film. (Siamak and William 2019).

To understand infant chest radiography, a knowledge of how embryology, anatomy, physiology, pathology, immunology, and the physics of fluid mechanics influence its appearance is needed, this knowledge is critical in the interpretation of the infant chest radiograph (Frush et al., 2000). Given the embryological and anatomical descriptions of the infant's chest, it is believed that all generations of airways have developed by the time the foetus 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. Close to the lung’s hila, there may be as few as 10 generations of airways before the gas-exchange units-the respiratory bronchioles and alveolar sac are reached in the lung 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 (Frush et al.,2000). 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 get progressively thinner.

Chest radiography is indicated in an infant or toddler who presents with fever and any of the following conditions: Tachypnea, nasal flaring, retractions, grunting, decreased breath sounds, and respiratory distress; while in older children and adolescents, the diagnosis of pneumonia is often based on clinical presentation. The radiological findings of viral pneumonia are highly variable and could include poorly defined nodules, patchy areas of peribronchial ground-glass opacity and air space consolidation. CT findings, which were also overlapping, consisted of poorly defined centrilobular nodules, ground-glass attenuation with a lobular distribution, segmental consolidation, and diffuse ground-glass attenuation with thickened interlobular septa. The varying radiological findings reflect different underlying histopathological features: diffuse alveolar damage (intra-alveolar oedema, fibrin, and variable cellular infiltrates with a hyaline membrane), intra-alveolar haemorrhage, and interstitial (intrapulmonary or airway) inflammatory cell infiltration. Clinical features (e.g. patient age, immune status, time of year, illness in other family members, community outbreaks, symptom onset/severity/duration and the presence of a rash) remain important aids in diagnosing viral causes of both atypical pneumonia and pneumonia in immunocompromised patients (Roiha et al., 2008).

A lot of studies have been carried out around radiography diagnosis in children. For instance, Copley et al (2000) assessed the accuracy of thin-section CT and chest radiography to diagnose paediatric interstitial lung disease. Copley identified 20 infant boys and girls (age range, 1 month to 14 years) with histopathology confirmation of interstitial lung disease six boys and girls without interstitial assessed chest radiograph and CT images. The observers stated the most liked diagnosis and a differential diagnosis. He found that the observers' diagnosis on CT images was correct (first choice or differential in 66% of observations versus 45% on chest radiographs (p=0.025). correct diagnoses were made on first choice 61% of CT observations versus 34% on chest radiographs (=0.005). The interpretation was most accurate in the diagnosis of pulmonary alveolar proteinsis, co0ngential lymph angiectasia, and idiopathic pulmonary hemosiderosis all healthy. In his conclusion, he stated that a higher proportion of paediatric interstitial lung diseases can be diagnosed on thin-section CT than on chest radiographs.

Matthew et al (2016) studied chest radiographic findings and outcomes of pneumonia among children in Botswana. In this study, a hospital-based, prospective cohort study of children 1-23 months of age meeting clinical criteria for pneumonia in Botswana was conducted. Chest radiographs were reviewed by two paediatric radiologists to generate a consensus interpretation using standardized World Health Organization Criteria. They assessed whether final chest radiograph classification was associated with primary outcomes, treatment failure at 48 hours, and secondary outcomes. The findings showed that from April 2012 to November 2014, 249 children were enrolled with evaluable chest radiographs. Median age was 6.1 months and 58% were male. Chest radiograph classifications were primary end-point pneumonia (35%), other infiltrate/abnormality (42%), or no significant pathology (22%). The prevalence of end-point consolidation was higher in children with HIV Infection (P=0.0005), while end-point pleural effusions were more frequent among children with moderate or severe malnutrition (P=0.0003). Ninety-one (37%) children failed treatment and 12 (4.8%) children died. Primary end-point pneumonia was associated with an increased risk of treatment failure at 48 hours (P=0.002), a requirement for more days of respiratory support (P=0.002), and a longer length of stay (P=0.0003) compared with no significant pathology. Primary end-point pneumonia also predicted a higher risk of treatment failure than other infiltration/abnormality (P=0.004).

Ahmed et al (2006) conducted a study on the role of chest radiography in the management of chest pain and dyspnoea in the emergency department. This study aimed to investigate the essence of chest radiography in the management of chest pain and dyspnoea and to analyze the consistency of the treatment before and after the chest radiography. In conclusion, it was known that chest radiograph helps in the treatment of some selected patients with difficulty in breathing and chest pain.

In a study carried out by the World Health Organization(2005) to establish a standardized interpretation of paediatric chest radiographs for the diagnosis of pneumonia in epidemiological studies. They used a set of 222 chest radiologist's images which was measured by comparing the readings made by 20 radiologists and clinicians with reference readings. Intra-observer variability was measured by comparing the initial radiographs of a randomly chosen subset of 100 radiographs with repeat readings made 8-30 days later. It was observed that of the 222 images, 208 were considered interpretable. The reference reading categorized 43% of these images as showing alveolar consolidation or pleural effusion (primary end-point pneumonia). Hence, in their way of conclusion, it was stated that using standardized definitions and training, it is possible to achieve agreement in identifying radiological pneumonia, thus facilitating the comparison of results in epidemiological studies that use radiological studies as an outcome 21.

Sobia et al (2010) studied chest radiographs in the paediatric in-patient aimed at determining the usefulness of the chest radiography in reaching a clinical diagnosis in the paediatric inpatient population at a tertiary care in Karachi Pakistan. This was a retrospective chart review of paediatric inpatients (1 month- 14 years) at Aga Khan Hospital, Karachi between April and June 2009. Radiographs ordered to assist diagnosis of disease, or as 'routine', were selected samples (n=326). For each radiograph, the clinical diagnosis and the final clinical diagnosis were recorded and analyzed for frequencies and by cross-tabulation for concurrence clinical indications was the routine chest x-ray, at 39.3%. The most common diagnosis in radiology reports was 'no chest pathology' (39.9%). The second most common was 'pulmonary infection (62.3% and 49.1% respectively). He thereby concluded that significant proportion of the radiographs ordered for paediatric in-patients were normal and not associated with chest pathology on clinical diagnosis strong clinical suspicion of pulmonary infection, denoted by fever and cough, had the highest likelihood of giving the same radiological and clinical diagnosis.

In a retrospective cohort study performed by Yolanda et al (2006) to assess the influence of CXR on patient management in general practice. Seventy-eight GPs and three general hospitals were used. Patients (n=972) aged 18 years referred by their GPs for CXR were included. The main outcome was a change in patient management assessed utilizing a questionnaire filled in by GPs before and after CXR. It resulted that the mean age of the patients was 57.3± 16.2 years and 53% were male. Clinically relevant abnormalities were found in 24% of the CXRs. Patients' management changed in 60% of the patients following CXR. The main changes included fewer referrals to a medical specialist (from 26 to 46%). However, this reassurance e was not perceived as such in a quarter of these patients. A change in patient management occurred significantly more frequently in patients with complaints of cough (67%), those who exhibited abnormalities during physical examination (69&) or those with a suspected diagnosis of pneumonia (68%). He therefore concluded that inpatient management by the GP changed in 60% of patients following CXR. CXR substantially reduced the number of referrals and initiation or change in therapy, chest radiography is an important diagnostic tool for GPs and seems a cost-effective diagnostic test.

In a prospective study of paediatric chest pain done by Steven M. Salbot, children who were admitted to the emergency department with chest pain were evaluated prospectively. Patients who had ill-defined chest pain had ECGs and echocardiograms done on them. A total of 407 children were evaluated the most common cause of the pain was idiopathic (21% 1 and musculoskeletal 15%) cardiac problems were found in 4% chest pain was acute (of 48hours' duration) in 43% and chronic (6 months duration) in 7% pain caused 30% of children to stay out of school and 31% to awaken from sleep. Chest wall tenderness was the most common abnormality. ECGs were obtained in 47%; results of 31/197 ECGs abnormality were related to the diagnosis Echocardiograms were obtained in 34%, and results of 17/139 were abnormal (12/15, showed mitral valve prolapsed. Young children older than 12 years of age are more likely to have psychogenic pain. The description and site of the pain and the patient's sex are not related to the diagnosis. Laboratory tests are rarely helpful in evaluating children with chest pain. Chest pain in children is usually benign. Psychogenic pain and idiopathic pain are less common than previously believed.

In conclusion, Chest radiography often is a necessary preliminary study and is the most used requested study for paediatric chest pathological cases. Its availability, low cost, a reasonable amount of information it can give, 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.

Methods

This was a cross-sectional non-experimental, retrospective research and was carried out at Nnamdi Azikiwe University Teaching Hospital, Nnewi. The work targeted all paediatric patients who underwent chest x-ray investigation in the radiology department of Nnamdi Azikiwe University in the year 2017. A purposive sampling method was adopted in sampling participants for the study. The research was done using records that met the inclusion criteria dating the year 2017. A total of 100 patient records that met the criteria for inclusion were used after scrutinizing records of patients. Inclusion Criteria require that radiographs must be chest X-rays of patients less than 14 years old, radiographs must be carried out in Nnamdi Azikiwe University Teaching Hospital, and they must be chest X-ray cases undertaken in year 2017 while radiographs of chest x-ray of patients above 14 years, radiographs carried out in any institution of learning not Nnamdi Azikiwe University Teaching hospital and chest x-ray cases not undertaken in year 2017 were excluded from use for the study. The data were collected from the request cards and radiologist reports in the filing unit of the radiology department, Nnamdi Azikiwe University Teaching Hospital, Nnewi. The information that was obtained from the request card includes Patient number, Date of exam, Patient's age, Patient's sex, and Clinical history. The data collected were analyzed using Tables, charts, frequency, and percentages.

Ethical Consideration

Ethical approval for the study was obtained from the Faculty of Health Sciences and Technology, Nnamdi Azikiwe University, Nnewi Campus.

Results

Table 1: Percentage Distribution of the Age Range of the Studied Subjects

Age Range	Frequency	Percentage (%)
0-3	29	29%
4-6	13	13%
7-9	26	26%
10-13	32	32%
	100%	100%

Table 1 revealed that the age range of the patients from the data collected was from 0-13 years. Table 4.1 shows the age distribution of the patients, where it can be seen that the individual within the age range of 0-3 years comprised of 29%(n=29), then the age range of 4-6 comprised of 13%(n=13), while those within 7-9 comprised of 26%(n=26) and then finally 10-13 years comprised of 32%(n=32) which was the highest participants.

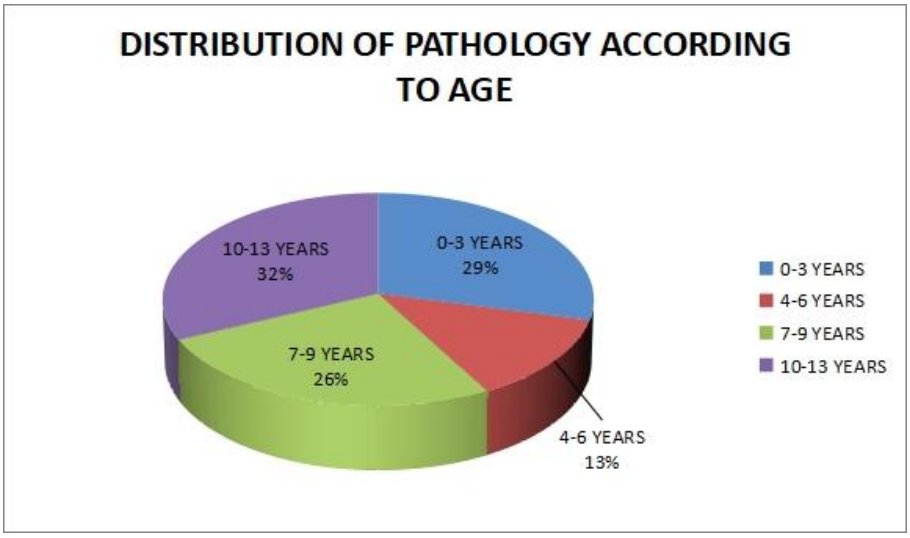


Table 2: Distribution of the Studied Subjects according to Gender

Gender	Frequency
Male	68
Female	32
Total	**100**

Table 2 showed that the male patients comprised of 68% (n=68) of the data collected while the female patients comprised of 32% (n=32).

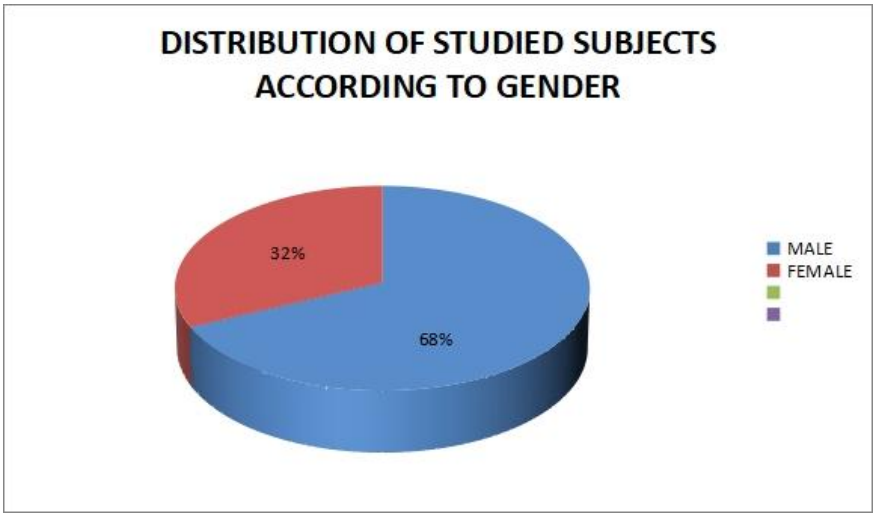


Table 3: Percentage Distribution of the Subjects according to their Pathological findings

Findings	Frequency	Percentage (%)
Normal	52	52%
Broncho-pneumonia	19	19%
PTB	5	5%
Foreign Body	8	8%
ILD	8	8%
Pneumonic Consolidation	3	3%
CCF	4	4%
Pleural Effusion	1	1%
TOTAL	**100**	**100%**

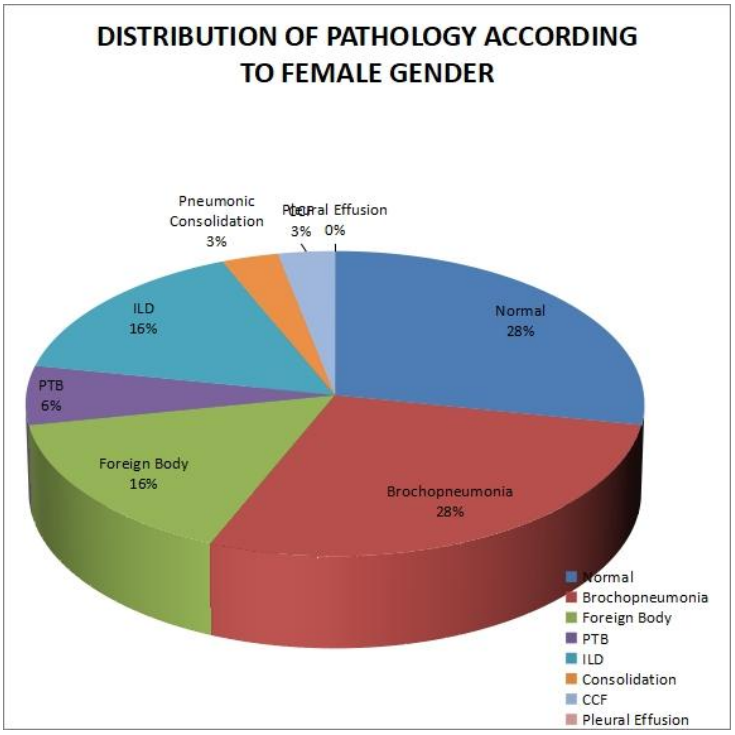
KEY: PTB means Pulmonary Tuberculosis, ILD means Interstitial Lung disease, CCF means Congestive cardiac failure and P.E. means Pleural effusion

Table 4: Distribution of the Radiological Finding according to Gender of the Studied Subjects

Findings	Male	Female	Total
Normal	43(63%)	9(28%)	52
Broncho-pneumonia	10(15%)	9(28%)	19
PTB	3(5%)	2(6%)	5
Foreign Body	3(4%)	5(16%)	8
ILD	3(4%)	5(16%)	8
Pneumonic Consolidation	2(3%)	1(3%)	3
CCF	3(4%)	1(3%)	4
Pleural Effusion	1(2%)	0(0%)	1
TOTAL	68	32	100

Table 4 above shows the distribution of pathological findings according to the gender of the studied subjects. From the Table, it can be revealed that normal study has the highest occurrence among paediatric patients comprising 63%(n=52), while bronchopneumonia is the second

highest most occurring which is the highest most occurring positive pathological finding comprising 15%(n=19). Interstitial lung disease and foreign body are the third most occurring pathological finding which comprises 4%(n=8). Congestive cardiac failure was the fourth manifestation seen comprising 4%(n=4). Those with pneumonic consolidation comprise of 3%(n=3). Patients with pleural effusion showed the least manifestation which comprises 2%(n=1).



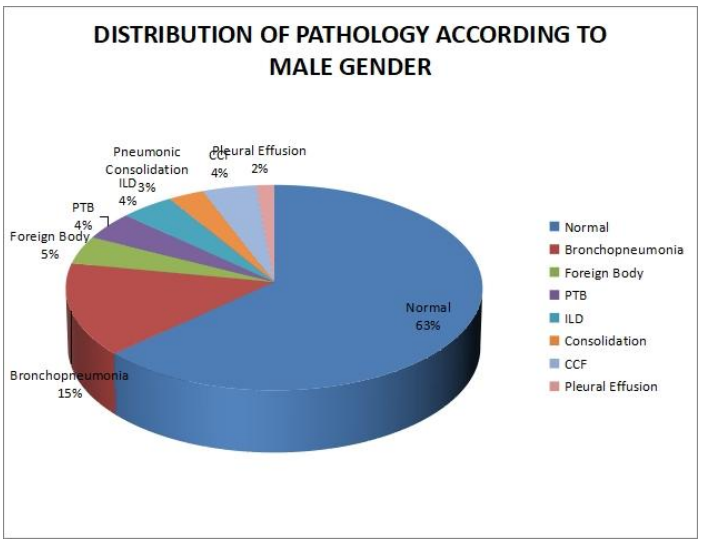


Table 5: Percentage Distribution of Findings According to Age Range of the Studied Subjects

Age	Normal	Broncho-pneumonia	Foreign Body	PTB	ILD	Pneumonic Consolidation	CCF	P.E	Total %
0-3	8%	5%	5%	3%	2%	3%	2%	1%	29%
4-6	11%	0%	1%	0%	1%	0%	0%	0%	13%
7-9	13%	8%	2%	1%	1%	0%	1%	0%	26%
10-13	20%	6%	0%	1%	4%	0%	1%	0%	32%
Total	**52%**	**19%**	**8%**	**5%**	**8%**	**3%**	**4%**	**1%**	**100%**

It can be seen from Table 5 that most disease manifestations that are seen in children were mostly seen within the age range of 0-3 years. Bronchopneumonia which is the second highest occurring disease manifestation was seen to be more occurring within the age range of 7-9 years, foreign body, pulmonary tuberculosis, pneumonic consolidation, congestive cardiac failure, and pleural effusion manifestation were seen in the age range of 0-3 years, then interstitial lung disease manifestation was mostly seen at the age range of 10-13 years.

Discussion of Findings

Chest X-ray is the first imaging modality used to examine paediatric patients presenting with symptoms like cough, wheezing, difficulty in breathing, chest pain, suspected foreign body etc. This study aims to assess the common pathological findings in paediatric chest radiographs.

This study shows that out of 100 patients that were studied 63%(n=52) normal findings and the remaining 37%(n=48) radiographs presented positive pathological findings; in which the distribution of pathological findings among males and females are 24 and 24 respectively and the normal distribution are 43 and 9 respectively. The patients that presented with Bronchopneumonia as their diagnosis were greater than other indications which were in correlation to Nabil et al (2009) findings where their most abnormal chest x-ray diagnoses were pneumonia and congestive cardiac failure. This finding is also similar to that of Davis II et al

(2001) findings where the most prevalent pathological finding is bronchopneumonia. According to the result of the finding, the age group range of 10-13 years has the maximum incident of abnormal findings followed by the age group of 0-3 years before any other age group. This research shows that apart from normal radiographic findings of the paediatric chest that the age range of 0-3 years are more susceptible to most diseases, this may be related to this age's physiological immune status (congenital or non-congenital) or social behaviour. The common pathological findings of this study include bronchopneumonia 15%(n=19), foreign body 4%(n=8), pulmonary tuberculosis 4%(n=5), interstitial lung disease 4%(n=8), pneumonic consolidation 3%(n=3), congestive cardiac failure 4%(n=4), pleural effusion 2%(n=1), then the normal findings of this study include normal study 63%(n=52). However, the gender distribution of this study shows that the male gender had the maximum incident of occurrence representing 68% which is greater than that of the female gender which is 32%. Paediatric chest disorders are common presentations in both in-patient and out-patient departments; it is also the first line of diagnosis to be performed in emergencies for patients presenting with chest pain and other related symptoms. The chest x-ray is indicated for diagnosing paediatric chest pathologies.

Summary of the Findings

At Nnamdi Azikiwe University Teaching Hospital (NAUTH), out of 100 paediatric patients recorded who had plain chest x-ray examinations, 63%(n=52) patients presented with normal radiographic findings while 37%(n=48) presented with pathological findings.

The common pathological findings are bronchopneumonia 15%(n=19), foreign body 4%(n=8), pulmonary tuberculosis 4%(n=5), interstitial lung disease 4%(n=8), pneumonic consolidation 3%(n=3), congestive cardiac failure 4%(n=4), pleural effusion 2%(n=1), then the normal findings of this study include normal study 63%(n=52).

According to the result, bronchopneumonia has the highest frequency of occurrence at 15%, where male patients were more affected than females.

The age group range of range of 0-3 years is more susceptible to most diseases apart from normal findings, this may be related to this age's physiological immune status (congenital or non-congenital) or social behaviour.

Conclusion

This study showed that bronchopneumonia is the most common pathological finding. The incidence of pathological chest findings is greater in paediatrics between the ages of 0-3 years. Pleural effusion is the least occurring pathology, and pathological chest findings are the least in paediatrics between the ages of 4-6 years.

Recommendations

Based on the findings of the study, the following recommendations were made:

1. Chest X-ray should be used primarily in the diagnosis of paediatric chest pathologies since it remains the first imaging modality in the management and diagnosis of paediatric patients presented with difficulty in breathing, chest pain, wheezing sounds, cardiac

murmur and cough problems due to its availability, cost-efficient, lower radiation exposure compared to other imaging modality emitting radiation.
2. Chest X-rays should also be seconded with 2-D echocardiography or ultrasound for most cases of congenital cardiopathies.
3. There should be improvement towards radiographic skills and procedures, thereby helping in obtaining optimum radiographs for better patient management.

Limitations of the Study

The study covered only records of 2017 chest x-ray for patients at Nnamdi Azikiwe University Teaching Hospital, Nnewi who were below 14 years and only a limited number of 100 patients met the criteria for inclusion in the study. Consequently, caution should be taken in generalizing the findings of this study. Based on these limitations, the researcher recommends that further study should be done to cover some year intervals and the role of chest X-rays in the management of patients with bronchopneumonia. Common pathological findings in adult chest radiographs with correlation of signs and symptoms in paediatric and adult chest radiographs could also be studied.

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