East African Medical Journal Vol. 95 No. 6 June 2018
THE PREVALENCE OF ABNORMAL CHEST RADIOGRAPH FINDINGS AMONG HIV INFECTED CHILDREN
John C. Rodrigues, MBChB, MMed (Diag. Radiol), Department of Radiology, Kenyatta National Hospital, P.O. Box 20723-00202. Gladys N. Mwango, MBChB. MMed (Radiol), Department of Diagnostic Imaging and Radiation Medicine, University of Nairobi, P.O. Box 19676-00202, Nairobi, Kenya and Callen K. Onyambu, MBChB. MMed (Radiol), Department of Diagnostic Imaging and Radiation Medicine, University of Nairobi, P.O. Box 19676-00202, Nairobi, Kenya

Corresponding author: Dr. G. Mwango, Department of Diagnostic Imaging and Radiation Medicine, College of Health Sciences, University of Nairobi, P.O. Box 19676-00202, Nairobi, Kenya.

# THE PREVALENCE OF ABNORMAL CHEST RADIOGRAPH FINDINGS AMONG HIV INFECTED CHILDREN

J. C. Rodrigues, G. N. Mwango, and C. K. Onyambu

## ABSTRACT

***Background*: Human Immunodeficiency virus infected children are highly susceptible to opportunistic infections of the respiratory system which are the most common cause of morbidity and mortality.**

**The chest radiograph is the most frequently requested examination for the evaluation of respiratory disease. Its applications include screening, diagnosis and monitoring response to medication of respiratory illnesses.**

***Objective*: To determine the prevalence of abnormal chest radiograph findings among HIV infected children.**

***Design*: Prospective cross-sectional descriptive study**

***Setting*: Kenyatta National Hospital and Mbagathi Level 5 Nairobi County hospital**

***Subjects*: The chest radiographs and clinical history of 123 HIV infected children below 15 years were studied between November 2014 and February 2015.**

***Results*: The age range of the children was 1-15 years with a median age of 24 months. The male: female ratio was 1:1.02. Normal chest radiographs were found in 54/123 (44%) while 69/123 (56%) had abnormal chest radiographic findings. Pulmonary opacities were identified in the majority of patients with abnormal chest radiographs (67%) while almost 51% showed lymphadenopathy. In the pulmonary opacities, "other infiltrate'' (61%) was found to be more common than consolidation (39%). Pleural effusions were not common while cavitary lesions and pneumothorax were not identified. There was no significant association between the radiographic findings and the children's age and sex. The findings of this study correlated well with similar studies in Africa.**

***Conclusion*: HIV infected children especially those below the age of 5 years, are highly susceptible to chest infections. This was seen in the high prevalence of**

**cough and severe respiratory distress as well as the significant number of abnormal chest radiograph findings. The high prevalence of 'other infiltrate' in this study may indicate that the causative pathogen may not respond to standard antibiotic regimes; and further clinical studies to confirm this are required.**

## INTRODUCTION

In 1999, the Government of Kenya declared HIV and AIDS to be a national disaster. Since then, reports on the number of children infected with HIV in the developing countries have risen dramatically (1). In 2006, there were 2.3 million children under the age of 15 years worldwide who were HIV infected (2). By 2011, 91% of the 3.4 million children living with HIV were in sub-Saharan Africa (3).

Approximately 260,000 children died of HIV related causes in 2009. A large proportion of these children died before the age of 5 with half of them dying before the age of 2 years. The mean age of mortality was 6 months (1). The United Nations Agency for International Development (UNAID) Global report 2012 documented that whereas access to HIV and AIDS treatment was on the rise, the proportion of eligible children receiving Anti-Retroviral therapy (ART) was much lower. This meant that more children continued to die as a result of HIV and AIDS (4).

HIV infected children have an increased susceptibility to developing infections. Severe infections of the respiratory tract have been found to be a major cause of morbidity and mortality in this age group (5, 6).

Chest radiography is often used as one of the main diagnostic investigations for patients with chest infections. It is available in most resource poor settings including the public sector. Although the radiological findings in children with HIV with chest infections can be non-specific, correlation with clinical findings can narrow down the possible diagnosis and aid in initiating treatment early (7, 8). Patients with HIV infection may have atypical chest radiographic findings in comparison to non-HIV infected patients with chest infections. These features include an increased frequency of lymphadenopathy, pulmonary tuberculosis and Pneumocystis jiroveci pneumonia (PJP) (9, 10).

This study assessed the prevalence of abnormal chest radiograph findings in HIV infected children with the view of aiding radiologists and paediatricians with an approach that can be used to narrow down the diagnoses thereby assisting in the investigation and management of these patients.

## MATERIALS AND METHODS

The study was conducted following ethical approval from the Research and Ethics Committee of Kenyatta National Hospital and the University of Nairobi (KNH-UoN ERC).

HIV infected infants and HIV positive children (on HIV antibody and/or virology testing) aged 1 month to 12 years in the general paediatric wards and Comprehensive Care Centre (CCC) of Kenyatta National Hospital and Mbagathi County Hospital, who had available or imaging requests for chest radiographs, were recruited into the study using purposive and consecutive sampling, the inclusion criteria and a written informed consent from the primary care giver.

A structured data collection tool was used to obtain the socio-demographic details of the child; the clinical respiratory complaints, the

most recent CD4 count (where available) and the chest radiograph findings. An erect Anteroposterior or postero-anterior (PA) chest radiograph at a distance of 150cm was obtained for the older children using age appropriate exposure factors. Where the child was too young or unable to stay erect a supine antero-posterior chest radiograph was performed. The chest radiographs were defined as adequate if the following criteria were met; minimal rotation, full inspiration with adequate penetration, correct labelling which includes patients name, identification number, date of examination and side markers. The radiographs were read and interpreted by two independent radiologists with minimum of 5 years' experience each and interpreted as normal chest radiograph or abnormal chest radiograph. Abnormal lung findings were further documented where present as mediastinal/hilar lymphadenopathy, parenchymal pathology (consolidation and/or other infiltrate) and pleural pathology in the data collection tool.

A written comprehensive radiological report was provided to the caregiver to return to their primary physician for further management of the patient.

## RESULTS

A total of 123 children who met the inclusion criteria were included in the study. Their age ranged between 1 month and 15 years. The median age was 24 months. There were 61 males (49.6%) and 62 females (50.4%) enrolled in the study (Fig 1).

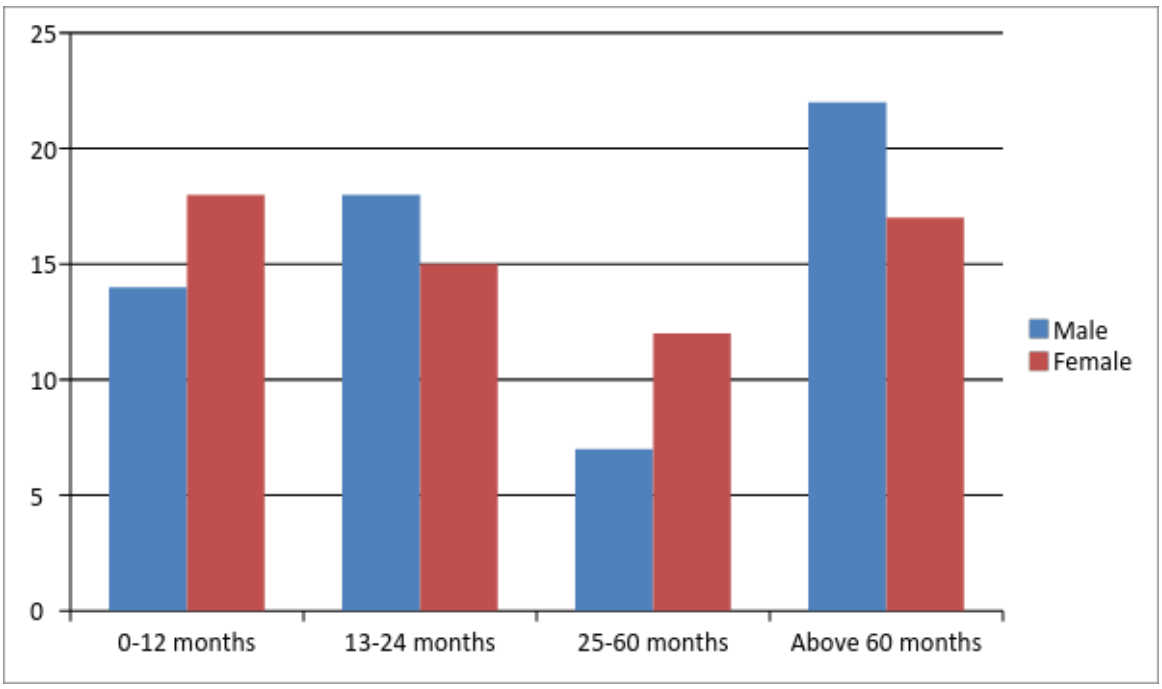


**Figure 1: Age and sex distribution**

***Chest Radiograph Findings:*** There were 54 children (44%) with normal chest radiographs and 69 children (56%) with abnormal chest radiographic findings. Pulmonary opacities

were identified in most patients (67%) and of these; "other infiltrate" (61%) (image 1) was found to be more common than consolidation (39%) (image 2). Thirty-five patients (51%) had lymphadenopathy. Pleural effusions were not common (image 3) while cavitary lesions and pneumothorax were not identified (Table 1).

**Table 1**

*Radiographic findings among the participating children (n=69)*

| **Abnormal chest radiograph findings** | **n (%)** |
|---|---|
| Lymphadenopathy | 35(50.7%) |
| Pulmonary opacities | 46 (66.7%) |
| Consolidation (n=46) | 20(43.5%) |
| Other infiltrate (n=46) | 28(60.9%) |
| Pleural effusion | 6(0.5%) |
| Cavity lesion | 0 |
| Pneumothorax | 0 |

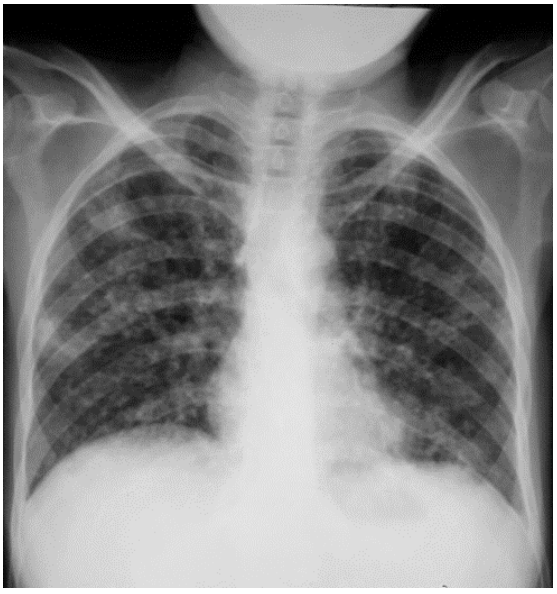

**Image 1: Bilateral "other pulmonary infiltrate" in a patient suspected to have LIP**

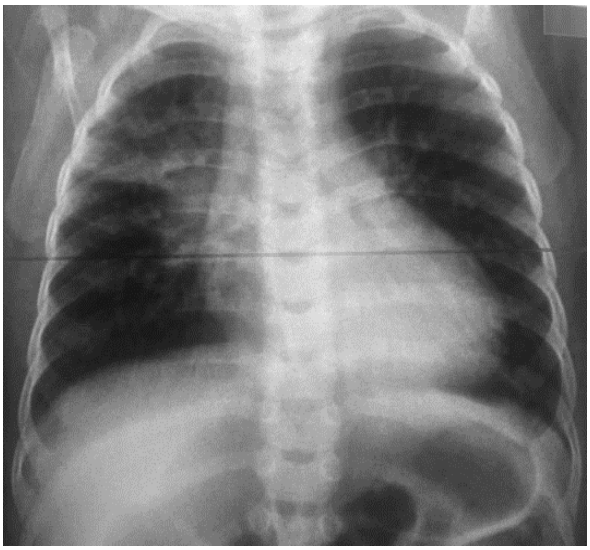

**Image 2: Lymphadenopathy with right upper and left lower-zone consolidations**

**Image 3: Left pleural effusion**

***Comparison of Radiographic Features with age:*** The predominant feature in children below 12 months was pulmonary opacity (28%) with a higher incidence of "other opacity" than consolidation. Lymphadenopathy was identified in 23% of these children. Lymphadenopathy (31%) was

the most prevalent abnormal chest radiograph finding in children between 13-24 months. There was also a higher incidence of consolidation (35%) in this age group compared to "other infiltrate".

Between the ages of 25-60 months the predominant chest radiograph finding was consolidation (15%) and lymphadenopathy (14%) while in children above the age of 60 months the main findings were "other infiltrate" in 39% and lymphadenopathy in 31%.

Lymphadenopathy was most prevalent in children below 24 months (57%). The children between 13-24 months had the highest incidence of consolidation (35%) while "other infiltrate'' was most prevalent in children above 60 months (39%). None of the children were diagnosed with cavity lesions and pneumothorax.

There was no significant association between the radiographic findings and the children's age.

## DISCUSSION

Findings from this study show that most patients (56%) were below the age of 5 years which is like studies carried out in Nigeria (11) and in South Africa (12) where most children were below 5 years of age in 64% and 55% respectively. The large proportion of under 5's in the study populations can be attributed to the increased susceptibility to chest infections in this age. There was no statistical difference in sex distribution in this study which is like the other studies in Africa (11, 12).

A significant number of chest radiographs were found to be abnormal (57%). These findings are similar to the study carried out by Onyambu et al (14) in 2002 in KNH on HIV infected children and adults where 58% had abnormal chest radiographs. This was attributed to the fact that the chest was the most common site of infection in HIV infected patients. The study by du Plessis et al (12) in South Africa reviewed 92 HIV infected children and found 46% to have an abnormal chest radiograph which was only slightly lower prevalence than in our study. Other studies showed a higher prevalence of abnormal chest radiograph findings such as 76% in south Nigeria (11) and 99% in Durban, South Africa (13) among HIV-infected children.

Age-related chest radiographic findings in paediatric HIV were shown to exist by Atalabi et al in Nigeria (11). Their study findings compared favorably with our study where the highest occurrence of abnormal chest radiograph findings occurred in children aged 1-5 years of age (78% in our study compared to 82% in Nigeria. The higher incidence of abnormal findings in children below the age of five years in comparison to those above five years of age was postulated to be related to their immature immune system and underlines the need for early diagnosis and initiation of treatment.

Lymphadenopathy was the second most common finding after pulmonary opacities in our study which again compared favorably with the study from Nigeria. We found 51% of HIV infected children had lymphadenopathy compared to 45% of patients in the study from Nigeria. (11)

Lung parenchymal lesions were the most common finding in the South African study (12) involving 34% of patients. In our study we found a higher prevalence of lung parenchymal disease, in 70% of children with HIV. The higher incidence is like the 2002 KNH study (14) which found that 75% of patients (adults and children) to have pulmonary opacities.

When evaluating the lung parenchymal opacities, the predominant finding in our study was ''other pulmonary infiltrate'' in 22% of patients and consolidation in 16%. These findings are similar to the Nigerian study (11). It is possible that the higher incidence of "other infiltrate'' in our study could represent viral infections, atypical pneumonia, tuberculosis, LIP or PCP and a follow-up study to determine response to treatment or the involved pathogen where possible would be contributory.

In 21% of the patients there was a presumptive diagnosis of pulmonary tuberculosis dependent on the chest radiograph findings and the duration of symptoms. Parenchymal disease was reported to be seen in 70% of children with tuberculosis (15). Although it is difficult to conclusively diagnose TB on chest radiograph findings alone due to their non-specific features, the radiological findings are often similar to those on non-HIV infected children. The Atalabi et al's study in Nigeria was able to confirm AFB positive TB in 20% of the children. Pleural pathology was not a common feature in paediatric chest in HIV. We found less than 1% pleural pathology in our study which is comparable with the less than 1% of patients in the Nigerian study (11) and the 1% in the South African study (12). Features such as cavitation, miliary opacities were not identified in our study which compares to the uncommon finding in the South African and Nigerian studies.

## CONCLUSION

**C**hildren, especially those below the age of 5 years, are highly susceptible to HIV associated chest infections as seen in the high prevalence of cough and severe respiratory distress as well as the significant number of abnormal chest radiograph findings. The predominance of pulmonary infiltrates over consolidation could be attributed to the presence of atypical pneumonia, viral infections, PJP as well as pulmonary TB. The chest radiograph has been shown to be a useful study in the detection of pulmonary disease in symptomatic children with HIV and the radiologist can assist in narrowing the differential diagnosis. However further laboratory investigation is required to confirm the diagnosis as some of the chest radiograph findings are non-specific.

The main study limitation was the lack of correlation of the chest radiograph findings with laboratory findings and level of immune suppression (CD4 counts) to confirm the cause of chest radiograph abnormalities. Baseline chest radiographs are not part of the guidelines for management of HIV patients in Kenya limiting the study to symptomatic patients.

## REFRENCES

1. National AIDS and STI Control Programme (NASCOP). *Guidelines for Antiretroviral Therapy in Kenya.* 4th Edition. 2011
2. Joint United Nations Programme on HIV/AIDS (UNAIDS) *AIDS epidemic update - special report on HIV/AIDS.* December 2006, Geneva, Switzerland: UNAIDS (2006).
3. World Health Organization. *Treatment of children living with HIV.* 2013. Available from http://www.who.int/hiv/topics/paediatric/en/
4. Joint United Nations Programme on HIV/AIDS (UNAIDS). *World AIDS Day Report.* 2012.
5. Marais BJ, Rabie H, Schaaf SH, Cotton MF. *Common opportunistic infections in HIV infected infants and children, Part 1 - respiratory infections.* South African Family Practice Journal. 2006. 48(10); 52-57. Available from http://hdl.handle.net/10019.1/9283

6. Wallace JM, Hansen NI, Lavange L, Glassroth J, Browdy BL, Rosen MJ, et al. *Respiratory disease trends in the Pulmonary Complications of HIV Infection Study cohort. Pulmonary Complications of HIV Infection Study Group*. PubMed. [Online] 1997. 155(1):72-80 Available from http://www.ncbi.nlm.nih.gov/pubmed/9001292
7. Franquet T. *Respiratory infection in the AIDS and immunocompromised patient*. European Radiology Supplements. [Online] 2004.14; 21-33 Available from http://link.springer.com/article/10.1007%2Fs00330-003-2044-z
8. Oh YW, Effmann EL, Godwin JD. *Pulmonary infections in immunocompromised hosts: the importance of correlating the conventional radiologic appearance with the clinical setting.* PubMed. [Online] 2000. 217(3):647-56. Available from http://www.ncbi.nlm.nih.gov/pubmed/11110924
9. Mahomed, Nasreen.*Chest X-ray findings in HIV infected children starting HAART at a tertiary institution in South Africa.* Wits Institutional Repository. [Online] 2014. Available from http://hdl.handle.net10539/14562
10. Badie BM, Mostaan M, Izadi M, Alijani MAN, Rasoolinejad M. *Comparing Radiological Features of Pulmonary Tuberculosis with and without HIV Infection*. Jornal of AIDS and clinical research (2012) Res 3:188. doi: 10.4172/2155-6113.1000188
11. Atalabi OM, Oladokun R, Adedokun B, Obajimi MO, Osinusi K. *Baseline chest radiographic features among antiretroviral therapy naïve human immuno-deficiency virus positive children in a pediatric care program. West African Journal of Radiology*. [Online] 2012. 1:5-10. Available from http://www.wajradiology.org/article.asp?issn=1115
12. Vicci du Plessis, Savvas A, Gabriel S, Neil M, Aisne S. *Baseline chest radiographic features of HIV-infected children eligible for antiretroviral therapy*. The South African Medical Journal. [Online] 2011. 101:829-834 Available from http://www.samj.org.za/index.php/samj/article/view/4766/3677
13. Jeena PM, Minkara AK, Corr P, Bassa F, McNally LM, Coovadia HM. *Impact of HIV-1 status on the radiological presentation and clinical outcome of children with WHO defined community-aquired severe pneumonia*. Archives of Disease in Childhood. [Online]. 2007; 92(11): 976–979. Available from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2083594
14. Onyambu C. *Pattern of Chest Radiographic Findings in Immunocompromised Patients at the Kenyatta National Hospital*. M.Med Dissertation, 2002, University of Nairobi.
15. Leung AN. *Pulmonary tuberculosis: The essentials*. Radiology [Online]. 1999; 201(2): 307-322. Available from http://pubs.rsna.org/doi/full/10.1148/radiology.210.2.r99ja34307