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Childhood pneumonia at the University of Ilorin Teaching Hospital, Ilorin Nigeria

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Abstract *Background/Objectives:* Pneumonia is a leading cause of morbidity and mortality in children and thus this study was designed to document the sociodemographic, clinical features as well as the bacterial agents responsible for pneumonia in children seen at University of Ilorin Teaching Hospital.

Methodology: A descriptive cross-sectional study of children aged one month to 14 years with features of pneumonia admitted between July 1st 2010 and June 31st, 2011 was carried out. Sociodemograpic data, clinical features, complications and outcome were obtained. Chest radiographs and blood samples for culture of bacterial organism and full blood counts were obtained in all children.

Results: Pneumonia accounted for 13.3% (167 out of 1254) of the all admissions during this period. The male: female ratio was 1.5:1, and 101(60.5%) of the children were infants. Bronchopneumonia was identified in 147(88%) children, lobar pneumonia in 15 (9%) while 5(3%) had a combination of both. Cough, fever, difficulty in breathing, tachypnoea and chest wall recessions were recognised as clinical features in the study population. Bacteraemia was present in 46(27%)children and *Staphylococcus aureus* was the most common organism cultured from the blood of children with pneumonia present in 11 (23.9%) out of the 46 (100.0%) isolates. Heart failure was associated complication present in 52 of the 60 children with one or more complications accounting for over 30% of all patients. Eleven out of the 15 children with lobar pneumonia had pneumonia-related complications which was significantly higher compared to 46 of 157 children with bronchopneumonia, p=0.003. The case fatality was 6.6%. Eight (72.7%) of the children that died were infants while the remaining three (27.3%) were aged between 12 and 60 months. The mean duration of hospitalization among those who survived of 6.5 ±5.0 days was significantly lower than the corresponding value of 10.2 ±12.3 days in those that died, p= 0.042.

Conclusion: Pneumonia-related mortality and morbidity is high in under-five children, with the infant age group most affected. Bronchopneumonia is the most prevalent ALRI diagnosis but lobar pneumonia is associated with a higher mortality.

Introduction

Pneumonia continues to be a major contributor to childhood mortality and morbidity in developing countries including Nigeria.[1,2] Pneumonia is responsible for a quarter of all deaths in under-five children. Many of the deaths occur in those less than 24 months especially in infants.[1] A number of aetiologic agents, viruses and bacteria, have been associated with pneumonia, however it is the bacterial agents that are usually associated with severe pneumonia and result in complications or deaths. *Streptococcus pneumonia* and *Haemophilus Influenzae* remain the most important pathogens documented in previous studies.[3-6]*Staphylococcus* has also been found especially in patients with malnutrition.[8,9] A few studies in Africa have documented the presence of nontyphoidal *salmonella* in patients with radiologically confirmed severe pneumonia.[10,11] A number of conditions such as malnutrition, sickle cell anaemia and Human Immune deficiency virus infection can affect the severity and outcome of pneumonia cases.[8,9,11-13] Pneumonia is the second cause of admission and deaths among children seen at the University of Ilorin Teaching hospital (UITH). [14]

The challenge of inadequate and supportive laboratory services in developing countries cannot be overemphasized, hence it is important to follow disease burden in the community and in hospital settings using clinical features and parameters less reliant on the laboratory. This study was designed to document the sociodemographic data, clinical features as well as the bacterial agents responsible for pneumonia in children seen at University of Ilorin Teaching Hospital between 1st July 2010 and 30th June 2011. The outcome in all cases was also documented.

Materials and Method

Study Design

This was a prospective, cross-sectional, mainly descriptive study of children aged one month to fourteen years who were admitted to the Emergency Paediatric Unit (EPU) of the UITH which serves the state population of 2.4 million[11] and adjoining states of Ekiti, Osun, Oyo and Niger.

Sample size

The formula used for estimating the minimum sample size is the Fisher's formula [15] and with reference to the prevalence of 11.1% from a previous study,[16] a minimum total of 151 subjects were recruited for the study and at the end of study period 167 patients were enrolled.

Ethical clearance

Ethical clearance was duly obtained from the Ethics and Research Committee of the UITH. In addition, informed consent was obtained from the individual parent/ guardian or subject as appropriate, after a clear explanation of the objectives and logistics of the study to them.

Subject recruitment

All consecutive children who presented at the EPU of UITH initially with symptom complex of pneumonia, with or without features of measles or pertussis and intrathoracic complications like pleural effusion, in a child presenting with cough, fever, difficulty with breathing of less than 28 days duration with (a) age-specific increase in respiratory rate(tachypnoea) (b) lower chest wall indrawing (c) inability to feed or drink, with or without central cyanosis.[17] All subjects had chest radiographs and the presence of one or more of the chest radiographic features of patchy, segmental or lobar consolidation, +/- a positive air bronchogram and +/- pleural effusion was used to confirm the diagnosis. The radiographic findings were corroborated by at least one radiologist. All subject recruitment was done at presentation. Children that had previously been recruited for the study who re-present to the unit with symptom recrudescence are excluded from the study.

All subjects had blood specimen obtained for blood culture and total blood counts. Other relevant tests such as haemoglobin electrophoresis, HIV screening and pleural fluid analysis were done only when indicated. The subjects were treated with the most appropriate medication according to the current institutional guidelines.

Data was collected with the aid of a pre-coded study proforma and analysis was carried out with a microcomputer using the Epi info version 6.0 software packages. The *chi-square* and *student t*-tests were used to identify significant differences for categorical and continuous variables respectively. A *p*-value of <0.05 was considered significant.

Results

Background characteristic of study population

During the study period, a total of 1254 patients were admitted to the EPU and 167 (13.3%) were diagnosed with pneumonia. Of these recruited 167 subjects, 101 (60.5%) were infants and 80.3% were below 24 months. The mean age of the subjects was 14.8±16.1 months, with a range of 1-110 months. The Male: Female ratio was 1.5:1. The distribution of the social class of the children with pneumonia using classification modified by Ogunlesi et al [18] is as shown in Table 1 with 40 (24.0%) in social classes I and II and 127(76.0%) in the lower three social classes.

Table 1: Sociodemographic data of study population

Variable	Frequency	Percentage	Cumulative percent
Age (months)			
1-<12	101	60.5	60.5
12- <24	33	19.8	80.3
24- <36	17	10.2	90.5
36-<48	7	4.1	94.6
48<60	3	1.8	96.4
>60	6	3.6	100.0
Gender			
Male	100	59.9	59.9
Female	67	40.1	100.0
Social Class			
SCI	16	9.6	9.6
SCII	24	14.4	24.0
SCIII	60	35.9	59.9
SCIV	44	26.3	86.2
SCV	23	13.8	100.0

Clinical features of the patients with pneumonia

Symptoms at presentation

Fever was present in 129 (77.2%) of the children, while cough was present in 115 (68.9%) of the children as the single most common respiratory symptom. Table 2 below shows other constitutional and respiratory symptoms that were present in patients recruited during the study. The duration of symptoms at presentation ranged from one day to 10 days. The duration of symptoms in

101(60.6%) children was of three or less days before presentation, 46 (27.6%) children had symptoms for 4-7 days, while 20 (12.0%) had symptoms for 8 days or more.

Table 2: Symptoms at presentation

Variable	Frequency	%	Cumulative %
Constitutional symptoms			
Fever	129	77.2	77.2
Diarrhoea	24	14.4	91.6
Vomiting	6	3.6	95.2
Rashes	4	2.4	97.6
Others (convulsion, altered consciousness)	4	2.4	100.0
Respiratory symptom			
Cough	115	68.9	68.9
Difficult breathing	42	25.1	94.0
Noisy breathing	6	3.6	97.6
Fast breathing	4	2.4	100.0

Physical Signs at presentation

Eight (4.8%) children had an axillary temperature recording of less than 36.5^{o}C, 33 (19.8%) recorded temperatures between 36.5 to 37.4 ^{o}C, 70 (41.9%) between 37.5 and 38.5 ^{o}C, while 56 (33.5%) children recorded temperature readings of more than 38.5 ^{o}C. Six (3.6%) children were lethargic while two (1.2%) were irritable, five (3%) were unconscious. Three (1.8%) children had a maculopapular rash. Ninety-six (57.5%) of the children were well hydrated, sixty-four (38.3) were dehydrated, and seven were unspecified. The respiratory signs present include tachypnoea in 143 (85.6%), crepitations in 154 (92.2%), thoracic recessions in 133 (79.6%), nasal flaring in 134 (80.2%), and diminished breath sounds in 89 (53.4%). These findings are shown in table 3.

Table 3: Distribution of physical signs in children with Pneumonia

Signs	Frequency (%)
Crepitations	154 (92.2%)
Tachypnoea	143 (85.6%)
Nasal flaring	134 (80.2%)
Thoracic recessions	133 (79.6%)
Diminished BS	89 (53.4%)
Grunting	53 (31.7%)
Abnormal percussion note	29 (17.4%)
Central cyanosis	13 (7.8%)
Tracheal deviation	7 (4.2%)
Bronchial BS	6 (3.6%)
Hepatomegaly	69 (41.3%)

Diagnosis

Bronchopneumonia accounted for 147 (88.0%), Lobar pneumonia 15 (9%), and 5 (3%) had a combination of bronchopneumonia and lobar pneumonia. The diagnosis in study subjects is displayed below with respect to the age group

Table 4: Diagnosis by age groups

Variable Age (months)	Bronchopneumonia No (%)	LP No (%)	BP + LP No (%)
1-<12	90 (53.9%)	9 (5.4%)	2 (1.2%)
12- <60	52 (31.1%)	6 (3.6%)	2 (1.2%)
>60	5 (3.0%)	0	1 (0.6%)

Bacteraemia in children with pneumonia

Forty-six (27.5%) children with pneumonia had positive blood cultures, while 121 (72.5%) children had blood cultures which yielded no growth. 39 (25%) of the 156 children with a full recovery from the pneumonia had bacteraemia which compared with 7 (63.6%) of the 11 children with pneumonia who died had bacteraemia was significant, p=0.011.

Organisms in children with pneumonia

Staphylococcus aureus was cultured from the blood of 11 (23.9%) out of the 46 (100.0%) children with positive culture. *Klebsiella* species was isolated in 8 (17.4%); coliforms and *coagulase negative staphylococcus* in 7 (15.2%) each; *micrococcus* and non-haemolytic *streptococcus* were the least common yield, each present in three (6.5%) isolates. A mixed growth was isolated in 7 (15.2%) of the 46 patients with positive culture.

Complications/co-morbidities

A total of 60 (35.9%) cases developed one or more complications. Heart failure was seen in 52 (86.7%) of the 60 children with one or more complications making 31.1% of the 167 subjects recruited. Five patients (3%) each had pleural effusion and pneumothorax, 4 (2.4%) had acute renal failure and all these patients had vomiting and diarrhoea. Three (1.8%) had hypoglycaemia.

Eleven (73.3%) out of the 15 children with lobar pneumonia had pneumonia-related complications compared to 46 (29.3%) of 157 children with bronchopneumonia, p=0.003.

Five (45.5%) of 11 children with lobar pneumonia with complication had more than one pneumonia-related complication which was significantly higher compared to seven (15.2%) with more than one complication among the 46 children with bronchopneumonia who had pneumonia-related complication, p=0.045 (see table 5)

Co-morbidities in the children with pneumonia included measles present in 4 (2.4%) children, underlying congenital heart disease in 6 (3.6%) children, three of whom had Down's syndrome, and 11 (6.6%) had HIV infection

Table 5: Complication based on type of pneumonia

Variable	Type of pneumonia Broncho-pneumonia N	LP N	BP + LP N	*P*
Complication				
Present	46	11	3	0.003
Absent	101	4	2	
No. of complication				
One	39	6	2	0.045*a
More than one	7	5	1	

a: compares BP with a combination of LP and BP+LP
*: Fischers Exact test

Outcome of pneumonia

A case fatality of 6.6% (11 deaths) was recorded in this study. One hundred and fifty-six (93.4%) recovered from the illness. Ten (90.9%) of the children that died were male, while one (9.1%) was a female. Eight (72.7%) of the children that died were infants while the remaining three (27.3%) were aged between 12 and 60 months.

Outcome based on diagnosis and presence of complications

A percentage mortality of 13.3% was recorded among children with lobar pneumonia compared to the 6.1% mortality recorded in those with bronchopneumonia. The difference was not however statistically significant, *p*=0.469 as shown in table 6.
A mortality of 13.3% was recorded in those with pneumonia-related complication compared to the mortality of 2.8% recorded in those who had no pneumonia-related complication at presentation. This contrast was significant statistically at *p*=0.018 as also seen below in table 6.

Table 6: Outcome based on diagnosis and presence of complications

Parameter	Recovery No (%)	Death No (%)	Fisher exact derived *p-value*
Diagnosis			
Bronchopneumonia	138(93.9)	9(6.1)	0.469
Lobar pneumonia	13(86.7)	2(13.3)	
BP + LP	5(100.0)	0(0.0)	
Complication			
Present	52(86.7)	8(13.3)	0.018
Absent	104(97.2)	3(2.8)	
No. of complication			
None	104(97.2)	3(2.8)	0.009
One	42(89.4)	5(10.6)	
More than one	10(76.9)	3(23.1)	

Duration of hospitalization among children with Pneumonia

The overall mean duration of hospitalization among the children with pneumonia was 6.8±5.8 days. The mean duration of hospitalization among those who survived of 6.5 ±5.0 days was significantly lower than the corresponding value of 10.2 ±12.3 days in those that died, *p*= 0.042.

Discussion

Pneumonia is a leading cause of disease and death among children worldwide and the greatest burden of disease is in Under Fives in developing countries, including Nigeria.[1,2] At the study site, pneumonia constituted close to 15% of all paediatric admissions through the EPU over a 12 month period. Pneumonia affects the extremes of life more than other age groups as was documented in this study where two third of all patients were infants and 80% were below 24 months. The lowest three social classes were affected most by the disease. These findings are in agreement with those of previous workers. [3,7, 12,16] It therefore means that measures for the control of pneumonia in childhood must focus on the first four years of life.

In developing countries, the operational definition of pneumonia adopted by WHO are based on easily recognisable clinical parameters- signs and symptoms- and said to be reliable for diagnosing the disease.[5,17,] The most frequent constitutional symptom in the current study population was fever which was present in more than three quarter of the cases. Diarrhoea was found in 15% and this reflects the immunologic nature of the gut especially in children.[20,21] The paucity of cases with rash (case definition for measles was used) was because of the successful measles vaccination campaigns that dominated the last three years before the study.[22] this is in contrast with the findings of earlier workers in Ibadan who found measles to be a significant association in pneumonia cases.[8] Cough and difficulty in breathing are the main respiratory symptoms documented. The main respiratory signs were tachypnoea, nasal flaring, chest wall recessions and crepitations. These clinical parameters except for crepitations are indeed useful for diagnosis of pneumonia at all levels of health care in developing countries.[5,17] The use of cough and difficult/fast breathing for identifying and treating or referring cases at primary and secondary levels must be strengthened using the Integrated management of childhood illnesses (IMCI) guidelines.[23] This will help reduce delays in treatment/referral and also reduce complications.
Consequently, death and hospitalizations from pneumonia will reduce. Furthermore, where adequate microbiologic support is not available, non-aetiologically proven disease burden of pneumonia can be followed in developing countries using these clinical parameters. This is indeed important as Nigeria moves to introduce *Haemophilus influenzae* and pneumococcal vaccines into the routine immunization programme.

Bacteraemia was found in 27.5% of all cases and this is comparable to the findings of earlier workers.[24-26] *Staphylococcus aureus*, was the most commonly isolated organism and this finding is similar to the findings of earlier workers in Ilorin and elsewhere.[8,16] And together with *Klebsiella species (these were not characterised further because of laboratory constraints)* these two organisms formed more than 40% of the isolates. Significant number of coliforms and coagulase negative staphylococcus were also isolated. In contrast to some

workers in Nigeria and other developing countries, *Streptococcus pneumoniae, Haemophilus influenzae*, *Salmonella typhi* and *non-typhoidal salmonella* were not documented in this study.[6,10,13,24,25,27] The absence of two key organisms of pneumonia, *Streptococcus pneumoniae* and *Haemophilus influenzae*, from the isolates profile is most likely a reflection of the limited microbiologic support for the isolation of these organisms at the study site. However, extrapolated data from similar settings referenced above provide evidence of the importance of these organisms in causing invasive childhood diseases and pneumonia, and the need for collaboration between study sites. Bacteraemia was associated with increased mortality in the study population. This is more a consequence of the major organisms isolated in this study which result in severe disease.

Bronchopneumonia was the most common form of disease found in our patients and the most frequent complication in the group studied was heart failure. This is consistent with the findings of other workers.[5, 11, 15-16].Other potentially life-threatening complications seen in the cases were hypoglycaemia and renal failure in patients who had diarrhoea and vomiting. Management of patients with pre-renal renal failure and pneumonia can present challenges with fluid therapy as adequate renal perfusion needs to be achieved quickly. Pleural effusion and pneumothorax were seen in a few cases. The presence of complications was associated with significantly higher morbidity and mortality and must be managed at specialist centres. There were co-morbid conditions in more than 10% of the cases. Measles, HIV infection, congenital heart diseases with or without Down's syndrome were the associated conditions.

In Nigeria, the standard management plans to identify and treat children must be followed to reduce the risk of complications. Capacity building of different cadres of health care workers will ensure prompt treatment/ referral; hence reduce the chances of complications and death. Sustainable and widely accessible immunization programme that will control vaccine-preventable diseases such as measles, tuberculossis and pertussis, as well as the inclusion of *Streptococcus pneumoniae* and *Haemophilus influenzae* antigens in the given vaccines, will also see the prevention of diseases associated with these organisms. The emergence of a *Staphylococcus aureus* vaccine will be a welcome addition to the measures against pneumonia in the near future. There is a need to improve the socioeconomic status of many families in order to reduce the risk of disease. The need for health systems strengthening in order to improve aetiological diagnosis of pneumonia; institutionalize disease surveillance, and monitor and supervise all control and prevention activities cannot be overemphasized. It is only with these approaches that pneumonia associated mortality and morbidity can be averted.

Authors contribution
All authors contributed to the study protocol, data collection, data analysis and the correspondence author did the final draft of this paper.
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