

RESEARCH

## Prevalence of pneumonia and risk factors of pneumonia mortality among children under five years in Komfo Anokye Teaching Hospital, Kumasi, Ghana.

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### ARTICLE INFO

#### Article history:

Received 14-Mar-2016

Received in revised form

5-Jan-2018

Accepted 27-Feb-2018

Available online 7-Dec-2018

### KEYWORDS

Pneumonia prevalence,  
pneumonia mortality,  
Komfo Anokye Teaching  
Hospital, Kumasi, Ghana

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### Abstract

#### Background

Pneumonia remains the foremost cause of death in children under 5 years of age especially in sub-Saharan Africa killing nearly 1 million annually.

#### Purpose

Identify pneumonia prevalence, mortality rate and associated factors among children under five admitted to Komfo Anokye Teaching Hospital (KATH) in Ghana.

#### Methods

Using a cross-sectional study method, a purposive sampling of 157 children under 5 admitted to the KATH for pneumonia from June to August 2016 was selected. A structured questionnaire was used to collect primary data from their caregivers and secondary data from the patient record using a structured data extraction form. Continuous and categorical variables were described and chi-square test employed to determine the associated factors of pneumonia mortality. Multivariate Poisson regression model was used to test for the strength of the association to unearth the risk factors of pneumonia mortality. The incidence relative risk (IRR) at 95% confidence interval (CI) was presented.

#### Results

The study found a prevalence of pneumonia of 18.40% with a mortality rate of 12.74%. Pneumonia mortality was found to be associated with maternal education ( $p < 0.001$ ), occupation ( $p = 0.010$ ), income ( $p = 0.020$ ), pneumonia severity ( $p < 0.001$ ) and number of rooms occupied by a household ( $p = 0.010$ ). In multivariate Poisson regression model, maternal education increased the incidence rate of pneumonia mortality (IRR=8.0, 95% CI=3.06-21.13,  $p < 0.001$ ) and occupation (IRR=2.8, 95% CI 0.70-11.45,  $p = 0.143$ ). However, pneumonia severity (IRR=3.6, 95% CI=1.50-8.48,  $p = 0.004$ ), income (IRR=0.05, 95% CI=0.01-0.22,  $p < 0.001$ ), and number of rooms occupied by a household (IRR=0.2, 95% CI=0.07-0.51,  $p = 0.001$ ) all showed reduced incidence rate of pneumonia mortality.

#### Conclusion

Pneumonia places a high burden on the health of children under five years admitted to KATH. Health workers need to sensitize caregivers on the signs and symptoms of pneumonia to aid early detection and reporting which could reduce mortality.

### Introduction

Pneumonia is a leading cause of hospital admission among children less than five years in sub-Saharan Africa [1]. The global death toll of the disease was estimated at 0.935 million in 2013. [2] It is also estimated that about 81% of pneumonia deaths occur in the

first 2 years of life [3]. Research indicates that of the estimated 6.3 million worldwide deaths in children less than 5 years recorded in 2013, infectious diseases accounted for 51.8% (3.257 million), with the largest percentages due to pneumonia (14.9%, 0.935million). Of



the 3.113 million deaths that occurred in children less than 5 years in 2013 in Africa, pneumonia accounted for 0.493 million representing 15.8% [2]. In Ghana, pneumonia is a significant contributor to under-five hospitalization and mortalities.

Children who live in difficult to reach areas with parents of low socio-economic status are the worst affected. Nutritional status (particularly children not exclusively breastfed), vaccination status, birth weight, child's age, immunosuppression (due to other co-infections like AIDS, measles, malaria) and environmental factors (crowded living conditions, exposure to indoor air pollution and parental smoking) are important factors that add to the risk of pneumonia and pneumonia mortalities [4–6]. The burden pneumonia places on these families and the health systems further aggravates the existing health inequities.

Even though the disease burden of pneumonia (prevalence, mortality rate and its associated factors) have been studied in some countries, information in Ghana is limited. Some of these studies in Ghana mostly examined the burden among adults and in some cases from the community viewpoint. The estimates do not target the exact population who are affected the most. In this era of harnessing scarce resources towards increasing demand for universal coverage of health care services, pneumonia estimates targeting the most affected population and setting will offer a better opportunity for interventional studies.

This study therefore estimates the health burden of pneumonia by measuring the prevalence, mortality and its associated factors among children less than five years who were admitted to Komfo Anokye Teaching Hospital in Ghana.

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## Methodology

The study was conducted in the paediatric wards of the Komfo Anokye Teaching Hospital (KATH), the second largest hospital in Ghana located in its Ashanti Region. KATH serves a population of over 4 million within and outside Ashanti Region. It is the main referral centre from the middle to the northern zone of Ghana. A prospective cross-sectional study that involved children less than 5 years admitted to the KATH for pneumonia was done from June to August 2016.

A purposive sampling technique was employed to select 157 eligible subjects for the study. The sample size was estimated based on previous study that reported pneumonia burden of 16.8% and 22.3% in rural and urban settings respectively.[7] The sample size was estimated to detect a difference of 8% with a power of 80% which corresponds to 0.84 and 95% confidence interval which corresponds to 1.96 standard values and an alpha of 0.05. A child was included when he/she was admitted with a clinical diagnosis of pneumonia.

A structured questionnaire was used to collect primary data from caregivers of subjects and data collected from the patient medical record using a structured data extraction form. Data was entered into Microsoft Access 2013 and was exported to STATA 13.0 (Standard Edition) for analysis. Basic summary statistics of socio-demographic variables and other variables conducted, and bivariate analysis of association between pneumonia mortality and other variables was also conducted. The prevalence were determined

considering the total number of patients hospitalized for pneumonia (numerator) and the total under five admissions (denominator) in the pediatric wards. Chi square test was used to determine the associated factors of pneumonia mortality. Multivariate regression using poisson model with robust error variance was used to test for the strength of the association to unearth the risk factors of pneumonia mortality.

## Ethics approval and consent to participate

Permission to conduct the study was obtained from the Committee on Human Research Publications and Ethics (CHRPE), of Kwame Nkrumah University of Science and technology and the Research and Development Unit of Komfo Anokye Teaching Hospital in Ghana. Written Informed consent were obtained from respondents to affirm their willingness to participate. Also in this report, there are no individual details or images included.

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## Results

### Sociodemographic characteristics of respondents

A total of 157 children less than five years with pneumonia were recruited in 8 weeks of the study period. The median age was 7 months ranging from 1 week to 59 months. More than half (59.87% n=94) of the children were less than 1 year old and the male to female ratio was 1.2:1. Almost sixty percent of the children (59.9%, n=95) had a birth weight of 2.5 and above. More than half (61.8%, n=97) of the respondents resided in urban areas with diverse educational backgrounds. Trading was the most reported (43% n=68) occupation of the caregivers whilst 13.4 % (n=21) of the caregivers were unemployed. The median income of the caregivers was 300 Ghana cedis (USD 76.9) monthly ranging from persons with no monthly income to a monthly income of up to GHC1, 500 (USD 384.6). (Table 1)

### Prevalence and mortality rate of pneumonia

The prevalence of pneumonia for children less than 5 years on admission at KATH was 18.4% (157/853). Overall only 16 bacterial isolates were identified in blood cultures (13 *Staphylococcus aureus* and 3 *Streptococcus pneumoniae*). 27 children representing 17.20% were diagnosed as having severe pneumonia with the rest diagnosed of non-severe pneumonia. About 66% of the participants stayed beyond 7 days post hospitalization with a median hospital stay of 9 days. A total of 20 deaths were recorded among participants accounting for mortality rate of 12.74%. (Table 2).

The commonest co-morbidities reported among clients with pneumonia were bronchiolitis, (17%), sickle cell disease (13%), malaria (12%) and aspiration pneumonitis (11%) (Figure 1).

### Risk factors of pneumonia mortality

Outcome of pneumonia hospitalization when compared with socio-demographic characteristics revealed statistical significant difference in terms of maternal education ( $p < 0.001$ ), occupation ( $p = 0.01$ ) and income ( $p = 0.02$ ) (Table 3).

**Table 1: Socio-demographic characteristics of respondents**

VARIABLE	FREQUENCY (N=157)	PERCENTAGE (%)
<b>Age</b>		
- up to 11 months	94	59.87
- 12-23 months	19	12.10
- 24-35 months	20	12.74
- 36-47 months	10	6.37
- 48-59 months	14	8.92
median (min, max)	7 months (1 week, 59 months)	
<b>Sex of children</b>		
- Male	86	54.78
- Female	71	45.22
<b>Birth weight</b>		
- Up to 2.4	62	39.49
- 2.5 to 3.5	74	47.13
- 3.6 to 4.6	21	13.38
<b>Residential status</b>		
- Rural	60	38.22
- Urban	97	61.78
<b>Maternal education</b>		
- None	20	12.74
- Primary	28	17.83
- JHS	53	33.76
- SHS	37	23.57
- Tertiary	19	12.10
<b>Occupation</b>		
- Professionals	22	14.01
- Skilled/semi-skilled	21	13.38
- Catering	10	6.37
- Traders	68	43.31
- Farmers	15	9.55
- Unemployed	21	13.38
<b>Income</b>		
- < 200 GHC	43	27.39
- 200-400	60	38.22
- 401-599	7	4.46
- 600-1000	34	21.66
- > 1000	13	8.28
median (Min, Max)	300 (0.00, 1,500)	

**Table 2: Information on hospitalization**

VARIABLE	FREQUENCY	PERCENTAGE (%)
<b>Organisms isolated</b> n=16		
- Strept pneumo	3	18.75
- Staph aureus	13	81.25
<b>Presence or absence of comorbidity</b>		
- No comorbidity	26	16.56
- One comorbidity	101	63.69
- Two or more comorbidities	31	19.75
<b>Duration of stay</b>		
- Up to 7 days	58	36.94
- 8 to 14 days	42	26.75
- 15 to 21 days	26	16.56
- 22 to 28 days	17	10.83
- 29 and above	14	8.92
median (Min, Max)	9 days (1, 69)	
<b>Rating the severity of pneumonia</b>		
- Pneumonia	130	82.80
- Severe pneumonia	27	17.20
<b>Outcome of hospitalisation</b>		
- Survived/Discharged home	137	87.26
- Death	20	12.74
mortality rate	12.74	

**Table 3: Risk factors of pneumonia mortality**

VARIABLE	Outcome		Total n (%)	χ <sup>2</sup>	p-value
	Survived n (%)	Died n (%)			
<b>Age</b>					
- up to 11 months	84 (61.31)	10 (50.00)	94 (59.87)	8.66	0.07
- 12-23 months	17 (12.41)	2 (10.00)	19 (12.10)		
- 24-35 months	17 (12.41)	3 (15.00)	20 (12.74)		
- 36-47 months	10 (7.3)	0 (0.00)	10 (6.37)		
- 48-59 months	9 (6.57)	5 (25.00)	14 (8.92)		
<b>Sex of children</b>					
- Male	72 (52.55)	14 (70.00)	86 (54.78)	2.14	0.14
- Female	65 (47.45)	6 (30.00)	71 (45.22)		
<b>Birth weight</b>					
- Up to 2.4	55 (40.15)	7 (35.00)	62 (39.49)	0.89	0.64
- 2.5 to 3.5	65 (47.45)	9 (45.00)	74 (47.13)		
- 3.6 to 4.6	17 (12.41)	4 (20.00)	21 (13.38)		
<b>Health insurance status</b>					
- Have NHIS	114 (83.21)	15 (73.00)	129 (82.17)	0.80	0.37
- Does not have NHIS	23 (16.79)	5 (25.00)	28 (17.83)		
<b>Residential status</b>					
- Rural	50 (36.50)	10 (50.00)	60 (38.22)	1.35	0.25
- Urban	87 (63.50)	10 (50.00)	97 (61.78)		
<b>Maternal education</b>					
- None	12 (8.76)	8 (40.00)	20 (12.74)	20.12	<0.001*
- Primary	27 (19.71)	1 (5.00)	28 (17.83)		
- JHS	47 (34.31)	6 (30.00)	53 (33.76)		
- SHS	36 (26.28)	1 (5.00)	37 (23.57)		
- Tertiary	15 (10.95)	4 (20.00)	19 (12.10)		
<b>Occupation</b>					
- Professionals	19 (13.87)	3 (15.00)	22 (14.01)	15.35	0.01*
- Skilled/semi-skilled	20 (14.60)	1 (5.00)	21 (13.38)		
- Catering	8 (5.84)	2 (10.00)	10 (6.37)		
- Traders	64 (46.72)	4 (20.00)	68 (43.31)		
- Farmers	9 (6.57)	6 (30.00)	15 (9.55)		
- Unemployed	17 (12.41)	4 (20.00)	21 (13.38)		
<b>Income</b>					
- < 200 GHC	40 (29.20)	3 (15.00)	43 (27.39)	12.4	0.02*
- 200-400	46 (33.58)	14 (70.00)	60 (38.22)		
- 401-599	6 (4.38)	1 (5.00)	7 (4.46)		
- 600-1000	34 (24.82)	0 (0.00)	34 (21.66)		
- > 1000	11 (8.03)	2 (10.00)	13 (8.28)		

\*p is less than 0.05 (significant)

It was further observed that severity of pneumonia ( $p < 0.001$ ) and number of rooms occupied by a household ( $p = 0.01$ ) are significant risk factors of pneumonia mortality. (Table 3 cont)

**Table 3: Risk factors of pneumonia mortality cont.**

VARIABLE	Outcome		Total n (%)	χ <sup>2</sup>	p-value
	Survived n (%)	Died n (%)			
<b>severity of the disease</b>					
- Pneumonia	120 (87.59)	10 (50.00)	130 (82.80)	17.32	<0.001*
- Severe pneumonia	17 (12.41)	10 (50.00)	27 (17.20)		
<b>presence of chronic condition</b>					
- Yes	23 (16.78)	7 (35.00)	30 (19.11)	3.74	0.05
- No	114 (83.21)	13 (65.00)	127 (80.89)		
<b>Vaccination status</b>					
- Child is not due for PCV vaccination	37 (27.01)	3 (15.00)	40 (25.48)	4.86	0.18
- Child has received one dose of PCV	6 (4.38)	0 (0.00)	6 (3.82)		
- Child has received 2 doses of PCV	19 (13.87)	1 (5.00)	20 (12.74)		
- Child has received 3 doses of PCV	75 (54.74)	16 (80.00)	91 (57.96)		
<b>Exclusive breastfeeding (EBF)</b>					
- Yes	74 (54.01)	8 (40.00)	82 (52.23)	1.37	0.24
- No	63 (45.99)	12 (60.00)	75 (47.77)		
<b>Number of people in the household</b>					
- 1-3	23 (16.79)	1 (5.00)	24 (15.29)	5.74	0.13
- 4-6	87 (63.50)	12 (60.00)	99 (63.06)		
- 7-8	22 (16.06)	7 (35.00)	29 (18.47)		
- 9 and above	5 (3.65)	0 (0.00)	5 (3.18)		
<b>Rooms occupied by household</b>					
- 1-2	118 (86.13)	13 (65.00)	131 (83.44)	10.73	0.01*
- 3-4	13 (9.49)	7 (35.00)	20 (12.74)		
- 5-6	6 (4.38)	0 (0.00)	6 (3.82)		
<b>people occupying a room with child</b>					
- 1-2	19 (13.87)	2 (10.00)	21 (13.38)	0.45	0.8
- 3-4	85 (62.04)	12 (60.00)	97 (61.78)		
- 5-7	33 (24.09)	6 (30.00)	39 (24.84)		
<b>Location of kitchen</b>					
- In the verandah of the house	49 (35.77)	9 (45.00)	58 (36.94)	0.7	0.71
- Somewhere far from room	69 (50.36)	9 (45.00)	78 (49.68)		
- Very far from the room	19 (13.87)	2 (10.00)	21 (13.38)		
<b>Type of fuel used</b>					
- Gas	65 (47.45)	10 (50.00)	75 (36.31)	5.68	0.13
- Electric cooker	2 (1.46)	0 (0.00)	2 (1.27)		
- Charcoal	53 (38.69)	4 (20.00)	57 (36.31)		
- Fire-wood	17 (12.41)	6 (30.00)	23 (14.65)		
<b>Smoking by a household member</b>					
- Yes	24 (17.52)	3 (15.00)	27 (17.20)	0.08	0.78
- No	113 (82.48)	17 (85.00)	130 (82.80)		

\*p is less than 0.05 (significant)



Significant variables were included in a multivariate poisson regression model. Having severe pneumonia, maternal education and number of rooms occupied by households were found to be predictors of pneumonia mortality. Persons with severe form of pneumonia are three times more likely to die from pneumonia (Adjusted IRR=3.6, 95% CI=1.50-8.48,  $p=0.004$ ). Also, maternal education (having had no formal education) showed an increased likelihood of pneumonia mortality (Adjusted IRR=8.0, 95% CI=3.06-21.13,  $p<0.001$ ). Income (IRR=0.05, 95% CI=0.01-0.22,  $p<0.001$ ), and number of rooms occupied by a household (IRR=0.2, 95% CI=0.07-0.51,  $p=0.001$ ) all showed reduced incidence rate of pneumonia mortality as detailed in Table 5.

**Table 4: Multivariate Poisson regression of associated risk factors of pneumonia mortality**

VARIABLE	Crude IRR	P value	95% CI	Adjusted IRR	P value	95% CI
Maternal education (Having had no formal education)	4.6	<0.001	2.13-9.81	8.0	<0.001*	3.06-21.13
Income (Less than USD 250 a month)	0.5	0.440	0.07-3.26	0.05	<0.001*	0.01-0.22
Occupation (Not working)	1.6	0.344	0.60-4.39	2.8	0.143*	0.70-11.45
Having a severe form of pneumonia	4.8	<0.001	2.22-10.45	3.6	0.004*	1.50-8.48
Number of household occupying a room	0.4	0.017	0.16-0.84	0.2	0.001*	0.07-0.51

IRR: Incidence Relative Risk. CI: Confidence Interval

\*p is less than 0.05 (significant)

five years.[8–10] The case fatality rate of 12.7% found in this study compares with a findings by Sehgal et al (1997) which found a case fatality rate of 10.45%.[10] The risk factors that were noted was patients who had a severe form of pneumonia. Age was not a significant risk factor for pneumonia mortality. Other studies[10] found pneumonia mortality to be associated with age. KATH has specialized personnel and machinery to support even critically ill patients of all ages.

Among the cases with comorbidities, Sickle Cell Disease (SCD) emerged as the main comorbidities of pneumonia. SCD is a leading genetic disorder in sub-Saharan Africa. Ghana had a prevalence of about 2% of SCD's. SCD's are at risk of Acute Chest Syndrome (ACS), hence it was not surprising that it came out as one main differential diagnosis. However the classical definition of ACS was not used because there were not previous x-rays to confirm new chest infiltrate for these cases. SCD patients are also at risk of other acute respiratory infections (ARI).[11–13] It was therefore not surprising to see SCD emerging as the main chronic condition followed by HIV. HIV continues to be a significant public health burden in Ghana, the average prevalence among the 10 regions currently stands at 1.8%, with Ashanti region as the second highest with a prevalence of 3.2%. It is therefore expected to find retroviral exposed children reporting respiratory pathologies. The increased likelihood of pneumonia mortality among cases with severe form of the disease was not surprising since severe pneumonia is associated with metabolic imbalance, respiratory failure and multi-organ failure.

Malnutrition was observed as a significant pneumonia comorbidity which collaborates with studies by Arpitha et al (2014) which indicated that morbidity and mortality due to Pneumonia is unacceptably high in malnourished children. Undernourished children were found to have a substantially higher risk of suffering childhood death. Studies have shown that under nutrition of children contributes to more than half of all child deaths in developing countries. This phenomenon may place children at an increased risk of developing pneumonia in two ways. First, malnutrition weakens a child's overall immune system, affecting the immune functions. Secondary, undernourished children have weakened respiratory muscles, which inhibits the system from adequately clearing secretions found in the respiratory tract [15].

International accepted number of persons to live in a room was 2. This study found it to be higher which gives a cause of worry. The average household composition appears to be higher as compared with the national average of 4 [16]. A previous study conducted at

## Discussion

The study has revealed that pneumonia is among the leading cause of admissions in the pediatric wards of KATH with a prevalence rate of 18.4% (about two in every ten cases admitted). A study by Rudan et al (2008) reported a slightly higher under five pneumonia prevalence of 22.3%[7]. Some risk factors of pneumonia mortalities have also been identified in this study; maternal education, income, severity of pneumonia and number of rooms occupied by a household.

It is expected that majority of the study participant will be coming from the urban areas since it was conducted in the city and also referral hospital for most of the critically ill patients. The educational levels of caregivers were even across the educational categories. This signifies the fact that pneumonia does not necessarily affect persons with particular educational status. Various occupational categories were identified in the study with even distribution across categories with trading found to be the dominant occupation. This to a large extent is due to the fact that the study was conducted at a setting where the main occupation is known to be trading.

Pneumonia mortality is generally high. WHO and other studies estimates the case fatality rate between 8% to 16% in children under

the same study site found overcrowding to be a risk factor of pneumonia mortality.[17]

The findings of this study is relevant and call for comprehensive study of the risk factors identified. as the use of cross-sectional design, sampling technique and the study site (tertiary institution) limits the strength of any generalizability of the findings. A multi-center comprising of rural and urban setting and case control study design is recommended for future studies.

## Conclusion

The study has revealed that pneumonia places a high burden on the health of children under five years admitted in the pediatric wards of KATH. Community health workers at the healthcare facilities need

to sensitize caregivers to be aware of the signs and symptoms of pneumonia in order to detect early and report promptly to healthcare facilities as this could reduce the burden of the disease. Despite the increasing vaccination rates being recorded for the vaccines preventable diseases, the burden of pneumonia continues to be high among reported cases in healthcare facilities. It is therefore of urgent need to further test the immunogenicity of children being given pneumonia vaccines.

## Acknowledgement

We acknowledge the support of our nursing and medical staff at the child health department of Komfo Anokye Teaching Hospital, the children and their parents who agreed to take part in this study.

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