Factors associated with pneumonia in children under five (2-59 months) in Nairobi, Kenya

Caroline M.W[1], Maina E.N.M.[2], Karanja S[2],

1. Jomo Kenyatta University of Agriculture and Technology, Department of Public Health , Nairobi
2. Nairobi University, Department of Biochemistry, Nairobi

Corresponding Author: Caroline Muthoni Wachira, P.O Box 54583--00200; E-mail: Wachira.carol@gmail.com

ABSTRACT

Introduction: Pneumonia the leading cause of mortality and morbidity in children under five in the world. Most deaths occur in Sub-Saharan Africa and South Asia.

Objective: This study investigated factors associated with pneumonia at their first presentation in Mbagathi District Hospital, Nairobi County.

Methods: We conducted a hospital based cross-sectional study at the pediatric department at Mbagathi District Hospital. All guardians of children between 2-59 months were recruited at the hospital causality and inpatient department. Pneumonia diagnosis was based on WHO definitions. Pneumonia was associated with fast breathing with or without chest in drawing. Severe pneumonia was defined as fast breathing with any danger signs. Systematic random sampling procedure was used to select study participants. A total of 384 guardians together with their children were sampled.

Results: Childhood pneumonia was caused by a combination of exposure to risk factors related to the host, the environment and infection. Low level of education of guardians was associated with pneumonia in children p<0.0.5 (Wald= 8.358, df =3). Crowding was associated with pneumonia in children p<0.05 (OR 0.33, 95% CI, 0.11-0.95). Birth weight of children was significantly associated with pneumonia p<0.05 (OR 0.59, 95% CI 0.38-0.92).

Conclusions: The prevalence of pneumonia in children is reducing, this due to the public health interventions in the households and the hospital facility. Poor environmental factors increase the suffering of the community and this makes it difficult to prevent and control pneumonia.

Increased pneumococcal conjugate vaccine coverage in children could significantly reduce the burden of pneumonia in sub-Saharan African countries.

Key words: Childhood pneumonia, *streptococcus pneumoniae*, under five (2-59 months), Acute lower Respiratory Infection (ALRI).

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Introduction

Pneumonia remains the leading infectious cause of death among children under five[1]. Bacteria, fungi, viruses or parasitic infection causes pneumonia. Bacteria such as *Streptococcus pneumoniae (pneumococcus*) and *Haemophilus influenzae* cause severe cases of pneumonia. Respiratory syncytial virus is the most common viral cause of pneumonia[2]. On average, 2-3% of children have pneumonia severe enough to require hospitalization yearly, for every 1,000 children born, about 100- 150 episodes of severe pneumonia arise most during the first 2 years of life[3]. The incidence in the age group was estimated to be 0.29 episodes per child year in developing and 0.05 episodes per child-year in developed counties. This translates into about 156 million new episodes each year worldwide, of which 151 million episodes are in the developing world[4]. The leading risk factors contributing to pneumonia are nutritional factors such as malnutrition, lack of exclusive breastfeeding, iron deficiency, environmental factors such as overcrowding, indoor air pollution due to use of biomass fuel for cooking, poor housing and social and behavioral factors such as hand washing[5]. The leading causes of mortality in Sub Saharan Africa was from pneumonia (15.8% UR 13.1 -18.7); UR 0.407- 0.581 million)[6]. Childhood pneumonia is a major public health issue in Kenya. In 2008 pneumonia was the second leading cause of death in under five years claiming over 30,000 children. Kenya is currently ranked among the 15 countries with the highest estimated number of deaths due to clinical pneumonia, the mortality rate being 50.3 per 10,000 under five per year[4]. A decline in mortality was observed by Rudan and colleagues, all Acute Lower Respiratory Infection (ALRI) caused deaths reduced to 17,064 in 2010[7]. Pneumonia is currently diagnosed by World Health organization (WHO) criteria in Public health facilities. Community Acquired Pneumonia in children under five is categorized into two: pneumonia and severe pneumonia. Fast breathing with or without chest in drawing is pneumonia and fast breathing with any danger signs as severe pneumonia[8]. Pneumonia can be prevented by immunization, adequate nutrition and by addressing environmental factors.

We conducted this study to identify factors associated with pneumonia in children aged 2-59 months in a public health facility in Nairobi, Kenya.

Materials and methods

Study design

We conducted a hospital based cross-sectional study at the pediatric department at Mbagathi District Hospital. All guardians of the children between 2-59 months were recruited at the hospital causality and inpatient department. Pneumonia diagnosis was based on WHO definitions. Pneumonia was associated with fast breathing with or without chest in drawing. Severe pneumonia was defined as fast breathing with any danger signs. [8]. We collected data on social-demographic, socio-economic, knowledge, attitude and practices of guardians,

nutritional status and environmental factors using a structured questionnaire.

This study was conducted according to the guidelines of the Declaration of Helsinki and Kenyatta National Hospital Ethical Review Committee approved the research (KNH-ERC/RR/344). Written informed consent was obtained from all legal guardians of the patients after careful and complete explanation of the research contents. An interview was conducted after consent was given.

Sample size

Cochran formula[9] was used to calculate the sample size. A total of 384 questionnaires were administered to guardians of children under five, this was calculated as follows.

$n = Z^2 P (1-P) / d^2$

$= \underline{1.96^2 \times 0.5 \times (1 - 0.5)} = 384$

0.05^2

Where:

n = Sample size

Z = Confidence level at 95% (standard value of 1.96)

P = Prevalence 50% (will take an estimated value of 50% = 0.5% where the prevalence of disease is not known)

d = Level of Precision at 5%

A total of 384 guardians together with their children were sampled. The random start was adopted every day on the first patient who attended the hospital facility and every third patient until a desired samples size of 384 was achieved.

Data analysis

Data was analyzed using SPPS version 20 and WHO anthro version 3.2.2. Descriptive statistics were computed for demographic variables using means, proportions and frequencies. Anthropometric measurements were analyzed using Z-score measures such as weight for age (stunting), weight for height (wasting) was determined. Association between categorical variables was determined using Chi statistics. The interaction between independent variables was analyzed using logistic regression analysis. The level of significance was set at $p<0.05$ with 95% confidence interval.

Results

Socio-demographic characteristics of the study population

A total of 384 participants were interviewed. The majority of those interviewed 360 (93.8%) were mothers of the children, only 24(6.2%) of the respondents were fathers. The mean age for mothers was 27.42 (SD±5.17) with a range of 18 to 48 years. The mean age for fathers was 28.46 (SD±6.16) with a range of 18 to 38 years.

Of the 384 participants, 31% were aged between 18-24 years, 48.6% were between 25-32 years and 20.4% were above 31 years. Those who reported being married were 84.6% of the sample population. The proportion of participants with primary level education was 34.9%, secondary level education was 46.4%, tertiary level education was 16.1% and no formal education was 2.6%.

A total of 384 children (2-59months) participated in the study, 213 (55.5%) of who were males and 171

(44.5%) were females. The mean age group of males was 16.71 (SD±12.25) and 18.56 months (SD±14.06) for females. The proportion children less than 5 months was 11.7%, 6-11 months was 29.7%, 12-23 months was 34.1% and 24.5% were above 24 months as shown in table 1.

The coverage of pneumonia vaccination for children who attended Mbagathi District Hospital was 88.3% (339/384 cases).

Table 1: Summary of selected demographic characteristics of the study participants

Demographic characteristics	**n= 384**	**Proportion %**
Age of respondent (years)		
Mean age Range	27.49(18-48)	
18-24 years	118	30.7%
25-31 years	185	48.2%
> 31years	72	20.4%
Age of children (months)		
Mean age Range	17.53(2-59)	
0-5 months	45	11.7%
6-11 months	114	29.7%
12-23 months	131	34.1%
24-60 months	94	24.5%
Marital Status of respondents		
Single	51	13.3%
Married	325	84.6%
Separated/widowedd divorced	8	2.1%
Highest level of Education of respondents		
No education	10	2.6%
Primary	134	34.9%
Secondary	178	46.4%
Tertiary	62	16.1%

Bivariate Analysis

The chi-square test of association was used in bivariate analysis to find associations between pneumonia diagnosis and socio-demographic, socio-economic, knowledge, attitude and practices, nutritional and environmental factors.

Out of 384 children below five years, 82 children (OR 1.17, 95% CI (0.72-1.91) were diagnosed with pneumonia. Children between 2-5months accounted for 11% (9/384 cases), 6-11 months accounted for 24.4% (20/384 cases) and 12-23 months 35.4% (29/384 cases), 24-35 months 9.8% (8/384 cases), 36-47 months 8.5% (7/384 cases) and 48-59 months accounted for 11% (9/384 cases) of pneumonia, this was not significant to pneumonia diagnosis $\chi 2$ (df= 5) = 6.58 p=0.25.

Children with low birth weight accounted for 22.55% (18/378 cases), there was a significant relationship between birth weight and pneumonia $\chi 2$ (df =36) = 51.62, p= 0.04.

Children in crowded households had an increased likelihood of exhibiting pneumonia, crowding was

associated with pneumonia in the study population $\chi 2$ (2) = 5.99, p=0.05.

The use of kerosene in the households was associated with pneumonia in children $\chi 2$ (1) = 5.23, p=0.02.

Level of education of guardians was significantly associated with pneumonia in children in the study population $\chi 2$ (3) = 7.95, p=0.05.

Multivariate analysis

The significant factors from bivariate analysis (with p<0.05) were subjected to multivariate analysis (logistic regression) to determine

association of pneumonia in children. Three hundred and seventy eight cases were included in the analysis and 6 cases missed in the analysis. Logistic regression was performed to ascertain the effects of birth weight, crowding, level of education and use of biomass fuel on pneumonia and the model as significant $\chi 2(8)=29.08$, p=0.00. The model explained 11.5% (Nagelkerke R) of the variance in pneumonia and correctly classified 78.3% as cases. Low level of education of guardians was associated with pneumonia in children p<0.0.5 (Wald= 8.358, df =3), crowding was associated with pneumonia in children p<0.05 (OR 0.33, 95% CI, 0.11-0.95). Birth weight of children was significantly associated with pneumonia p<0.05 (OR 0.59, 95% CI 0.38-0.92).

Table 2: Logistic regression of factors associated with pneumonia

Variables in the Equation								
	B	**S.E.**	**Wald**	**df**	**Sig.**	**Exp(B)**	**95% C.I.for EXP(B)**	
							Lower	**Upper**
Level of education - No education			8.36	3	**.039**			
Primary	-.55	.87	.40	1	.53	.58	.11	3.15
Secondary	-.84	.87	.94	1	.33	.43	.08	2.36
Tertiary	.16	.89	.03	1	.86	1.17	.21	6.69
Crowding (>5 people in a room)			6.11	2	**.047**			
Crowding (0-3 people in a room)	-1.11	.54	4.20	1	**.040**	.33	.11	.95
Crowding (3-5 people in a room)	-.58	.53	1.18	1	.28	.56	.20	1.59
Kerosene	-.41	.27	2.24	1	.14	.66	.39	1.14
Electricity	.83	.37	5.16	1	**.023**	2.30	1.12	4.71
Birth weight(kgs)	-.53	.22	5.51	1	**.019**	.59	.38	.92
Constant	1.69	1.23	1.89	1	.169	5.44		
a. Variable(s) entered on step 1: level of education, crowding, use of kerosene, use of electricity, Birth weight.								

Discussion

This study investigated factors associated with pneumonia at their first presentation in a public hospital outpatient and inpatient department in Mbagathi District Hospital. The leading factors contributing to pneumonia are low level of education , low birth weight, environmental factors such as overcrowding, indoor air pollution due to use of biomass fuel for cooking, poor housing, this is similar to previously documented study[8].

Out of 384 children below five years, 82 children (OR 1.17, 95% CI (0.72-1.91) were diagnosed with pneumonia. Pneumonia was more common among children between ages of 6-24 months (49/384 cases) in this study but this was not statistically significant p>0.05. Pneumonia is common in the age group due to narrow airways, relatively short bronchial tree and incomplete development in young children[10]. Studies conducted in Greenland have shown that upper respiratory tract infection had an increased risk in children aged 6-23 months. Possible mechanisms for increased risk include immaturity of the adaptive immune system, degradation of maternal antibodies, termination of breastfeeding and start of child-care centers[11].

There was a significant association between the levels of education p<0.0.5 (Wald= 8.358, df =3) and occurrence of pneumonia. Guardians of children with higher education were more likely to seek appropriate and early care for illness. In other studies low educational levels were found to be associated with increased risk of Acute Lower Respiratory Infection hospitalization and mortality in children[10].

While the influence of crowding on the risk of pneumonia is well understood, there are only a few studies documenting influence of crowding on the outcome of pneumonia in children. The possible mechanism is the influence of crowding on the selection and spread of resistant bacteria. Sharing of the bedroom by more than two persons increases the risk of severe pneumonia by 1.8 times[12]. Cardoso and colleagues described 2.5 fold increase in the odds of Lower Respiratory Tract Infection among young children living crowded households[13].

In our study 100(28.4%) of the children of a sample of 384 that attended the health facility had a history of recurrent pneumonia p<0.05 (95% CI 25.72-165.59). Ozdemir and colleagues found that 62(10.4%) patients of a sample of 595 hospitalized children had histories of recurrent pneumonia. This can be attributed to an underlying disorder such as asthma and immune deficiency[11].

A history of Low Birth Weight in children increases the risk of pneumonia compared to children with normal birth weight, this was significant p<0.05 in our study. This is due to poor pulmonary function and low immunity in low birth weight babies[14]. Coles and colleagues observed that low birth weight was a risk factor for community-acquired pneumonia[15].

Malnourished children are more at risk of pneumonia but this was not significant (p>0.05) in this study. Malnutrition has been identified as a significant and

independent risk factor of mortality from pneumonia[16].

Conclusion

This study describes only the distribution of disease in terms of time, place and characteristics of the distribution of pneumonia in children under five registered in the outpatient and inpatient department of Mbagathi District Hospital.

This study has identified factors associated with pneumonia such as level of education, crowding, low birth weight, this was similar to other studies[5]. These risk factors can be modified with simple strategies such as adequate nutrition, immunization, parental education, environmental sanitation.

Increased pneumococcal conjugate vaccine coverage in children could significantly reduce the burden of pneumonia in sub-Saharan African countries.

Author's contribution

All authors contributed to the conception, design of the study, data analysis and writing the article.

Conflicting interests

The authors declared no potential conflicts of interest with respect to research, authorship or publication of this article, student supervision and project leadership.

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