



## **Environmental Risk Determinants Associated with pneumonia among children under five years in Kapenguria County Referral Hospital, West Pokot County, Kenya**

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### **Abstract**

According to (WHO, 2017) pneumonia remains the biggest killer of children under 5 globally, claiming the lives of more than 1 million girls and boys every year. In Kenya, pneumonia is the second leading cause of death among children under the age of five years and causes 16% of deaths in the age group. The purpose of this study is to examine the environmental factors associated with pneumonia infection among children under five years who seek medical care at Kapenguria referral hospital. The study adopted a case-control study design involving 206 consecutively sampled mothers of children under five years for cases and controls respectively. 7 public health officers were purposively selected as key informants. Case control study design was involving 206 mothers was adopted. The mothers were consecutively sampled for a period of one month. Data was collected using a pretested structured interviewer-administered questionnaire for mothers and an interview guide for public health officers. Data analysis was done using Statistical Program for Social Scientist (SPSS) version 21. Pearson correlation tests was employed in the analysis to establish the relationship between the factors and pneumonia infection. Results were considered at 95% confidence level. Data was presented in the form of graphs, tables and pie charts. The findings revealed that 73% of mothers lived in an environment that was not conducive for the children and has contaminated air exposing a risk in pneumonia infection. The findings further showed a significant positive correlation ( $r = .684$ ,  $p = .002$ ) between environmental and occurrence of pneumonia among children. The meant that the families were exposed to an environment that was not conducive for the children that would lead to prevalence of pneumonia. The study therefore recommended that the National Environmental Management Authority should conduct environmental impact assessment to before construction of factories and other physical structures which release toxic products to the environment. It is expected that findings will be helpful to the community and more so to the health centres in planning and educating the community on how to prevent and control the disease.

**Keywords:** *Environmental factors, Pneumonia, Children under 5 years, Kapenguria County Referral Hospital*

## 1.0 Introduction

Public health facilities in Kenya use the Integrated Management of Childhood Illness (IMCI) criteria to diagnose pneumonia in children under the age of five (WHO 2010). In IMCI, three categories of acute respiratory illness based on severity of their clinical presentation are distinguishable by use of physical examination findings. These are: pneumonia (cough or cold), pneumonia and severe pneumonia (WHO, 2002). Approximately 13% of pneumonia cases are severe enough to require hospitalization. Of all the pneumonia cases occurring in countries with high incidence, 8.7% are severe enough to be life threatening (reference). Severe pneumonia in childhood is associated with increased long-term respiratory morbidity and disease burden and is more fatal than the non-severe disease. Understanding the epidemiology of severe pneumonia has been identified as a pressing priority for public health research. Risk factors for pneumonia have been classified into three groups: definite (most evidence consistently pointing to the role of the risk factor); likely (most evidence consistently pointing to the role, but with some opposing findings; or scarce but consistent evidence of the role) and possible (with sporadic and inconsistent reports of the role in some contexts (ref). Studies on the risks factors for severe pneumonia are few and done more than a decade ago (Broor & Pandey, 2001)

According to WHO (2010) pneumonia remains the single biggest killer of children under 5 globally, claiming the lives of more than 1 million girls and boys every year. But pneumonia deaths are preventable. Every 30 seconds, a child younger than 5 dies of pneumonia (WHO, 2013). The fourth Millennium Development Goal calls for reducing child mortality by two-thirds between 1990 and 2015, but about 29,000 children under-five die worldwide every day, mainly from preventable causes (WHO, 2009).

Childhood pneumonia remains a leading killer of children in developing countries where it accounts for up to 21% of deaths in children under the age of five years (Rudan et al, 2008). The mortality rates of children under the age of five years in most developing countries ranges from 60 to 100 per 1000 live births, one fifth of these deaths are due to pneumonia (UNICEF/WHO, 2006). In Kenya, pneumonia is the second leading cause of death among children under the age of five years and causes 16% of deaths in the age group. This study therefore aims at determining the factors predisposing to pneumonia infection among children under five years attending Kapenguria referral hospital so that to help the community and more so the health centres in planning and educating the community on how to prevent and control the disease. Give some highlights on the results in the last paragraph of the introduction.

## 2.0 Literature review

According to Okiro and colleagues (2008)), pneumonia has multiple aetiologies and risk factors hence they can be common to all types of pneumonia, specific to viral pneumonias or may be agent specific. According to (Rudan, 2008), some of the risk factors associated with pneumonia and also further classifying them into definite, likely and possible factors. Definite risk factors are malnutrition, no exclusive breast feeding, and lack of measles immunization, low birth weight, indoor air pollution and crowding. Likely risk factors are parental smoking, zinc deficiency, mother's experience as a care giver. Possible factors include mother's education, day-care attendance, rainfall (humidity), high altitudes (cold air), vitamin A deficiency, and outdoor pollution. (Rudan et al., 2008)

Malnutrition is biologically plausible because the malnourished children are have impaired immunological responses and more severe infections thus increasing the risk and severity of pneumonia. Malnutrition itself is a cause of mortality in children under 5 years as well as a risk factor for incidence of and mortality due to other major causes of under-5 mortality such as HIV-infection. (Davies and Zar 2005) There is a very high risk of contracting pneumonia in children who are not or partially breastfed than in children who are breastfed exclusively. Breastfeeding has a protective effect which is due to its special or unique anti-infective properties which

facilitate passive protection against microorganisms, immune system stimulation and inhibition of gastro-intestinal invasion by Gram- negative species. Breast-feeding affords protection against childhood pneumonia which persists beyond the breastfeeding period. (Davies and Zar 2005) Short period of breastfeeding and poorer nutritional status are examples of socio-economic deprivation which are associated with low birth weight, which in turn, increases the risk of contraction pneumonia in children. Low birth weight is associated with the morbidity and mortality of pneumonia and, furthermore, there are other means where low birth weight makes children prone to pneumonia i.e. reduction in immune system competence and lung function impairment. (Davies and Zar 2005)

Pneumonia being an inflammation of the lower respiratory tract is caused by various microorganisms i.e. bacteria, viruses, fungi, and protozoa. The most common causes of bacterial pneumonia in children are group B Streptococcus and gram-negative enteric bacteria. The respiratory syncytial virus is the most common virus cause of pneumonia in children aged four months to five years (Kliegman, 2016) Indoor air pollution and sanitation are important risk environmental factors associated with pneumonia. Children who exposed during the critical period of lung development showed an increased risk of acute lower respiratory tract infections, oxidative stress from exposure to air pollutants, and asthma. (Smith et al., 2011; Heinzerling et al., 2016).

Indoor air pollution affects alveolar macrophages (AM) in the lungs, alveolar macrophages regulate the prevention process of infection especially Streptococcus pneumoniae by activating NADPH oxidase that will kill the bacteria that cause pneumonia and trigger the release of cytokine enzymes that can prevent inflammation (Gordon et al., 2000; Xu et al., 2008; Rylance et al., 2015). However, particles in wood smoke combustion will induce free radicals, activate macrophage NF-B, decrease intracellular glutathione exposure, strengthen TNF $\alpha$ , IL-6, and CXCL8 excretion. Both of these substances will be absorbed by lipopolysaccharide and increase the effects of inflammation in the lungs. (Leonard et al., 2000; Semple et al., 2010).

Exposure to acute burning particles will produce a pro-inflammatory effect, this has been increasing the cycle of CXCL8 and neutrophilia systemically because wood burning releases a lot of nitric oxide and malondialdehyde substances that cause the lungs to experience oxidative stress (Barregard et al., 2008). Leung et al. (2016) has reported the areas where morbidity and mortality from pneumonia remain high have less access to clean water, less latrine, poor sanitation and low immunization status. Therefore, WHO creates a monitoring program aimed at preventing environmental contamination from the faeces of an infected person to improve sanitation to be more hygienic by making connections to sewerage systems, septic tanks, and flush toilets with ventilation and latrines with concrete slabs (Brown et al, 2013).

Inadequate ventilation includes households with less than 50 sq.ft. floor area per person irrespective of the presence of fan or 50–100 sq.ft. of floor area per person without a fan. Adequate ventilation included households with 50–100 sq.ft. area per person with a fan or more than 100 sq.ft. per person irrespective of the presence of a fan. Accepted standards of number of persons per room were used. If the number of persons per room is more than these criteria, overcrowding was considered to be existing for most of the days of the week was classified as clean and unclean fuel. Clean fuel included Liquefied Petroleum Gas (LPG) or Electric Shgedi; unclean fuel included biomass, coal Shgedi, stove with kerosene.

### **3.0 Methodology**

The study was conducted in Kapenguria County Referral Hospital, Kenya. The study adopted a case-control study design involving 206 consecutively sampled mothers of children aged under five years for cases and controls respectively. A total 7 public health officers were purposively selected to participate in interview. Data was collected using a pretested structured interviewer-

administered questionnaire for mothers and an interview guide for public health officers. Data analysis was done using Statistical Program for Social Scientist (SPSS) version 21. Pearson correlation tests was employed in the analysis to establish the relationship between the factors and pneumonia infection. Results were considered at 95% confidence level.

#### 4.0 Results and discussion

##### 4.1 Environmental Factors associated with Pneumonia

The purpose of this study was to examine environmental factors associated with pneumonia in Kapenguria County Referral Hospital. These factors include the living conditions and the environmental risks expose the children to pneumonia infection. The information was summarized in table 1.

**Table 1: Housing and environment characteristics**

Housing and environmental characteristics	Frequency	Percentage
<b>Father Smoke (n=158)</b>		
Yes	32	20.2
No	126	79.8
<b>Mother Smoke (n=198)</b>		
Yes	8	4.1
No	190	95.9
<b>Household member smoke cigarette (n=198)</b>		
Yes	43	27.2
No	155	72.8
<b>Fuel for cooking(n=198)</b>		
Firewood	90	45.5
Charcoal	54	27.3
Gas	18	9.1
Paraffin stove	36	18.2
<b>Do children sleep in the same house used for cooking ((n=198)</b>		
Yes	90	45.5
No	108	54.5

**Source: Field Data, 2018**

The findings from table 1 revealed that majority of the fathers 126(79.9%) do not smoke while 32(20.2%) smoke. The findings showed that 20% of the fathers were smokers and would possibly affect their children’s health including pneumonia. Further, majority of mothers 190(95.9%%) did not smoke while a small percentage 8(4.1%) smoked cigarette. When asked whether there was a household member smoked cigarette, it was found out that majority 155(72.8%) smoked cigarette.

Further, Majority of the respondents 90(45.5) said that they use firewood in cooking 54(27.3%) used charcoal 36(18.2%) used paraffin stove in cooking while 18(9.1%) used gas for cooking. This showed that a good number of respondents still used some of the fuel which studies have confirmed as the cause of pneumonia. Further the study sought to establish whether children lived in the same house used for cooking and interestingly majority 108(54.5%) did not sleep there but close to half the respondents (45.5%) slept where cooking is done. This suggested that children could be prone to pneumonia since the rate of exposure is too much.

**Table 2: Mothers perception on environmental factors**

Statement	SD		D		UD		A		SA	
	F	%	F	%	F	%	F	%	F	%
The environment that we live in is quite conducive for the children and free from air pollution	74	36.8	74	36.8	18	9.0	16	8.0	19	9.5
The environment that we live in is free from water contamination	0	0.0	50	24.9	16	8.0	64	31.8	71	35.3
I always ensure that my children are dressed warmly	64	31.8	56	27.9	28	13.9	31	15.4	22	10.9
Distance from the hospital is sometimes causes me not to attend hospital and therefore increases chances of the child missing medical attention.	47	23.4	10	5.0	39	19.4	11	5.5	94	46.8
Our house has enough ventilation	0	0.0	6	3.0	34	16.9	133	66.2	28	13.9

**n=198**

**Source: Field Data, 2018**

From the Table 2, majority 74(36.8%) of the respondents strongly disagreed with the statement that the environment that they live in is quite conducive for the children and free from air pollution, 74(36.8%) respondents disagreed with the statement, and 19(9.5%) respondents strongly agreed while 18(9.0%) respondents were undecided on the statement. The study findings showed that a majority of (73.6%) of mothers lived in an environment that was not conducive for the children and has contaminated air. This finding concurs with the WHO, (2010) found out that lung inflammation was associated with air pollutants.

The results of data analysis further showed that 135(67.1%) respondents were in agreement with the statement the environment that we live in environment that is free from water contamination, 50(24.9%) respondents were in disagreement while 16(8.0%) respondents were undecided with the statement. This shows that a majority of the mothers faced the challenge of water pollution. On the statement that “I always ensure that my children are dressed warmly”, 64(31.8%) respondents strongly disagreed with the statement, 56(27.9%) respondents disagreed with the statement, while 28(13.9%) respondents were undecided. This shows that majority of the respondents (59.7%) reported that parents lacked warm clothing for the children rarely dress their children well. This implies that most of the children were in a risk of infection of pneumonia. The findings agree with Noor et al, (2019) who found out that Respiratory Infection is primarily seen in the winter or colder months.

Moreover, 94(46.8%) respondents strongly agreed with the statement that distance from the hospital is sometimes causes me not to attend hospital and therefore increases chances of the child missing medical attention, 47(23.4%) respondents strongly disagreed with the statement while 10.5% respondents were in agreement with the statement. It emerged from the study findings that a majority of respondents at 70.2% cited that parents face a lot of challenges travelling to the hospital is sometimes causes me not to attend hospital and therefore increases chances of the child missing medical attention and follow up. In a study, Noor et al, (2019) noted that lack of routine checkup and early detection among the children increases severity of respiratory infections.

In addition, it emerged that 133(66.2%) respondents agreed with the statement that their houses have enough ventilation, 28(13.9%) respondents strongly agreed with the statement while 6(3.0%) respondents were in disagreement with the statement. From the responses it can be shown that a majority of respondents at 66.2% reported that their room is well ventilated. The interview from the key informants revealed most infection of pneumonia was caused by environmental factors these factors include Indoor air pollution and sanitation risk environmental factors associated with pneumonia. Their comments agreed with the respondents who strongly disagreed with the statement that the environment that they live was quite conducive for the children and free from air pollution. This finding is also supported by Smith, 2011 and Heinzerling, (2016) who noted that children who exposed during the critical period of lung development showed an increased risk of acute lower respiratory tract infections, oxidative stress from exposure to air pollutants, and asthma.

**Hypothesis Testing**

The hypothesis of this study was;

**H0<sub>1</sub>:** There is no significant relationship between environmental variables and occurrence of pneumonia among children under the age of five years in Kapenguria County Referral Hospital. The results are presented in Table 3.

**Table 3: Relationship between environmental variables and occurrence of pneumonia**

	<b>Pneumonia infection</b>
<b>Environmental variables</b>	$r = 0.684^{**}$ $p = .002$ $n = 198$

Table 3 shows a significant positive correlation ( $r = .684, p = .002$ ) between environmental variables and occurrence of pneumonia among children. Therefore, the hypothesis that “There is no significant relationship between environmental variables and occurrence of pneumonia among children under the age of five years in Kapenguria County Referral Hospital”, was rejected. This shows that there is a statistically significant relationship between environmental variables and occurrence of pneumonia among children under the age of five years in Kapenguria County Referral Hospital.

**5.0 Conclusion and recommendations**

The findings concluded that there was a significant positive correlation ( $r = .684, p = .002$ ) between environmental variables and occurrence of pneumonia among children. This implied that environmental factors influenced the occurrence of pneumonia among the children under five years in Kapenguria County Referral Hospital. The study therefore recommended that the government through the public health officers should ensure that the public live in conducive environment free from water and air pollution which are the major predisposing factors of pneumonia. The national environmental management authority should conduct environmental impact assessment to before construction of factories and other physical structures which release toxic products to the environment.

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