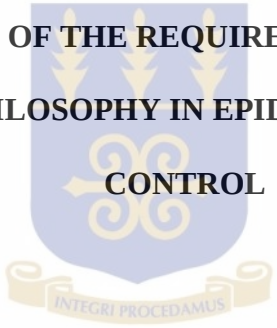
SCHOOL OF PUBLIC HEALTH, COLLEGE OF HEALTH SCIENCES,

UNIVERSITY OF GHANA

RISK FACTORS FOR PNEUMONIA IN CHILDREN UNDER FIVE AT KOMFO ANOKYE TEACHING HOSPITAL

A DISSERTATION SUBMITTED TO THE SCHOOL OF PUBLIC HEALTH, COLLEGE OF HEALTH SCIENCES, UNIVERSITY OF GHANA, LEGON IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE MASTER OF PHILOSOPHY IN EPIDEMIOLOGY AND DISEASE CONTROL



BY

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(10358409)

JULY 2012

DECLARATION

I do hereby declare that duly acknowledged citations and ideas. This dissertation is an original work produced by me from a study personally undertaken under supervision. This work has never on any previous occasion been submitted in part or whole to any institution or board for award of any degree.

CANDIDATE:

…… Date.....

AKOSUA GYASI DARKWA

SUPERVISOR

…… Date.....

DR. PRISCILLIA NORTEY

DEDICATION

This piece of work is dedicated to Akosua Aboagyewaa Darkwa , Akosua Agyeiwaa Darkwa and Dr. Dominic Akuoko Darkwa for their cooperation and understanding. It is also dedicated to all children less than five years of age.

ACKNOWLEDGEMENT

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I appreciate the support from the medical director, Dr. Baffour-Awuah as well as all staff of paediatric department of Komfo Anokye Teaching Hospital. I wish to thank all children and their parents or guardians who participated in this study after consenting.

Above all, I thank the God almighty for bringing me this far.

ABSTRACT

Background: Pneumonia kills more children under-five than AIDS, malaria and measles combined and yet has received far less attention. Each year, more than two million children under-five die of pneumonia in the developing world, compared to an estimated 800,000 children who die from malaria and around 300,000 children under-five who die from AIDS. In Ghana, pneumonia is one of the leading causes of death of under-five mortality and morbidity. Most mothers or care givers do not recognize the danger signs of pneumonia and realize the need for immediate medical care. Identification of modifiable risk factors may help reduce the disease burden. The objectives of this study are to study some of the environmental, nutritional and socio-demographic factors contributing to risk of pneumonia in children under five and to assess knowledge of mothers on health information about pneumonia.

Methods: A case-control study was conducted at Komfo Anokye Teaching Hospital. We investigated 228 children, 114 cases and 114 controls. A structured questionnaire was administered to consenting mothers or caretakers of each case or control from March 2012 to May 2012. A case definition of pneumonia as given by World Health Organization (WHO) was used for cases and children without pneumonia or any respiratory disease seen at the Pediatric Out-patient department were enrolled as controls. Data was entered into MS Excel and imported into SPSS version 16 and Epi Info version 3.5.1. for statistical analysis.

Results: 228 children including 114 cases and 114 controls were enrolled in the study. On univariate analysis, low maternal educational level (Odds Ratio (OR) =5.37, 95% Confidence Interval (CI) =2.09-14.14), overcrowding (OR=2.20, 95 % CI=1.22-3.99) and cooking fuel other liquid petroleum gas (OR=3.98, 95% CI=2.21-3.99) were the significant risk factors. Logistic regression analysis identified attendance at day-care center (OR=3.16, 95% CI=1.54-6.46) as the significant risk factor.

Children under five with low birth weight, partial/no immunization, partially breastfed, exposed to tobacco smoke or weaned before six months or malnourished were likely of getting pneumonia but association was not significant. There was no association between gestational maturity status, sex and age of mother.

Of the 228 mothers, 153(67.11%) have heard about pneumonia, 142(62.28%) believed exposure to cold weather and only 32(14.04%) said a germ causes pneumonia. 68(29.28%) know chest in-drawing, 137(60.89%) agreed fast breathing or difficult breathing and 22(9.65%) know breastfeeding as a preventive measure.

Conclusion: The present study identified low maternal age, overcrowding, cooking fuel other liquid petroleum gas and attendance at day-care center as risk factors for pneumonia in children under five at Komfo Anokye Teaching hospital. A lot of the mothers have heard about pneumonia but few know about the danger signs/symptoms, causes as well preventive measures for pneumonia

The information can be used to reduce the burden of pneumonia by effective education of the mothers and through appropriate public health measures.

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LIST OF ABBREVIATIONS

AIDS	-	Acquired Immunodeficiency Syndrome
ALRI	-	Acute Lower Respiratory Infection
ARI	-	Acute Respiratory Infection
AURI	-	Acute Upper Respiratory Infection
CI	-	Confidence Interval
DHS	-	Demographic and Health Survey
ETS	-	Environmental Tobacco Smoke
EPI	-	Expanded Programme on Immunization
GAPP	-	Global Action Plan for Prevention of Control of Pneumonia
KATH	-	Komfo Anokye Teaching Hospital
LBW	-	Low Birth Weight
LPG	-	Liquefied Petroleum Gas
HB	-	Haemoglobin level
HIV	-	Human Immunodeficiency Virus
ID	-	Identity
IGME	-	Inter-agency Group for Child Mortality Estimation
MDG	-	Millennium Development Goals
MICS	-	Multiple Indicator Cluster Surveys
OR	-	Odds Ratio
PAG	-	Pediatric Association of Ghana
UNICEF	-	United Nations Children's Fund
USA	-	United States of America
WBC	-	White Blood Count
WHO	-	World Health Organization

CHAPTER ONE

INTRODUCTION

1.1 Background

Child mortality, also known as under – five mortality refers to the deaths of infants and children under the age of five. Globally, child mortality continues to fall and the total number of under five deaths decreased to 8.1million per year in 2009 from 12.4 million per year in 1990 (UNICEF report, 2010).

The highest child mortality rates are still in sub-Saharan Africa where one in eight children dies before their fifth birthday nearly twenty times the average for developed regions (1 in 67). Southern Asia has the second highest rate with about one in fourteen children dying before reaching five. Sub-Saharan Africa have achieved only around a thirty percent reduction in under five mortality, less than half that required to reach MDG4. (IGME report 2011).

Six conditions account for about 70% of all child deaths: acute lower respiratory infections, mostly pneumonia (18%), diarrhea (18%), malaria (9%), Measles (1%), HIV/AIDS (2%) and neonatal conditions mainly pre-term birth, birth asphyxia and infections (37%)

Pneumonia is a form of acute respiratory infection that affects the lungs and is the leading cause of death in children worldwide. Pneumonia can be caused by bacteria, viruses or fungi. *Streptococcus pneumonia* is the most common cause of bacterial pneumonia in

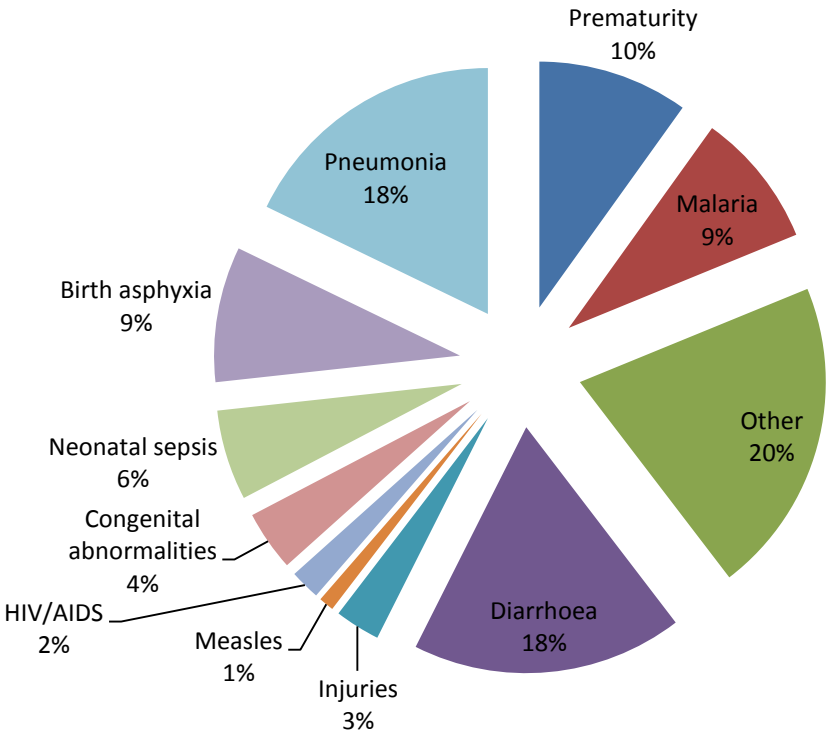
children whilst *Haemophilus influenza* type b is the second most common cause of bacterial pneumonia. Respiratory synctial virus is the most common cause of viral cause of pneumonia. It can be prevented by immunization, adequate nutrition and by addressing environmental factors. Pneumonia can be treated with antibiotics.

Pneumonia is frequently an associated cause of mortality in children with other underlying conditions. Co-morbid conditions especially malnutrition, measles or HIV increase the severity and risk mortality from pneumonia (Black et al., 2003.,Zar, 2004; Duke et al., 2003.)There are multiple risk factors identified to increase the risk of pneumonia in children under five. These have been grouped into demographic (gender and age), nutritional (low birth weight, malnutrition, inadequate breastfeeding, vitamin and micronutrient deficiencies, environmental (crowding, air pollution, smoking), lack of immunization, attendance to day-care centres and socio-demographic factors such as large family size, short birth interval, low income, low level of parental education, poor housing and in-appropriate child care practices.

Pneumonia accounts for approximately 1.9million deaths globally in children under five each year (Black et al., 2003; Campbell, 1995; Malholland, 1999; Williams et al., 2002). The WHO estimates that there are more than 150 million cases of pneumonia each year in children under five. It is the leading cause of death in children worldwide, killing 1.6 million children yearly and this accounts for 19% of all deaths of children under five years old worldwide. According to Paediatric Association of Ghana (PAG, 2010), pneumonia has been rated as one of the leading cause of under-five mortality and morbidity in Ghana, with twenty two percent of children under five dying from it.

Childhood pneumonia has been identified as a major "forgotten killer of children" by UNICEF and WHO.

Fig. 1.1: Causes of Under-five child deaths in low income countries



Source: WHO World Health Statistics, 2011

1.2 Problem Statement

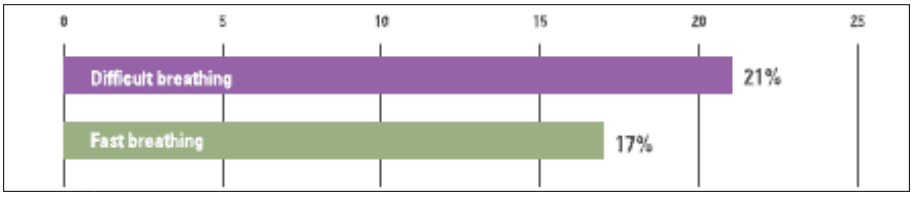
Pneumonia kills more children under five than AIDS, malaria and measles combined and is the single major killer of children under five in developing world. In spite of these relatively few global resources are dedicated to solving the problem and have received far less attention. Each year, more than two million children under five die of pneumonia in

the developing world, compared to an estimated 800,000 children who die from malaria and around 300,000 children under five who die from AIDS (out of about three million total AIDS deaths).

Recognizing the symptoms of pneumonia is the first step in reducing deaths among children under five. Caregivers or mothers play a critical role in recognizing pneumonia's symptoms and immediately seeking appropriate care for their sick children. Indeed it is critical that caregivers or mothers understand the importance of this disease and the risk it poses to their children's health. Yet, even though pneumonia is the leading killer of children in the developing world, most mothers and caregivers are ignorant about the danger signs and risk factors for pneumonia. Only about one in five caregivers know the danger signs of pneumonia (UNICEF 2004).

A case-control study in Atlanta (USA) to assess risk factors for pneumonia in children showed the odds ratio for children attending child-care centres was 2.96 ($p<0.05$) relative to children cared for at home. In another study done in Brazil (1996), odds ratio for attendance at child care facilities compared to home care was 5.2. In Ghana, there is little information on the association between these risk factors and pneumonia in children under five.

Fig 1.2: Percentage of Caregivers who know the 2 key signs of Pneumonia



Source: UNICEF, 33MIC, 1999-2001

1.3 Justification

In order to achieve MDG4 to reduce child mortality by two-thirds by 2015 there is the need to scale up interventions that contribute to reducing the burden of childhood pneumonia. This study seeks to provide evidence based information on the risk factors for pneumonia in children less than five. This will increase the knowledge and understanding of risk factors for pneumonia which can be used to improve the efficiency of health education programs both for mothers and health workers. The findings may provide information for possible interventions in order to the number of hospitalizations due to pneumonia among children under five. Knowing the risk factors for pneumonia can help us to be aware about various situations when we are at a higher risk of suffering from the infection.

1.4 Objectives

1.4.1 Main Objective

The aim of the study is to assess the risk factors of pneumonia in children less than five years at KATH.

1.4.2 Specific Objectives

1. To assess socio-demographic factors contributing to risk of pneumonia in children under five
2. To assess environmental factors contributing to risk of pneumonia in children under five.

3. To assess nutritional factors contributing to risk of pneumonia in children under five.
4. To assess knowledge of mothers about the causes, danger signs/symptoms and prevention of pneumonia.

CHAPTER TWO

LITERATURE REVIEW

2.1 Definitions

Pneumonia

The term ‘pneumonia’ refers to ‘suspected pneumonia’. A suspected case of pneumonia is identified by its clinical symptoms, since diagnostic confirmation using radiography or laboratory tests is usually not available in resource-poor settings. All children under five of age with suspected pneumonia, therefore, are defined as having cough and fast breathing. Suspected pneumonia cases are further classified as either ‘severe’ or ‘non-severe’.

Acute Respiratory Infections

This includes any infection of the upper or lower respiratory system, as defined by the International Classification of Diseases. Acute lower respiratory infections affect the airways below the epiglottis and include severe infections, such as pneumonia. Pneumonia accounts for a significant proportion of the disease burden attributed to lower respiratory infections. Acute respiratory infections (ARI) range in spectrum from mild colds and coughs to life-threatening pneumonias. ARI particularly pneumonia is the major cause of morbidity and mortality among young children.

Incidence

It is estimated that more than150 million episodes of pneumonia occur every year among children under five in developing countries, accounting for more than 95per cent of all

new cases worldwide. Between 11million and 20million children with pneumonia will require hospitalization, and more than 2million will die from the disease. Incidence of pneumonia decreases with age among children.

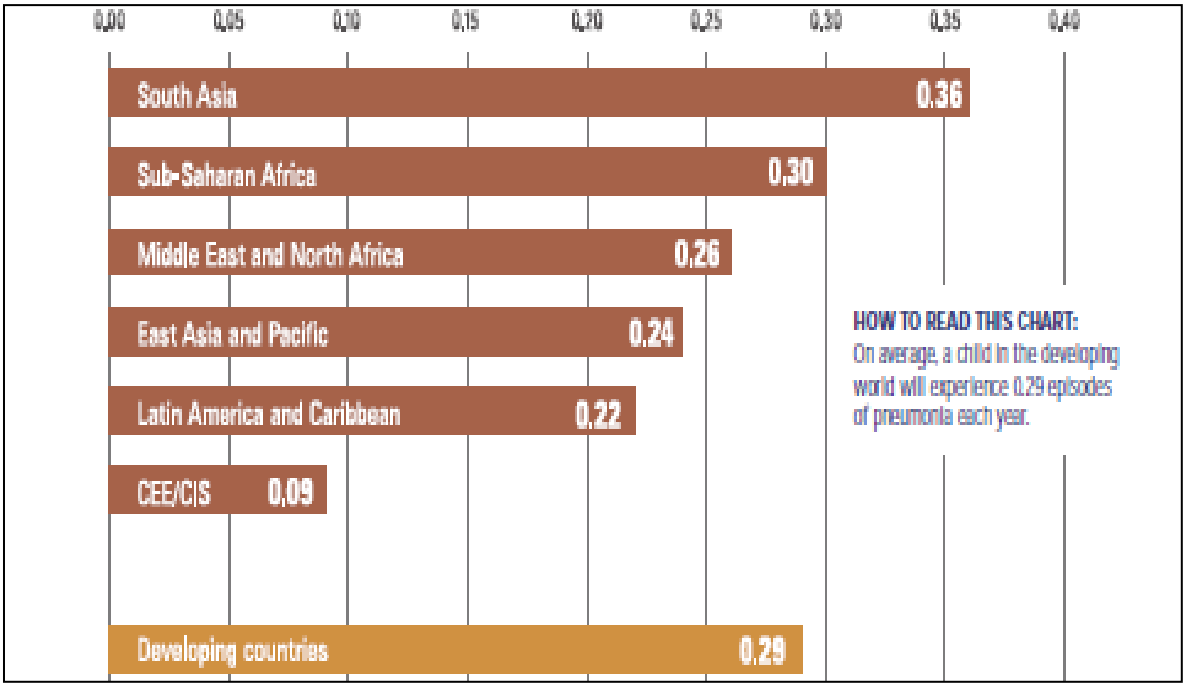
Table 2.1: Incidence of pneumonia in children under five, 2004

UNICEF region	No. of under five children(000)	No. of childhood pneumonia deaths(000)	Incidence of pneumonia cases(episodes/child/yr)	Total no. of pneumonia episodes(000)
South Asia	169,300	702	0.36	61,300
Sub-Saharan Africa	117,300	1022	0.30	35,200
Middle east and North Africa	43,400	82	0.26	11,300
East Asia and pacific	146,400	158	0.24	34,500
Latin American and Caribbean	56,500	50	0.22	12,200
CEE/CIS	26,400	29	0.09	2,400
Developing countries	533,000	2,039	0.29	154,500
Industrialized countries	54,200	1	0.03	1,600
World	613,600	2,044	0.26	158,500

Note: Regional estimates in columns 2, 3 & 5 do not add up to world total due to rounding

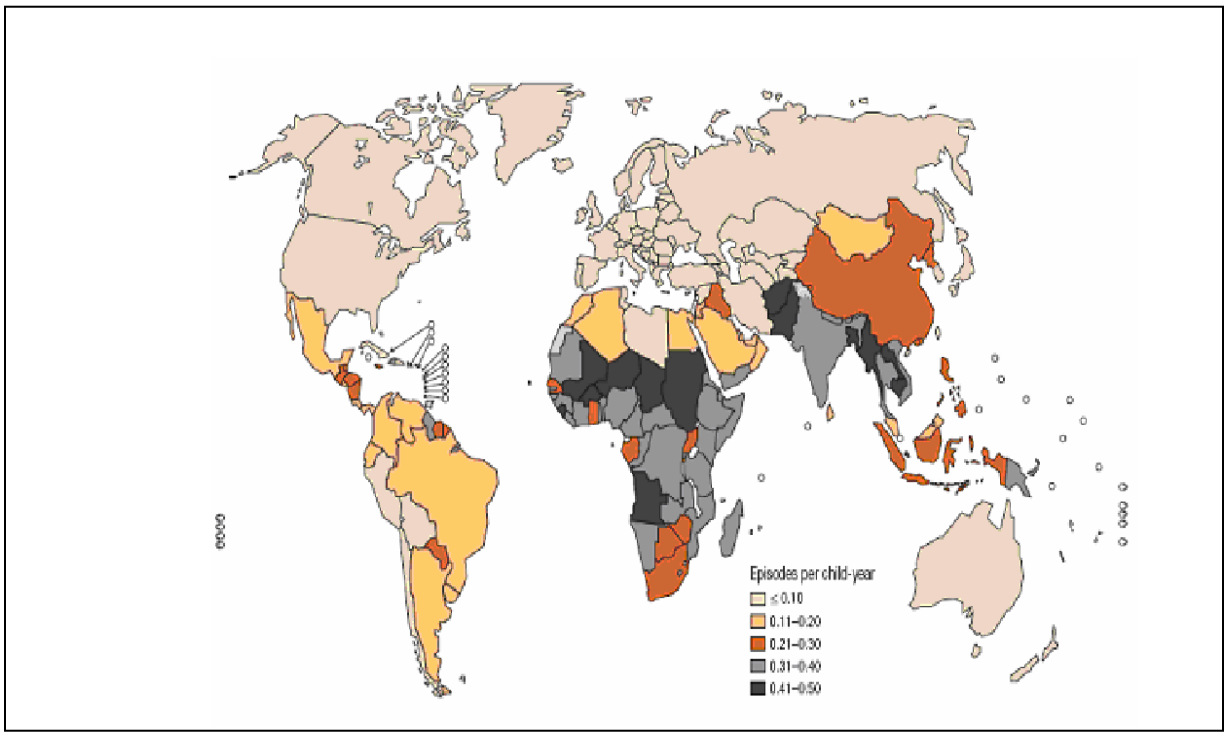
Sub-Saharan Africa together with South Asia bears the burden of more than half of the total number of pneumonia episodes worldwide among children under five.

Fig 2.1: Episodes of Pneumonia per Child per year by UNICEF Region, 2004



Source: UNICEF, 2004

Fig 2.2: Incidence of Pneumonia at country Level



Source: UNICEF/WHO, 2004

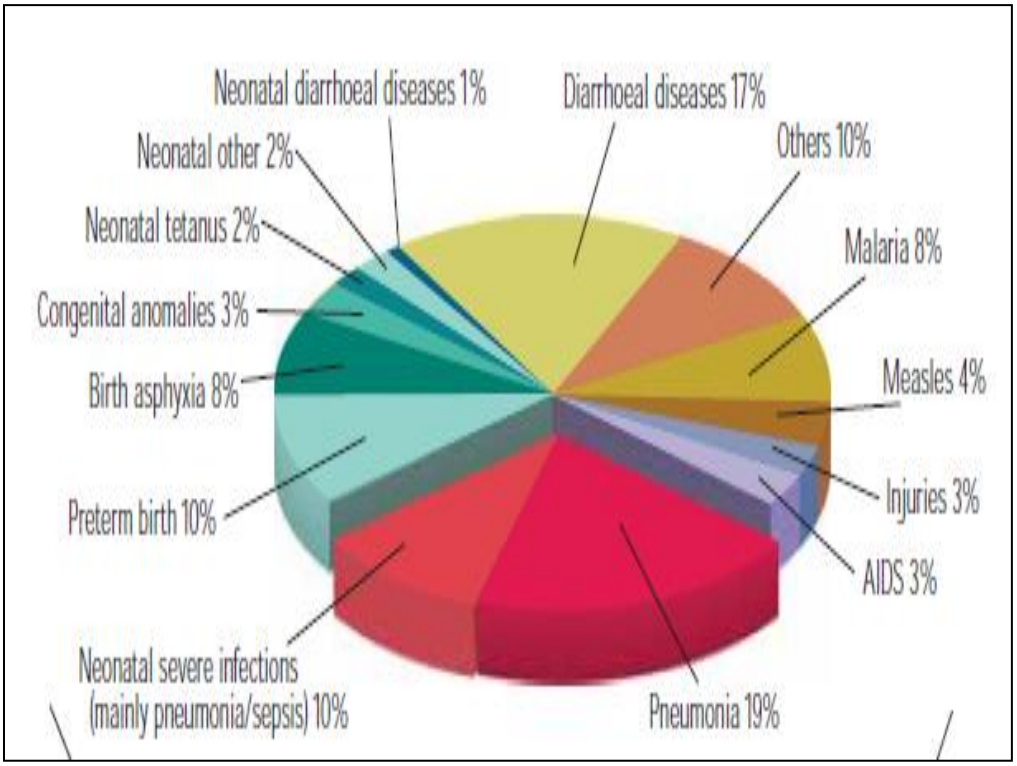
2.2 Mortality

Around 10.5 million children still die every year before reaching their fifth birth day. Most of these deaths occur in low and middle income countries and pneumonia is the major cause of these deaths.

Figure 2.3 represents the global of the primary causes of all under-five deaths and shows the pneumonia kills more children than any other illness – accounting for 19 per cent of all under-five deaths. However, this does not include deaths due to pneumonia during the neonatal period- the first four weeks of life. It has been estimated that 26 per cent of neonatal deaths are caused by severe infections during the neonatal period and a

significant proportion of these infections is caused by pneumonia/sepsis. If these deaths were included in the overall estimate, pneumonia would account for up to 3 million.

Fig 2.3: Global distribution of mortality causes among children under five, 2004



Source: UNICEF, 2004

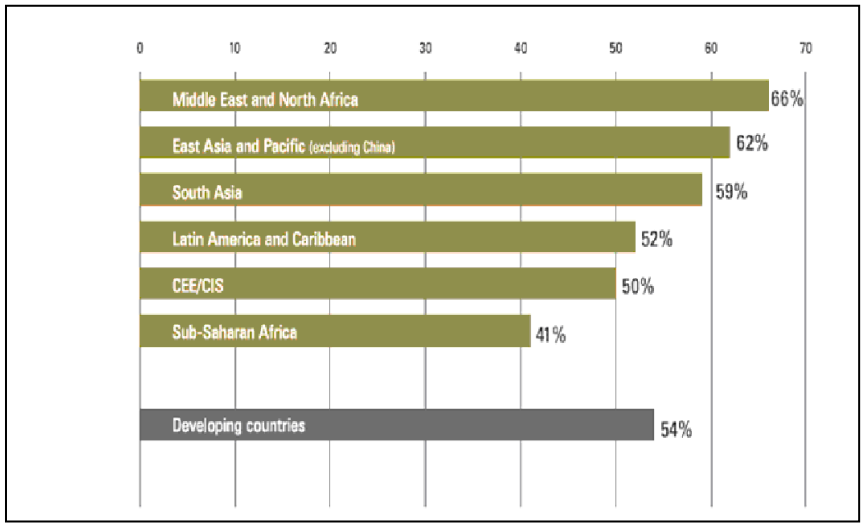
2.3 Care Seeking Behaviour

The second step in reducing deaths among children under –five with pneumonia is for caregivers to seek appropriate medical care for a child with suspected pneumonia. Appropriate care, as defined by WHO and UNICEF includes providers that can diagnose correctly and treat pneumonia, such as hospitals, health centers, dispensaries, community

health workers, maternal and child health clinics, outreach clinics, and physicians' private offices.

Only about half (54 per cent) of children under five in the developing world were taken to an appropriate provider. Sub-Saharan Africa has the lowest levels of care-seeking for pneumonia (41 per cent) while the Middle East and North Africa (66 per cent) and East Asia and Pacific (62 per cent) have the highest rates.

Fig 2.4: Children under five with pneumonia taken to health care provider



Source: UNICEF, 2004

Data for 67 countries indicate that caregivers take boys and girls to appropriate medical care almost equally, children in urban area and those whose mothers have higher education are more likely to be taken to an appropriate provider. Again, compared to poor children, children from richer families are about 30 per cent more likely to be taken for appropriate medical care.

2.4 Etiology

The bacterial pathogen *streptococcus pneumonia* is the leading cause of pneumonia among children across the developing world. Another major cause is the bacteria, *Haemophilus influenza* type b (Hib). Other pathogens include viruses and fungi.

Table 2.2: Pathogen specific causes of Pneumonia

Pathogen	Distribution of Pneumonia by Cause
Streptococcus pneumonia	Leading cause
Haemophilus influenza	Major cause
Other viruses- RSV, Influenza	Less common
Other bacterias- *Staph. Aureaus, Klebsiella*	

2.5 Risk factors for pneumonia

2.5.1 Demographic risk factors

Gender

In a number of community based studies, boys appear more frequently affected by pneumonia than girls. However in clinical studies, possibility of gender bias in seeking care cannot be ruled out, which may show male preponderance. The excess risk for boys was confirmed in a case control study conducted by Victora CG et al. (1994) in Brazil.

A study conducted by Dharmage SC et al (1996) in Srilanka and by Selwyn BJ et al., (1990) has also shown increased risk of ALRI in male children.

Age

In a study by Koch A et al., (2003) and Banjesh et al., (1998) showed that age up to 12 months was found a risk factor for pneumonia. There has also been reports by Selwyn BJ et al. (1990) and Shah et al. (1994) that incidence rate for ARI are highest in younger children. In a study by Thamer KY et al. (2006), it was shown that early infancy less than two months of age has a highly significant association with severe ARI. About one half of all respiratory deaths among children under five occur in the first six months after birth.

2.5.2 Socio-economic risk factors

Income

The first indication that pneumonia is associated with socio economic risk factors is the pronounced difference between countries especially developed and developing countries.

The estimated incidence of clinical pneumonia in children under five years for developing countries is 0.29 episodes per child year, with a maximum of 0.36 for south east Asia and for developed countries it is only about 0.05 episodes per child year. The incidence of new cases of clinical pneumonia is 151.8 million in developing countries while it is only about 4.08 million new cases in developed countries (Igor et al., 2008).

Savitha MR et al. (2007) in their case control study of modifiable risk factors for ALRI have shown that, ALRI cases were significantly higher (93.3%) in children belonging to class IV and V of Kuppuswamy's socio economic class (Farhan et al, 2007).

Interestingly, O' Dempsey et al. (1996) in the Gambia found children of mothers with a personal source of income to be at lower risk of ALRI. This highlights the challenges faced by mothers who while enhancing their children's health by increasing their income through working, may paradoxically place their children at risk by shortening duration of breastfeeding and placing children in daycare centers from a young age.

Parental education

Low educational level of parents is associated with an increased risk of pneumonia. In a study conducted by Savitha MR et al. (2007), there were significantly higher numbers of illiterate mothers in cases compared to controls (63.46% Vs 19.23%).

However in a pneumonia case control study by Victoria CG et al. (1999), father's education was more strongly correlated than the mother's education.

A study by Halder A et al. (2005) done in West Bengal, India, has shown that 93% of children whose parents were up to primary education level suffered from >5 episodes of ALRTI as compared to 55.3% whose parents had higher literacy levels ($Z=7$, $P<0.05$).

Ballard TJ et al. (1995) in their study have shown that having more than five siblings and parents with low reading skills were risk factors for ALRTI in young Kenyan children. Shan N et al. (1994) in a study of risk factors for severe pneumonia in children have shown that parental education was a significant risk factor for severe pneumonia.

Place of residence

ARI incidence rates vary markedly between urban children (5-9 episodes per child per year) and rural children (3-5 episodes) (AHRTAG, 1992) which may be due to increased

transmission due to overcrowding. Cardoso et al. (2004) found children with respiratory disease to come from houses with poor sanitation than controls. Even in urban areas of South Africa, 20% of people use inadequate sanitation facilities, while in rural areas this is as high as 35%. (UNICEF 2007)

2.5.3 Environmental risk factors

The most frequently studied environmental risk factors for respiratory infections include exposure to smoke, crowding and humidity.

Domestic biomass pollution: The high costs and limited availability of electricity and fossil fuels in many developing countries lead to frequent domestic use of biomass fuels, like wood and agricultural waste. It is estimated that in developing countries, 30% of urban households and 90% of rural households use biomass fuels as the major source of energy for cooking and heating (WHO, 1985). These are usually burned under inefficient conditions and often without any type chimney. Particulate levels in these houses are about twenty times greater than in developed countries (Pandey MR et al, 1989). Studies from Gambia, South Africa, Zimbabwe and Argentina have reported higher respiratory morbidity among young children exposed to indoor pollution. (Armstrong JAM et al,1991; Collins DA et al,1990; Kossove D et al,1982; Cerqueiro et al, 1990). Broor S et al (2001) in their study have shown that use of cooking fuel other than LPG was a significant risk factor (OR 2.5) for severe ALRTI in under five children. Savitha MR et al (2007) have also shown in their study that use of cooking fuel other than LPG was strongly associated with ALRI (98% in cases Vs 55% in controls).

Environmental tobacco smoke (ETS): Cigarette smoke contains measurable quantities of carbon monoxide, ammonia, nicotine, hydrogen cyanide, particulates, and a number of

carcinogens. The concentrations of most of these products are higher in side stream than in mainstream smoke (Surgeon General Report, 1984). The association between environmental tobacco smoke, often referred to as passive smoking, and respiratory illness in children has been clearly established by large number of studies. In a case control study by Ihaz Hafez et al (1997) in Egypt, it is shown that household passive smoking is a risk factor for ALRI in young children. Similar results were obtained in a study conducted by Dharmage SC et al (1996) in Srilanka. This association is stronger for infants than for older children and also stronger for maternal than paternal smoking (Prietsch SO et al., 2003; Hjern A et al., 2000; Macebo et al., 2007). More than 150 studies have been published linking ETS to respiratory illness in children with meta-analysis finding strong evidence for associations between both prenatal maternal smoking and postnatal ETS exposure and risk of ARI in children. (DiFranca et al, 2004). In a review of 38 studies, Strachan et al. (1997) found all but one to be consistent with an increased risk of ARI for children exposed to parental smoking, with pooled ORs of 1.57 (95% CI 1.42 - 1.74) for smoking by either parent and 1.72 (95% CI 1.55 - 1.91) for maternal smoking. Risk of respiratory illness was increased if household members other than the child's parents smoked. (OR: 1.29, 95% CI 1.16 to 1.44). When limited to children under five, the effect is even more marked with an OR of 2.5 (95% CI 1.86 – 3.36)

Crowding: Crowding, which is notably common in developing countries contributes to transmission of infections through respiratory droplets and has been clearly shown to be associated with respiratory infections (Savitha MR et al., 2007; Rahman MM et al., 1997). In a case control study in Sao Paulo, Cardoso et al (2004), found crowding (≥ 4

people sharing the child's bedroom) to be associated with 2.5 fold increase risk of ALRI, with case tending to live in smaller houses than controls. Other studies from developing and developed countries have found similar effects for crowding and number of siblings. (Fonseca et al., 1996a; Brims et al., 2005; Ozcirpici et al., 2004; Howden-Chapman, 2004; Graham 1990). Crowding may occur outside the home in day care centres. Day care centers, which increase the contact between young children are also associated with pneumonia (Fonseca W et al.,1996; Hassan MK et al., 2001). Risk of acquiring ARI in day care centers is particularly increased for younger children (less than18 months of age) and those with poorer access to health care services. (Lu et al., 2004) A study done by Victoria CG et al (1994) in Brazil showed a strong association between day care attendance and pneumonia among children less than two years of age. Crowding, therefore, whether at home or in institutions, is one of the best established risk factors for pneumonia.

Exposure to cold and humidity: According to popular belief, cold weather brings about respiratory infections, as implied by words cold and flu (Italian influenza del frigore, influence of cold). In a study conducted by Wg Cdr. JMukhopadhya (2001), 68% of ARI cases were seen in winter. Deaths due to pneumonia are considerably higher during winter months as shown by a study in Brazil (Victoria CG et al., 1985). It is possible that correlates of cold weather, such as crowding or domestic biomass pollution may be responsible for the higher respiratory morbidity and mortality during winter months (Graham NM et al., 1990).

Atmospheric pollution: Morbidity and mortality from respiratory diseases due to air pollution is well documented. Studies from Industrialized countries provide supporting

evidence for the existence of effects from suspended particles and sulfur dioxide (Graham NM et al, 1990). An ecological study conducted by Bobak M et al (1992) in Czech Republic showed a strong association between postnatal respiratory mortality and levels of total suspended particulates and possibly sulfur dioxide, after controlling for several confounding factors.

In a study conducted by Penna MLF et al (1991) in Brazil, infant mortality from pneumonia was compared with suspended particulate levels. A direct association (r=0.3) was observed, independent of socioeconomic differences. Studies on the effects of air pollution have been affected by a number of methodological difficulties, including ecological design and problems in air pollution measurement (Graham NM et al, 1990).

2.5.4 Nutritional risk factors

Nutritional factors that may influence the risk of ALRI include birth weight, nutritional status, breast feeding, and levels of vitamin A and other micronutrients.

Low birth weight (LBW): It is estimated that 19% of all babies born in developing countries have low birth weight (i.e. birthweight <2.5 kg). Mechanisms that link birth weight to pneumonia are reduced immunity, disruption in integrated development of airways alveoli and impaired lung functions.LBW babies may have a higher incidence of pneumonia because LBW may lead to short duration of breastfeeding and to poor nutritional status. LBW infants are mostly born preterm (<37 weeks gestation). Preterm infants tend to have impaired lung function during childhood. This impairment may be a consequence of mechanical ventilation for neonatal respiratory illness with resulting bronchopulmonary dysplasia. In Argentina, LBW children under five years had 2.2 times more hospital admissions than other children (Cerqueiro MC et al., 1990). A case control

study conducted by Shah N et al in Kerala, India has shown that low birth weight is a risk factor for severe pneumonia in children under five (Shah N et al., 1994). Similarly studies conducted in Srilanka by Dhaarmage SC et al (1996) and Fonseca W et al(1996) in Brazil have also shown a low birth weight as risk factor for pneumonia.

Malnutrition: Nutritional status is an important determinant of pneumonia case fatality and morbidity (Victora C G et al., 1999). Protein energy malnutrition results from inadequate intake, poor utilization of calories or protein in the diet, or from childhood infectious diseases such as diarrhea and pneumonia. Immunosuppression is more in severely malnourished children and is responsible for the increased incidence and severity of infection including pneumonia. Numerous studies in developing countries, have shown consistent significant relationship between malnutrition and both incidence of, and mortality due to, ARI in children (Victora et al, 1999; Fonseca et al., 1996; Broor et al., 2001). A study by Victora et al (1999) in Brazil showed that moderately or severely malnourished children were 4.6 times at risk of pneumonia compared to well nourished children. In epidemiological studies, malnutrition is usually assessed by using anthropometric measurements. Studies of malnutrition and ALRI have reported different indicators like low height for age (stunting), low weight foe height (wasting) and low weight for age(under weight) or combinations of three. Study conducted by Savitha MR et al (2007) in India has reported malnutrition as the risk factor for ALRI with low weight for age as indicator. Similarly, studies conducted by Shan N et al (1994) and Broor S et al (2001) have reported low weight for age as risk factor for ALRI. Dharmage SC et al (1996) have also reported malnutrition in the form of stunting (low height for age) as risk factor for ALRTI. In another study, all three indicators of malnutrition, weight for height,

height for age, and weight for age have been reported as risk factors for childhood pneumonia with OR 6.75, 5.05 and 4.57 respectively (Fonseca W et al., 1996).

Lack of breast feeding: Breast milk protects against pneumonia through a number of mechanisms, including its antibacterial and antiviral substances, immunologically active cells and stimulants of the infant immune system. Savitha MR et al (2007), Broors et al (2001) and Dharmage SC et al (1996), have reported lack of exclusive breast feeding for at least four months as a risk factor for ALRI. Hassan MK et al (2001), in their study have reported that weaning from breast milk at less than six months as risk factor for pneumonia in children in Iraq. Breatfeeding protects against pneumonia by providing antibacterial and antiviral factors including secretory IgA, lactoferrin, oligosaccharides, and the bifidus factors which inhibits colonization by gram-negative pathogens (May JT et al., 1998; Garza C et al., 1990; Hanson LA et al., 1990). Breast milk has shown to inhibit the attachment of *Steptoccocus pneumoniae* and *Haemophilus influenza* tybe b to the epithelial cells from the human respiratory tract (Anderson B et al., 1986).

Vitamin A deficiency: The evidence on the role of vitamin A deficiency as risk factor for pneumonia results mainly from randomized controlled trials. A study conducted by Shan N. Et al (1994) in India has shown a significant association between vitamin A deficiency and severe pneumonia. Another study showed a dose response effect of vitamin A level with a gradient. Serum vitamin A level was 22.08µg/dl for severe cases of respiratory infections (Dudley L et al., 1997). Other micronutrients like iron, zinc, copper and vitamin D may also play a role in the causation of ALRI as Wayse V et al (2004) in their study have reported a significant association between subclinical vitamin

D deficiency and ALRI. Similarly Savitha MD et al (2007) have also reported significant association of Ricketts with ALRI.

2.5.5 Immunization

Lack of appropriate immunization for age especially immunization against measles is a risk factor for pneumonia. Studies conducted in India has confirmed the lack of complete immunization for age as a risk factor for pneumonia (Broor S et al., 2001; Savitha MR et al., 2007). Haldar A et al (2005) in their study showed that absence of measles immunization as a risk factor for ALRI with odds ratio of 6.

2.6 Control of acute respiratory infections

2.6.1 Management of pneumonia

The WHO's Global Action Plan for Prevention and Control of Pneumonia (GAPP) has been developed in order to increase awareness of pneumonia as a major cause of child death, call for scaling up the use of interventions of proven benefit, and provide guidance on how this can be done (WHO/UNICEF, 2009). The various interventions for controlling pneumonia in children under-five under GAPP are categorized as follows:

Protect children by providing an environment where they are at low risk of pneumonia - children by providing a healthy environment, exclusive breastfeeding for six months, adequate nutrition, Prevent low birth weight, reduce indoor air pollution, and Hand washing.

Hand washing with soap reduces the risk of acute respiratory infections and diarrhoea (Luby & Halder, 2008). In a randomized controlled trial in Pakistan, neighbourhoods

received hand washing education and then were randomly provided with plain or antibacterial soap. Control neighbourhoods received neither education nor soap. Children <5 years from the household who received soap had a 50% reduction in pneumonia episodes (95%CI -65 to -34) (Luby & Halder, 2008). There was no difference between the households that used plain or antibacterial soap (Luby & Halder, 2008). Widespread implementation of hand washing when used together with improved water and sanitation has been estimated to reduce child deaths by 3%.

Prevent children becoming ill with pneumonia - children becoming ill with pneumonia vaccination against measles, pertussis, Spna and Hib, Prevention of HIV in children, co-trimoxazole prophylaxis for HIV-infected and exposed children Zinc supplementation for children with diarrhea (WHO/UNICEF, 2009). Development of vaccines against the common respiratory pathogens has been a major advance in reducing the global burden of childhood pneumonia. Pertussis and measles immunisation, as part of the global Expanded Program on Immunisation (EPI), have significantly reduced childhood deaths in low and middle income countries (WHO, 2008). Conjugate vaccines against two of the common bacterial causes of childhood pneumonia, *H. influenzae* type b (Hib) and *S. pneumoniae*, are now available with widespread coverage in high income countries. However, these vaccines have not yet been widely incorporated into the EPI of most low and middle income countries.

Improving the primary medical care services and developing better methods for early detection, treatment and where possible prevention of acute respiratory infections is the best strategy to control ARI.

Effective reduction of mortality due to pneumonia is possible if children suffering from pneumonia are treated correctly. Education of mother is also crucial since compliance with treatment and seeking care promptly where signs of pneumonia are observed is important.

2.7 Classification of acute respiratory infections

The guidelines for case management and antibiotic use recommended by WHO ARI programme are appropriate for developing countries with limited resources and an infant mortality rate of more than 40 per 1000 live births. They are predicted on the assumption that the incidence of bacterial pneumonia among children seen in primary health care establishments is high and that the risk factors for pneumonia (For example malnutrition and LBW) are relatively common, leading to high pneumonia deaths rates.

Standard plan for case management

The core of WHO protocol for case management of ARI for use in first level health facilities is distinguishing cases of pneumonia from other cases of acute respiratory infection and providing appropriate treatment. For simplicity the smallest number of criteria is used for the diagnosis of cases.

The WHO protocol consists of three essential steps.

i. Identification of children who should be examined for possible pneumonia (case finding or assessment on the basis of 'entry criteria')
ii. Identify the cases of pneumonia (case classification)
iii. Institute the appropriate treatment (home treatment or referral).

Entry criteria

Cough and difficult breathing are the two entry criteria for assessing children for pneumonia, as they are present in almost all children under five with respiratory tract infections.

Identification of pneumonia cases

To identify pneumonia in children among the many children assessed presenting with cough or difficulty in breathing, respiratory frequency and chest in-drawing are selected as two signs most predictive of pneumonia.

It is necessary to distinguish between infants under months of age and older children since the etiology and clinical manifestations of pneumonia are different in these age groups.

For Children aged less than 2 months

In young infants pneumonia is identified if the Respiratory rat ≥ 60 breaths per minute or when there is marked chest in-drawing. They can become sick and die very quickly from pneumonia and frequently have only non specific signs such as poor feeding or low body

temperature. Therefore any young infant who has a sign of pneumonia is classified as having severe pneumonia.

The danger signs of very severe disease are convulsions, abnormally sleepy or difficult to wake, stridor in when calm, infants stops feeding well, wheezing, has fever or hypothermia (Temp. 35.5^{O} C)

For Children 2 months – 5 years old

Children are considered to have pneumonia if the respiratory rate is

≥ 50 breaths per minute – 2-11 months old

≥ 40 breaths per minute – 12- 59 months old

Presence of lower chest in-drawing is considered is considered sign of severe pneumonia.

The danger signs of very severe disease are

- Not able to drink
- Convulsions, abnormally sleepy or difficult to wake
- Stridor in a calm child
- Severe malnutrition

Table 2.3 Classification of ARI in children

For children aged below 2 months				
Signs	Stopped feeding well Convulsions Abnormally sleepy Stridor in calm child Fever or hypothermia	Severe chest indrawing or fast breathing	No severe indrawing and no fast breathing	
Classify as	Very severe disease	Severe pneumonia	No pneumonia cough or cold	
Treatment	Refer urgently to hospital Keep child warm Give first dose of antibiotic	Refer urgently to hospital Keep child warm Give first dose of antibiotic	Advise mother to keep child warm Breastfeed frequently Clear nose if interferes with feeding Return quickly if Breathing becomes difficult Breathing becomes fast Feeding becomes difficult Child becomes sick	
For Children aged between 2 months - 5 years				
Signs	• Not able to drink • Convulsions • Abnormally sleepy • Stridor in calm child • Fever or hypothermia	Chest in-drawing	Fast breathing No chest in-drawing	No fast breathing No chest in-drawing
Classify	Very severe pneumonia	Severe pneumonia	Pneumonia	No pneumonia (cough or cold)
Treatment	Refer urgently to hospital Give first dose of antibiotic Treat fever if present Treat wheeze if present	Refer urgently to hospital Give first dose of antibiotic Treat fever if present Treat wheeze if present	Advise to mother to give home care Give an antibiotic Treat fever if present Treat wheeze if present Reassessment after two days	Advise to mother to give home care Treat fever if present Treat wheeze if present

2.8 Treatment of pneumonia

For children aged 2months-5 years

Pneumonia: Co-trimoxazole is the drug of choice for treatment of pneumonia. The condition of child should be assessed after 48 hours. Co-trimoxazole should be continued for another 3 days in children who show improvement in clinical condition, if condition worsens child should be hospitalized immediately.

Severe pneumonia: children with severe pneumonia should be treated as inpatients with intramuscular injections of benzyl penicillin for 5 days and continued for at least 3 days after child gets well. In a study in Ghana (Addo-Yobo et al., 2004), it was found that injectable penicillin and oral amoxicillin are equivalent for severe pneumonia treatment in controlled settings.

Very severe disease: Children with signs of very severe disease are in imminent danger of death and should be treated in a health facility, with provision for oxygen therapy and intensive monitoring.

For children aged less than 2months

If pneumonia is suspected the child should be treated with intramuscular injections of benzyl penicillin along with gentamycin.

Management of AURI (No pneumonia)

Antibiotics are not recommended for coughs and colds. Symptomatic treatment and care at home is generally enough in such cases. The mothers must be advised on how to take care of the child at home.

Hospitalized patients are usually treated with intravenous antibiotics, an advanced generation cephalosporin in combination with a macrolide. The choice of initial, empiric agent is selected according to the susceptibility and resistance pattern of the likely pathogens and experience of the health institution.

CHAPTER THREE

METHODS

3.1 Study Design

We conducted an unmatched case-control study involving children under five at the outpatient and inpatient paediatric department of KATH.

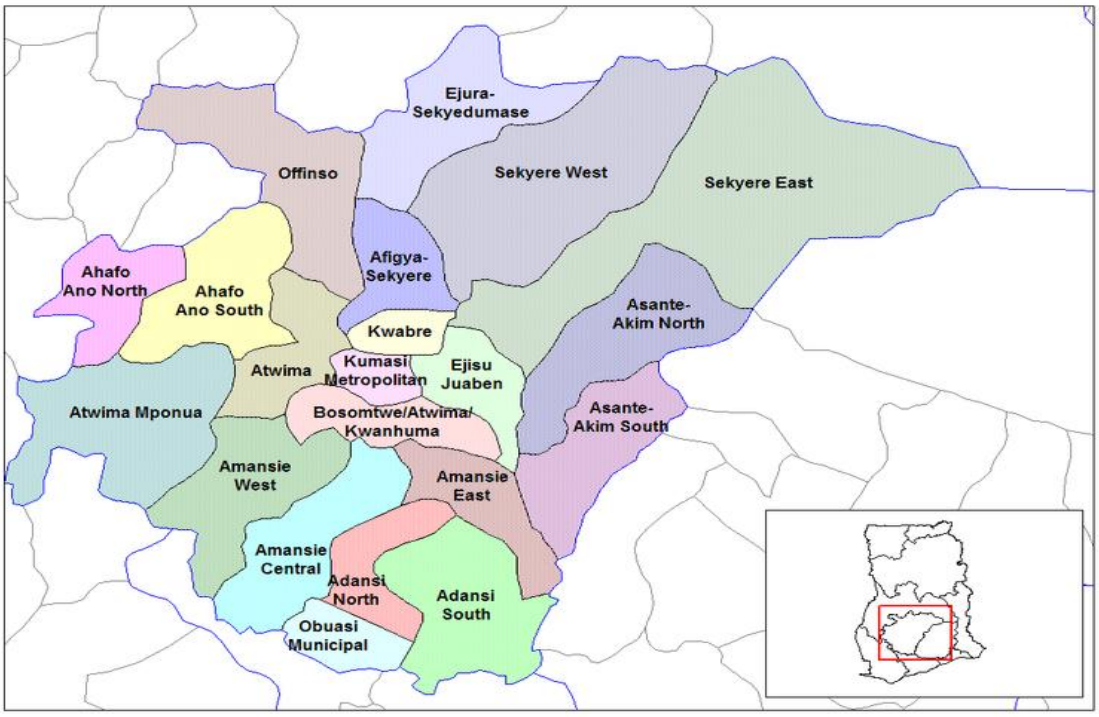
3.2 Study Area

The Kumasi Metropolitan Area is one of the twenty seven districts in the Ashanti Region of Ghana. It occupies a land area of approximately two hundred and fifty four square kilometers. Kumasi is approximately 480km north of the Equator and 160km north of the Gulf of Guinea. The metropolitan area shares boundaries to the North with the Kwabre district. The South is bordered by Bosomtwe district and to the East is Ejisu-Juaben Municipal. The West is bordered by the Atwima Kwanwoma and Atwima Nwabiagya districts. The population is estimated at about 1,517,000. There are six major hospitals in Kumasi Metropolitan Area. These are Komfo Anoke Teaching Hospital, Kwame Nkrumah University of Science and Technology Hospital, the Seventh Day Adventist Hospital (SDAH), the Animwa Medical Centre, Kumasi South Hospital and South Suntreso Health Centre.

The study was conducted at Komfo Anokye Teaching Hospital (KATH), Kumasi. The hospital established in 1955 is the second largest in Ghana and the only tertiary health institution in the Ashanti region. It is the main referral hospital for the Ashanti, Brong-

Ahafo, Northern, Upper East and Upper West Regions. The Directorate of Child Health is one of the clinical directorates of the hospital. It has an out-patient section, Pediatric Emergency Unit, in-patient and a diagnostic centre.

Fig 3.1: Map Showing Kumasi Metropolitan Area



Source: Map data 2006 Google

3.3 Study Population

The study population was children under five years of age seen at the outpatient pediatric department or admitted to the pediatric emergency unit of KATH.

3.4 Sample Size and sampling procedure

The Fleiss equation for analytic studies was used to calculate the minimum sample size.

$$N_1 = \frac{Z_{\alpha/2}\,(r+1)\,pq \;+\; Z_{1-\beta}\,rp_1q_1 + p_2q_2^{\,2}}{r\,(p_1-p_2)^2}$$

N_1 = Number of cases

N_2 = Number of controls

r = Ratio of cases to controls 1:1

P_1 = Proportion of cases with exposure

P_2 = Proportion of controls with exposure

q_1 = 1-p1

q_2 = 1-p2

A total of 114 cases and 114 controls were used in the study. It was calculated using the following parameters, for case-control study where proportion of controls with exposure of 60 and proportion of cases with exposure of 40. With a CI(1-α) of 95% and a power (1-β) of 80%, minimal detectable odds ratio of 2.25 and prevalence of 29% (WHO, 2004) and ratio of case to controls 1:1

3.4.1 Selection of Cases

Incident cases of pneumonia were selected by medical officers trained for the study from Paediatric Emergency Unit (PEU) until reaching the required sample size. Diagnosis of pneumonia was made by either specialist during ward rounds or resident paediatric medical officers in the paediatric emergency unit and mothers or caretakers were briefed about the study.

A case was a child under five years of age clinically diagnosed with pneumonia according to WHO (Geneva 2005) criteria admitted at the pediatric emergency unit of KATH, from March to May, 2012.

Case definition of pneumonia (WHO criteria)

- Children younger than 2months: greater than or equal to 60breaths per min

- Children aged 2-11months: greater than or equal to 50breaths per min

- Children aged 12-59months: greater than or equal to 40breaths per min

3.4.2 Selection of Controls

A control was also selected from the outpatient paediatric consulting room. The medical officer incharge of the paediatric consulting room was briefed about the study and directed mothers to the research assistants after seeing the children. A control was a child under five without pneumonia or any other respiratory condition from the outpatient pediatric consulting room of KATH, from March to May, 2012.

3.4.3 Inclusion Criteria

Any child

- under- five years admitted at the paediatric emergency unit or seen at the outpatient paediatric unit of KATH.
- under-five years who met the WHO criteria for diagnosis of pneumonia.
- whose mothers or caretakers agreed to participate in the study

3.4.4 Exclusion Criteria

Any child

- was above five years
- was severely ill
- presented with Asthma
- presented with history of aspiration of a liquid or foreign body
- who did not meet the WHO criteria for pneumonia
- whose mothers or caretakers did not agree to participate in the study

3.4.5 Variables

Dependent Variable

- Pneumonia

Independent Variables

- Age
- Nutritional status
- Crowding
- Type of cooking fuel
- Attendance at day-care
- Immunization status
- Breastfeeding status
- Educational level of mother

3.5 Data Collection Techniques and Tools

Verbal or informed consent was obtained from mothers or caretakers for both cases and controls.

A structured questionnaire was administered to each consenting mother or caretaker of each case or control. The questionnaire included questions on child care practices, anthropometric status, preschool or home conditions, vaccination or breastfeeding history, parental smoking status, socioeconomic status and reproductive history of mothers. Weight was measured to the nearest kilograms with a standardized weighing machine. Height was also measured to the nearest centimeter by drawing a metric scale on the wall and in case of small children by standard measuring tape. Modified Gomez classification was used for assessment of nutritional status. Permission was obtained from the head of the paediatric department. For both cases and controls detailed history and physical examination was done to elicit various potential risk factors. Data regarding age, sex, parents' literacy and parents' occupation was obtained. A detailed history of relevant symptoms was taken. History of immunization was elicited from informed parents and verified by checking the records whenever available or by mother recall. History of breastfeeding and weaning was recorded. History of smoking by family member and details of cooking fuel used was recorded. A detailed examination in each child was done. Respiratory rate was measured for one minute when child was quite by looking at the abdominal movement or lower chest wall. Height and weight were recorded and malnutrition was assessed by calculating weight for height 'z' scores.

A structured questionnaire was also administered to consenting mothers of both cases and controls and it covered questions about mothers knowledge about the causes, signs and symptoms as well as preventive measures against pneumonia.

3.6 Training

Two research assistants and two medical officers were trained by the Pricipal Investigator. The content of the training included an introduction to the main objectives and specific objectives of the study, data collection techniques, translation of the questionnaire into the local language, data collection and ethical issues.

3.7 Pre-testing

The structured questionnaire was pre-tested at the Maternal and Child Health Hospital. This health facility was not part of the study. The questionnaire was then reviewed and re-organized before the actual data collection.

3.8 Data Management and Analysis

Data was entered into MS Excel, all entries were doubled checked and imported into SPSS version 16 and Epi Info version 3.5.1 for all statistical analysis. Univariate analysis was done to examine single variables; frequencies of single variables have been summarized and presented in tables. Association of each of the categorical variable with pneumonia was assessed with two sided tests and the strength of their association was computed by unadjusted odds ratio (95% confidence interval). Simple logistic regression analysis of the risk factors was also done and subsequently, these variables were simultaneously subjected to multiple logistic regression models to determine the significant independent risk factors.

3.8.1 Quality assurance

In order to ensure quality in the data collection, the Principal Investigator was part of the team during interviews to ensure that the relevant information was collected and to detect any errors. Data were checked for completeness and internal inconsistencies. Double entry programmes were used to reduce possible errors.

3.9 Ethical Issues

Approval was sought from the Ghana Health Service Ethical Committee of the Ministry of Health, the Committee on Human Research Publication and Ethics-SMS/KNUST, Research and Development Unit of Kath, the Medical Director and Head of Pediatric Department of KATH. Participants were fully informed about the purpose, risks and benefits of participating in the study. Consent was sought from the mothers or caretakers of the children. Those who agreed to participate were asked to sign or thumb-print an informed consent form (Appendix). Participants were assured that their responses would be kept confidential and data collected was not disclosed to anyone but rather kept safely for the purpose of the study.

CHAPTER FOUR

RESULTS

4.1 General Overview of Results

An unmatched case-control study was conducted at the Komfo Anokye Teaching Hospital and a total of 228 children under five were enrolled in the study from March to May 2012. Of the 228, 114 were selected as cases and 114 as controls. The case definition of pneumonia as given by World Health Organization (WHO) was used for cases and controls were children without pneumonia or any respiratory illness from the paediatric outpatient department of the hospital. The cases were selected from the paediatric emergency unit. The results are also based on interviews of 228 mothers/caretakers of both cases and controls about their knowledge of the cause, signs/symptoms and preventive measures for pneumonia.

Table 4.1: Age and Sex Distribution of Cases and Control

Factors	Cases	Controls	OR	P value	95% CI	Total
	N (%)	N (%)				N (%)
Sex						
Male	54(45.38)	60(55.05)	0.68	0.15	0.39-1.18	114 (50)
Female	65(54.62)	49(44.95)				114 (50)
Total (%)						228 (100)
Age of child (months)						
0<2	4(28.57)	10(71.43)	-	-	-	14 (6.14)
2<12	54(64.29)	30(35.71)	0.17	<0.01	0.03-0.73	84(36.84)
12<60	56(43.08)	74(56.92)	2.38	<0.01	1.30-4.36	130 (57.02)
Total (%)						228 (100)

Table 4.1 shows out of 114 cases and 114 controls, more than half were above 12 months of age. There were more cases in the age category 2<12 months of age compared to controls. Children of age 12<60 were rather 2.38 times more significantly at risk of pneumonia (OR=2.38, 95% CI 1.30-4.36: p <0.01). Sex distribution did not show any significant difference between cases and controls (OR=0.68, 95% CI 0.39-1.18: p<0.15)

Table 4.2: Nutritional Risk Factors Assessment and Pneumonia

Factor	Cases N (%)	Control N (%)	OR (95% CI)	P value
Birth weight (Kg)				
≤2.50	14 (28.28)	60 (39.47)	1.43 (0.59-3.43	0.38
≥2.5	15 (51.72)	92 (60.53)		
Maturity status				
Premature	5 (41.67)	109 (50.46)	0.70 (0.17-2.66)	0.55
Mature	7 (58.33)	107 (49.54)		
Weaning started at				
Appropriate age	66 (61.11)	57 (55.88)	1.24(0.69-23)	0.44
Inappropriate age	42 (38.89)	45 (44.12)		
Malnourished				
Yes	22 (20.37)	11(10.28)	2.23 (0.97-5.39)	0.04
No	86 (79.63)	96 (89.72)		

From the table, percentage of cases who were malnourished were twice that of controls and were 2.23 times at risk of pneumonia but the difference did not reach statistical significance (OR=2.23, 95% CI 0.97-5.39: p<0.04). There was no association between low birth-weight (OR=1.43, 95% CI 0.5 –3.43: p<0.38), maturity status (OR=0.70, 95% CI 0.17-2.66) and age at which child was weaned (OR=1.24, 95% CI 0.69-23, p<0.44). Age at which child was weaned was divided into weaning at appropriate age and weaning at inappropriate age. Weaning at appropriate age was weaning started at the age of 4 to 6

months whilst weaning started after age of 6 months or not started even after 6 months was said to be weaning at inappropriate age.

Table 4.3: Distribution of Cases and Controls by Breastfeeding Status

Age	Breastfeeding levels	Cases	Control	OR(95% CI)	P-value
		N (%)	N (%)		
Age (months)	Exclusive	22(40.00)	7(25.00)	-	
≤12	Partial	32(58.18)	21(75.00)	2.06(0.69-6.71)	0.16
	Nil	1(1.82)	-	-	
Age (months)	Exclusive	25(44.64)	36(48.65)	-	
≥12	Partial	31(55.36)	38(51.35)	0.85(0.40-1.81)	0.65
	Nil	-	-		

The children were categorized as exclusively breastfed if he/she was given breastmilk up to the age of six months, partially breastfed if the child was given breastmilk along milk supplements and nil if no breastfeeding at all. From the table, partial or lack of breastfeeding was insignificantly associated with risk of pneumonia in both age categories (OR=2.06, 95% CI 0.69-6.71: p<0.16). However, children below age 12 months were 2.06 times at risk of pneumonia for partially breastfed

Table 4.4: Environmental Risk Factors Assessment and Pneumonia

Risk Factor	Cases N (%)	Control N (%)	OR (95% CI)	P value
Crowding				
Yes	51(45.13)	31(27.19)	**2.20 (1.22-3.99)**	**<0.01**
No	62 (54.87)	83 (72.81)		
Type of fuel				
Biomass	71(62.83)	34 (29.82)	**3.98 (2.21-7.19)**	**<0.01**
LPG	42 (37.17)	80 (70.18)		
Exposure to tobacco smoke				
Yes	11(9.65)	5 (4.39)	2.33 (0.71-8.82)	0.12
No	103 (90.35)	109 (95.61)		
Attendance at daycare				
Yes	20 (17.54)	41(35.96)	0.38 (0.19-0.73)	<0.01
No	94 (82.46)	73 (64.04)		

Crowding was defined as ≥ 4 people sharing the child's bedroom (Cardoso et al., 2004). From the table it was significantly associated with pneumonia (OR=2.20, 95% CI 1.22-3.99, p<0.01). Charcoal and firewood used for cooking were classified under biomass as cooking fuel and children whose mothers used biomass as cooking fuel were 3.98 more at risk of pneumonia compared to those whose mothers use LPG for cooking. This association was significant (OR=3.98, 95% CI 2.21-7.19, p<0.01). Children were rated as exposed to tobacco smoke if either parents or other household members smoked and from

the table children who were exposed to tobacco smoke were 2.33 more at risk of pneumonia. However the association was not significant.

Table 4.5: Distribution of Cases and Controls by Immunization Status

Age	Immunization	Cases	Control	OR(95% CI)	P-value
		N (%)	N (%)		
Age (months) ≤12	Fully immunized	20 (35.09)	13 (32.50)	-	-
	Partially immunized	36 (63.16)	26 (65.00)	1.11(0.42-2.90)	0.81
	Not immunized at all	1(1.75)	1(2.50)	1.54(0.02-126.71)	0.77
Age (months) ≥12	Fully immunized	49(92.45)	73(98.65)	-	-
	Partially immunized	4(7.55)	1(1.35)	0.17(0.00-1.78)	0.08
	Not immunized at all	-	-		

The children were divided into three categories as fully immunized, partially immunized or not immunized at all. A fully immunized child was one who had received all vaccines according to National Immunization Schedule as per his/her age at time of interview. A partially immunized child was also a child who had not some but not all vaccines according to National Immunization Schedule as per his/her age at time of interview. Lastly, a child was classified as not immunized at all if he/she has never received any vaccines according to National Immunization Schedule as per his/her age at time of

interview. The children were also grouped into two age categories since immunization would have been completed by the time the child reaches one year old. The table shows an equal distribution about the immunization status of both cases and controls across the two age categories. There was no significant association between immunization status and pneumonia although children <12 months who were partially or not immunized at all were 1.11 or 1.54 more at risk of getting pneumonia respectively .

Table 4.6: Demographic Risk Factors of Mothers

Risk Factor	Cases	Controls	OR (95% CI)	P value
	N (%)	N (%)		
Age of mother (years)				
<20	11(68.75)	5 (31.25)	2.15 (0.65-8.20)	0.16
20-35	91(50.56)	89 (49.44)	-	-
>35	12 (37.50)	20 (62.50)	1.70(0.74-4.06)	0.17
Occupation				
Unemployment	20 (57.14)	15 (42.86)	-	-
Artisan	15 (42.68)	20 (57.14)	1.78 (0.62-5.11)	0.23
Civil servant	16 (34.04)	31(65.96)	2.58 (0.96-7.03)	0.04
Farmer	10 (76.92)	3 (23.08)	0.40 (0.06-1.97)	0.21
Trader	53 (54.64)	44 (45.36)	1.11 (0.47-2.62)	0.80
Education of mother				
No education	31(73.81)	11 (26.19)	-	-
Primary	50 (57.47)	37(42.53)	2.09 (0.88-5.19)	0.07
Secondary	21(34.43)	40 (65.57)	5.37 (2.09-14.14)	<0.01
Tertiary	11(29.73)	26 (70.27)	6.66 (2.25-20.12)	<0.01

The table above shows 11(68.75%) of the cases were children of mothers below age 20 compared to 5(31.25%) of the controls. Majority of the mothers worked as traders both for the cases and the controls. Pneumonia was higher in children whose mothers have

never had any form of education 31 (73.81%) and only 11(26.19%) of children without pneumonia. Slightly more than half of the cases' mothers were educated to the primary level and very few to the tertiary level. Mother's level of education was significantly associated with pneumonia. Children of mothers who have never been to school were 5.37 or 6.66 times more likely of getting pneumonia than their counterparts whose mothers have had education up to the secondary or tertiary level respectively.

Table 4.7: Knowledge about Causes of Pneumonia among Mothers

Knowledge	Cases	Control	Total
	N (%)	N (%)	N (%)
Heard about Pneumonia			
Yes	69 (45.10)	84 (54.90)	153 (67.11)
No	45 (60.00)	30 (40.00)	75 (32.89)
Exposure to cold weather			
Yes	63 (44.37)	79 (55.63)	142 (62.28)
No	51 (59.30)	35 (40.70)	86 (37.71)
Cough			
Yes	28 (75.68)	9 (24.32)	37 (16.23)
No	86 (45.03)	105 (54.97)	191 (83.77)
Dirty environment			
Yes	18 (58.06)	13 (41.94)	31 (13.60)
No	96 (48.73)	101 (51.27)	197 (86.40)
Fever			
Yes	9 (81.82)	2 (18.18)	11 (4.82)
No	105 (48.39)	112 (51.61)	217 (95.18)
Do not know			
Yes	1(20.00)	4 (80.00)	5 (2.19)
No	113 (50.67)	110 (49.33)	223 (97.81)
Germs			
Yes	17 (53.13)	15 (46.88)	32 (14.04)
No	97 (49.49)	99 (50.51)	196 (85.96)

Of the 228 mothers interviewed, 153(67.11%) have heard about pneumonia and 142(62.28) believed is caused by exposure to cold weather whilst only 32(14.04%) reported that germs causes pneumonia.

Table 4.8: Knowledge about Signs/Symptoms of Pneumonia among Mothers

Knowledge	Cases	Controls	Total
	N (%)	N (%)	N (%)
Fever			
Yes	46 (47.42)	51(52.58)	97(42.54)
No	68 (51.91)	63 (48.09)	131 (57.46)
Cough			
Yes	58 (44.62)	72 (55.38)	130 (57.02)
No	56 (57.14)	42 (42.86)	98 (42.98)
Fast breathing/difficult breathing			
Yes	62 (45.26)	75 (54.74)	137(60.89)
No	52 (57.14)	39 (42.86)	88(39.11)
Noisy breathing			
Yes	48 (41.03)	69 (58.97)	117 (51.32)
No	66 (59.46)	45 (40.54)	111 (48.68)
Chest in-drawing			
Yes	7 (10.29)	61 (89.71)	68 (29.82)
No	107 (66.88)	53 (33.13)	160 (70.18)
Not able to drink/breastfeed			
Yes	6 (25.00)	18 (75.00)	24 (10.53)
No	108 (52.94)	96 (47.06)	204 (89.47)
Convulsion			
Yes	3 (100.00)	0 (0.00)	3 (1.32)
No	111 (49.33)	114 (50.67)	225 (98.68)
Do not know			
Yes	3 (21.43)	11 (78.57)	14 (6.14)
No	111 (51.87)	103 (48.13)	214 (93.86)

From the table, 131(57.46%) of mothers do not fever as a symptom of pneumonia, 130(57.02%) know cough as a symptom of pneumonia and only 68(29.82%) know chest in-drawing as a danger sign of pneumonia.

Table 4.9 Knowledge about Prevention of Pneumonia among Mothers

	Cases	Controls	Total
Knowledge	**N (%)**	**N (%)**	**N (%)**
Breastfeeding			
Yes	6 (27.27)	16 (72.73)	22 (9.65%)
No`	108 (52.43)	98 (47.57)	206 (90.35)
Personal hygiene			
Yes	92 (50.00)	92 (50.00)	184 (90.64)
No	19 (100.00)	0 (0.00)	19 (9.36)
Clean environment			
Yes	26 (56.52)	20 (43.48)	46 (20.18)
No	88 (48.35)	94 (51.65)	182 (79.82)
Proper diet			
Yes	23 (50.00)	23 (50.00)	46 (20.18)
No	91(50.00)	91 (50.00)	182 (79.82)
Vitamin A supplementation			
Yes	24 (48.98)	25 (51.02)	49 (21.49)
No	90 (50.28)	89 (49.72)	179 (78.51)
Immunization			
Yes	34 (56.67)	26 (43.33)	60 (26.32)
No	80 (47.62)	88 (52.38)	168 (73.68)
Do not know			
Yes	18 (26.06)	51 (73.91)	69 (30.26)
No	96 (60.38)	63 (39.62)	159 (69.74)

The table shows that only 22(9.65%) of mothers knew breastfeeding as a preventive measure and only 46(20.18%) choose clean environment.

Table 4.10: Logistic Regression of Risk Factors

Condition (Case /Control)	Odds ratio (95% CI)	P value
Weaning Age	1.15 (0.67-1.97)	0.613
Nature of House	0.85 (0.41-1.75)	0.656
People living in the house	0.93 (0.86-1.01)	0.076
Under five children in house	0.72 (0.51-1.01)	0.057
Number of people who sleep with child in the same room.	0.98 (0.85-1.14)	0.824
Exposure to tobacco smoke	0.88 (0.24-3.20)	0.842
Source of fuel for cooking	1.32 (0.88-1.99)	0.174
Source of drinking water	1.29 (0.93-1.78)	0.124
Attendance at day-care centre	**3.16 (1.54-6.46)**	**0.002**

Attendance at day-care was significantly associated with risk of pneumonia (OR=3.16, 95% CI 1.54-6.46, p=0.002)

CHAPTER FIVE

DISCUSSION

5.1 Discussion

The present study aimed at assessing risk factors for pneumonia in children under five. In the study, pneumonia was more common among children between the ages 2months to less than 60months but there was not statistically significant (OR=017, 95% CI 0.03-0.73: p<0.01). In a study by Koch A. et al (2003), it was reported that age up to 12 months was a risk factor for pneumonia. Selwyn BJ et al (1990) and Shah et al (1994) have reported that incidence rates for ARI are highest in younger children. This might be due to the fact that in young children immunity is not well established and also because of narrow airways, relatively short bronchial tree and incomplete development. Contrary to studies by Victora CG et al.,(1994) and Dharmage SC et al., (1996) that males appear more frequently affected by pneumonia, there was nearly an equal sex distribution with no significant difference (OR=0.68, 95% CI 0.38-1.18: p<0.15).

Children with a history of low birth weight were 1.43 times at risk of pneumonia compared to children with normal birth weight. This result is in agreement with Fonseca W et al., (1996) and Shah N et al., (1994). This might be due to poor pulmonary function and low immunity in LBW babies which makes them more liable to ARI (Mansell Al et al., 1987).

Children less than 12 months who were partially breastfed also appeared to have more risk of pneumonia with odds ratio of 2.06. The protective action of breast milk which is well known is due to its content of bacterial and viral antibiotics, macrophages

synthesizing complement and lysozymes which not only protect against severe ALRI but also protects from development of asthma and other allergic disorders. Broors et al., (2001) reported that lack of exclusive breastfeeding for at least four months as a risk factor for ALRI and weaning from breastmilk at less than six months was have also been found to be a risk factor for pneumonia. (Hassan et al., 2001)

There was significant association (OR=5.37, 95% CI 2.09-14.14: $p<0.01$) between the level of mothers' education and occurrence of pneumonia. This finding agreed with the findings of Hamid et al., (1996). Low educational level in mothers was found to be associated with increased risk of ALRI hospitalization and mortality in a study in Brazil (Victora CG et al., 1992). Parents especially mothers who have higher education are more likely to seek appropriate and early care for illness in their children. However in a case control study by Victoria CG (Victoria CG et al., 1994), father's education was more strongly correlated than the mother's education.

Use of biomass for cooking was found to be significant risk factor for pneumonia (OR=3.98, 95% CI 2.21-7.19: $p<0.01$). Biomass fuels (wood, crop residues, charcoal) and others like kerosene are important contributors to indoor air pollution. These are burnt in simple stoves with incomplete combustion generating a lot of toxic products that adversely affect specific and non-specific local defences of the respiratory tract. The risk is highest for mothers and young children due to longer stay in-door and close proximity during cooking. Similar studies have shown that indoor air pollution by biomass fuels increases the risk of pneumonia. (Bruce N et al., 2000; Smith KR et al., 2000)

Environmental tobacco smoke is another source of indoor pollution that reduces local defence mechanisms and predisposes children to respiratory illness (Cook Dg et al., 1999). In the present study, children exposed to tobacco smoke were 2.33 more at risk of getting pneumonia than children who are not exposed. This may be due to the fact majority of smokers in families are fathers and other relatives and the exposure of children due to smoking by fathers may be limited because of relatively greater time spent by fathers outside the house. Di Franca et al., (2004) found a strong evidence for associations between ETS exposure and risk of ARI in children. A lot of other studies have all found strong association between risk of pneumonia and tobacco exposure. (Macebo et al. 2007; Hjern A et al, 2000; Prietsch SO et al, 2003).

Attendance at day care was found to be significantly associated with risk of pneumonia (OR=3.16, 95% CI 1.54-6.46: $p<0.002$). Studies done by Hassan et al., (2001) found day-care attendance to be associated with risk of pneumonia. Lu et al., (2004) showed that risk of pneumonia is increased in day-care centers for younger children and those with poorer access to health care facilities. The number of children enrolled in day care centres has increased in developed countries and a similar increase is expected in developing countries since more women are participating in the labour force to supplement family incomes.

In the present study, there was statistically significant association between overcrowding (OR=2.20, 95% CI 1.22-3.99: $p<0.01$). Overcrowding increases the probability of transmission of infection among family members. Similar results were obtained by Cardoso et al., (2004) and found crowding to be associated with 2.5 fold increase risk of ALRI. Other studies from developing and developed countries have also found similar

effects for crowding. (Savitha MR et al., 2007; Brims et al., 2005; Ozcirpici et al., 2004; Howden-Chapman et al., 2005).

Malnourished children were 2.23 times more likely at risk of pneumonia but this was not significant (OR=2.23, 95% CI 0.97-5.39: p<0.04). However numerous studies by Dharmage SC et al., (1996), Savitha MR et al., (2007), Ballard TJ et al., (1995), Broor S et al., (2001) have shown consistent significant association between malnutrition and both incidence of, and mortality due to ARI in children. In Fortaleza, Brazil, for example, children moderately and severely malnourished were 4.6 times more likely to develop radiologically confirmed pneumonia compared to adequately nourished children while mortality studies have shown malnourished children to have between 2 and 25 times the risk of death from pneumonia (Victora et al., 1999). Malnourished children have defective cell mediated immunity secondary to thymolymphatic depletion leading to severe gram negative infections and sepsis. They may also have qualitatively abnormal immunoglobulins, and impairment of key enzymes involved in bactericidal infection of leucocytes. Humoral immune function is also impaired because of decrease secretory IgA that acts as a first-line defence at the mucosal surfaces, including the respiratory tract. A study in New Delhi revealed severe malnutrition as the predictor of mortality in ALRI in fewer than five children (Seghal V et al., 1997). Overall malnutrition is associated with a two to three fold increase in mortality from ALRI (Rice AL et al., 2000).

Only one-third of the cases were fully immunized. Fully immunized protects children against various respiratory infections like diphtheria, pertusis and also complications of measles. As these children are not fully immunized they are at risk of development of these infections. In this study, children below age 12 months who were not immunized at

all were 1.54 more likely at risk of pneumonia and 1.11 for those partially immunized. This observation has been quoted by Dr. Deepak Bhakve, Shah N, Ramanjutty V et al, W Fonseca, B R Kirkwood et al (Bhakve et al., 1991, Ramanjutty V et al., 1994., B R Kirkwood et al., 1996).

Of the 228 mothers, 75(32.89%) said they have never heard about pneumonia of which 45(60%) were mothers of the cases. When asked about the causes of pneumonia only 32(14.04%) said they believe a germ causes pneumonia. An equal number of both case and controls did not that a germ causes pneumonia and 142(62.28%) said exposure to cold weather. Cold, as a cause of pneumonia was also cited by Honduran and rural Bolivian mothers. (Hudelson P. et al. 1995).

Results from this study show that 137(60.89%) know fast breathing/difficult breathing and 68(29.82%) also know chest in-drawing as the danger signs/symptoms of pneumonia. Only 7(10.29%) of mothers of the cases knew chest in-drawing as a danger sign. Reasons could be due to health promotion in hospitals, clinics and communication among neighbors and relatives. In 1995, UNICEF reported that 40% of Peruvian mothers were able to recognize pneumonia signs such as rapid breathing and chest in-drawing (UNICEF report, 1995). In contrast, in studies of perceptions of pneumonia signs, Ethiopian and Pakistan mothers did not recognize rapid breathing or chest in-drawing as serious signs of pneumonia (Muhe Let al., 1996; Kundi MZ et al., 1993).

5.2 Limitations of the Study

Socio-economic status of parents could not be studied since majority of the mother/caretakers were not ready to disclose their income level or did know their

husband's income. Low birthweight and malnutrition are usually associated with low socio-economic status whilst breastfeeding may be associated with either higher or lower socio-economic status. Admission bias is another limitation on the study. Children from low- income households may be preferentially admitted because home management of pneumonia would be difficult and therefore the population studied does not accurately reflect the target population. There is the possibility of recall bias as mother/caretakers answered some of the questions from memory. Existing data on recent studies about the distribution of risk factors for pneumonia in children under five was limited.

CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

The study identified risk factors for pneumonia in children under five at KATH. The significant risk factors associated with children under five were low educational level of mothers, use of fuel other than cooking gas, overcrowding and attendance at day care centers.

Children under five with low birth weight, partial/no immunization, partially breastfed, malnourished, exposed to tobacco smoke or weaned before six months were likely of getting pneumonia but association was not significant. Association between gestational maturity status, gender, age of mother and risk of pneumonia was not statistically significant.

A lot of the mothers of both cases and controls have heard about pneumonia but few know about the danger signs/symptoms, causes as well preventive measures for pneumonia.

6.2 Recommendations

We recommend the following:

To Komfo Anokye Teaching Hospital

- Healthworkers in the paediatric department should educate mothers about pneumonia focusing on recognition of the danger signs/ syptoms and its predisposing factors so as to create awareness in them.
- Healthworkers to educate mothers on the health risks related to overcrowding.

To local Health Authority

- To encourage mothers to use LPG as fuel for cooking instead of biomass fuel

To the Department of Epidemiology and Disease Control, School of Public Health, University of Ghana

- Further studies be carried out to compare disease rates in day-care centres and to use the findings to improve the design of such centres and how they can be better managed to minimize the risk of pneumonia

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APPENDICES

APPENDIX 1

PARTICIPANT INFORMATION AND CONSENT FORM

STUDY TITLE	Risk Factors for Pneumonia in Children Under Five At KomfoAnokye Teaching Hospital
INVESTIGATOR	Akosua Gyasi Darkwa
SUPERVISOR	Dr Priscillia Nortey, Department of Epidemiology, School of Public Health

Before agreeing to participate, it is important that you read the following explanation of the study.

Voluntary participation: Participation is voluntary and you are free to withdraw from the study at any time without being penalized in any way.

What is involved: Your child is being invited to take part in this study and you will be asked some questions about the child and your knowledge about pneumonia. Questions will be asked by a medical officer as well as examine child for diagnosis.

Possible risks: There are no direct fits or risks involved in your child's participation in this study. However, this study is expected to provide data on risk factors for pneumonia

in children under five and will contribute to the content of health education programs both for mothers and health-workers.

Possible benefits: By participating in this study, you can assess your level of knowledge about the risk factors, danger signs and symptoms of pneumonia as well as preventive measures of pneumonia.

Confidentiality: The information you provide is totally confidential and will not be disclosed to any unauthorized persons. It will only be used for research purposes. No response you give will be specifically connected to you.

For further questions, you may contact me: Akosua Darkwa, School of Public Health, University of Ghana, Legon. Tel: 0206300415

I voluntarily consent to participate in this study

Signature/Thumbprint of parent/caretaker.....

Name……

Signature/Right thumbprint of witness of participant……

Nam of officer conducting interview…….

Date…….

Thumbprint of caretaker/parent who is unable to sign

RISK FACTORS FOR PNEUMONIA IN CHILDREN UNDER FIVE AT KOMFO ANOKYE TEACHING HOSPITAL, KUMASI

No.	Questionnaire	Responses	Code
SECTION A: DEMOGRAPHY			
RFP 1	Condition	01=Case 02=Control	__/__
RFP 2	ID NUMBER		
RFP 3	Date of interview		
RFP 4	Name of Hospital		
RFP 5	Name		
RFP 6	Age of Child (months)		
RFP 7	Sex	01=Male 02=Female	__/__
RFP 8	Birth weight (kg)		
RFP 9	Born Prematurely	01=Yes 02=No	__/__
RFP 10	Respondent's relationship to child		
RFP 11	Who is the main caretaker of this child?		
RFP 12	Age of mother (years)		
RFP 13	Parity of mother		
RFP 14	Maternal age at child's birth (years)		
RFP 15	Occupation of Mother/Caretaker		
RFP 16	Ethnicity		
RFP 17	Religion	01=Traditional 02=Islam 03=Christianity 04=Other	__/__
RFP 18	When did child start eating solid food/adult diet	01=Before six months 02=After six months 03=Don't know	__/__
RFP 19	Breastfeeding History during first six months	01=Exclusive	

		02=Partial 03=Nil	 __/__
RFP 20	Educational Level of mother/caretaker	01=Primary 02=Secondary 03=Tertiary 04=No education	 __/__
RFP 21	Educational Level of father	01=Primary 02=Secondary 03=Tertiary 04=No education	 __/__
RFP 22	Income level of mother/month (Gh cedis)	01=<100 02=100-200 03=>200	 __/__
RFP 23	Income level of father/month (Gh cedis)	01=<100 02=100-200 03=>200	 __/__

SECTION B: RESIDENTIAL STATUS			
RFP 1	Community of Residence		
RFP 2	House	01=Nuclear 02=Compound	__/__
RFP 3	How many people live in your house?		
RFP 4	How many children in house are less than five years?		
RFP 5	How many people sleep in the same room with child?		
RFP 6	Does anyone in the house smoke cigarette/other?	01=Yes 02=No	__/__
RFP 7	If yes, who?	01=Father 02=Mother 03=Other	__/__
RFP 8	Main source of fuel for cooking.	01=Charcoal 02=Gas 03=Firewood	__/__
RFP 9	Main source of drinking water for child.	01=Tap water 02=Borehole 03=Sachet water	__/__
RFP 10	Does your child attend a day-care centre?	01=Yes 02=No	__/__
RFP 11	At what age did the child start day care?		
RFP 12	How long does the child spend at day-care centre/day (range)?		
RFP 13	What does the child sleep on at day-care centre?		
RFP 14	How many children are in the class (range)?		

SECTION C: KNOWLEDGE OF MOTHERS/CAREGIVERS ON CAUSATION, DANGER SIGNS AND PREVENTION OF PNEUMONIA.			
RFP 1	Have you ever heard about Pneumonia?	01=Yes 02=No	__/__
RFP 2	If answer to Que. 1 is Yes, What are the causes of pneumonia? (*please choose as many as appropriate)*		
RFP 2A	Exposure to cold weather	01=Yes 02=No	__/__
RFP 2B	Cough	01=Yes 02=No	__/__
RFP 2C	Dirty environment	01=Yes 02=No	__/__
RFP 2D	Fever	01=Yes 02=No	__/__
RFP 2E	Germs	01= Yes 02= No	__/__
RFP 2F	Others (*please state*)		

SECTION D: KNOWLEDGE OF PNEUMONIA SIGNS/SYMPTOMS			
RFP 3	Are the following symptoms/signs of Pneumonia?		
RFP 3A	Fever	01=Yes 02=No	__/_
RFP 3B	Cough	01=Yes 02=No	__/_
RFP 3C	Fast breathing/Difficult breathing	01= Yes 02= No	__/_
RFP 3D	Noisy breathing	01=Yes 02=No	__/_
RFP 3E	Chest in-drawing	01=Yes 02=No	__/_
RFP 3F	Not able to drink/breastfeed	01=Yes 02=No	__/_
RFP 3G	Convulsion	01=Yes 02=No	__/_
RFP 3H	Others (please specify)	01=Yes 02=No	__/_
RFP 3I	Do not know	01=Yes 02=No	__/_

SECTION E: KNOWLEDGE OF PNEUMONIA PREVENTION			
RFP 4	Are the following preventive measures against Pneumonia?		
RFP 4A	Breastfeeding	01=Yes 02=No	__/_
RFP 4B	Personal hygiene	01=Yes 02=No	__/_
RFP 4C	Clean environment	01= Yes 02= No	__/_
RFP 4D	Proper diet	01=Yes 02=No	__/_
RFP 4E	Vitamin A supplementation	01=Yes 02=No	__/_
RFP 4F	Immunization	01=Yes 02=No	__/_
RFP 4G	Others (please specify)	01=Yes 02=No	__/_
RFP 4H	Do not know	01=Yes 02=No	__/_

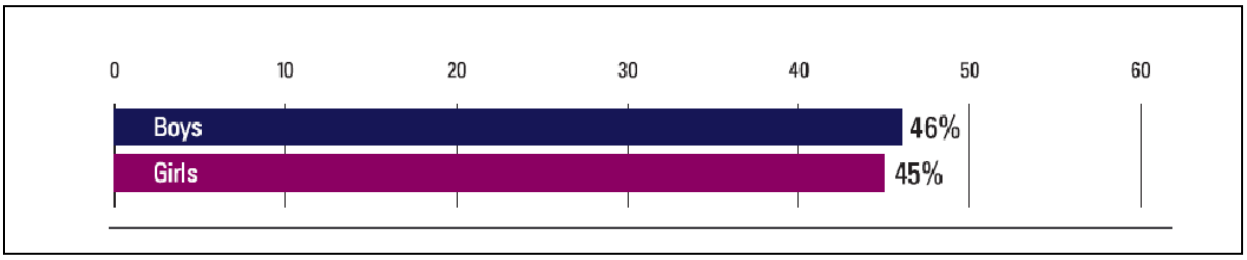
SECTION F: VACCINATION AND MEDICAL HISTORY			
RFP 1	Immunization card seen	01=Fully immunized 02=Not fully immunized 03=No immunization	__/__
RFP 2	Vitamin A supplement	01=Yes 02=No	__/__
RFP 3	Symptoms		
RFP 3A	Cough	01=Yes 02=No	__/__
RFP 3B	Runny nose	01=Yes 02=No	__/__
RFP 3C	Fever	01=Yes 02=No	__/__
RFP 3D	Cyanosis	01=Yes 02=No	__/__
RFP 3E	Tachypnea	01=Yes 02=No	__/__
RFP 3F	Altered sensorium/irritability	01=Yes 02=No	__/__
RFP 3G	Others		

SECTION G: PHYSICAL EXAMINATION.			
RFP 1	Weight(Kg)		
RFP 2	Height(cm)		
RFP 3	Nutritional Status	01=Well Nourished 02=Undernourished	__/__
RFP 4	Heart Rate		
RFP 5	Respiratory Rate		
RFP 6	Temperature		
RFP 7	Pallor	01=Present 02=Absent	__/__
RFP 8	Cyanosis	01=Present 02=Absent	__/__
RFP 9	Hydration status	01=Well Hydrated 02=Dehydrated	
RFP 10	Central Nervous System/GCS		

SECTION H: LABORATORY INVESTIGATION.			
RFP 1	HB *(current results)*		
RFP 2	WBC *(current results)*		
RFP 3	Sickling	01=Positive 02=Negative	__/__

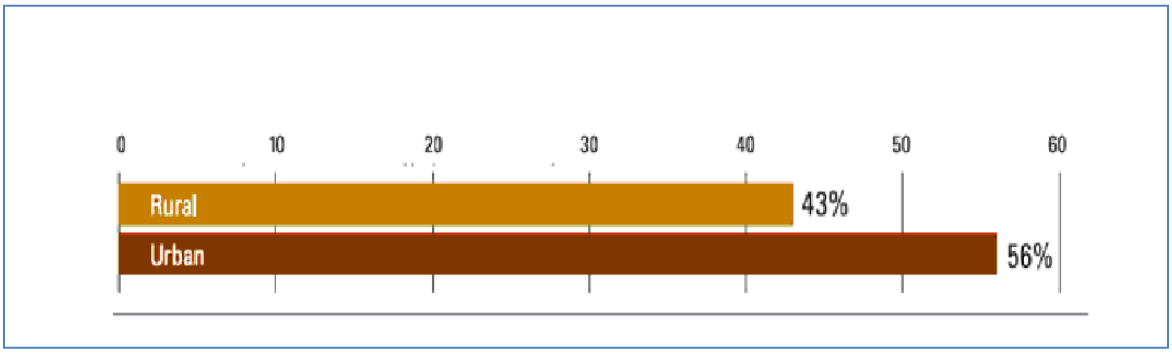
APPENDIX 2

Figure showing children under five with pneumonia by sex taken to health care provider



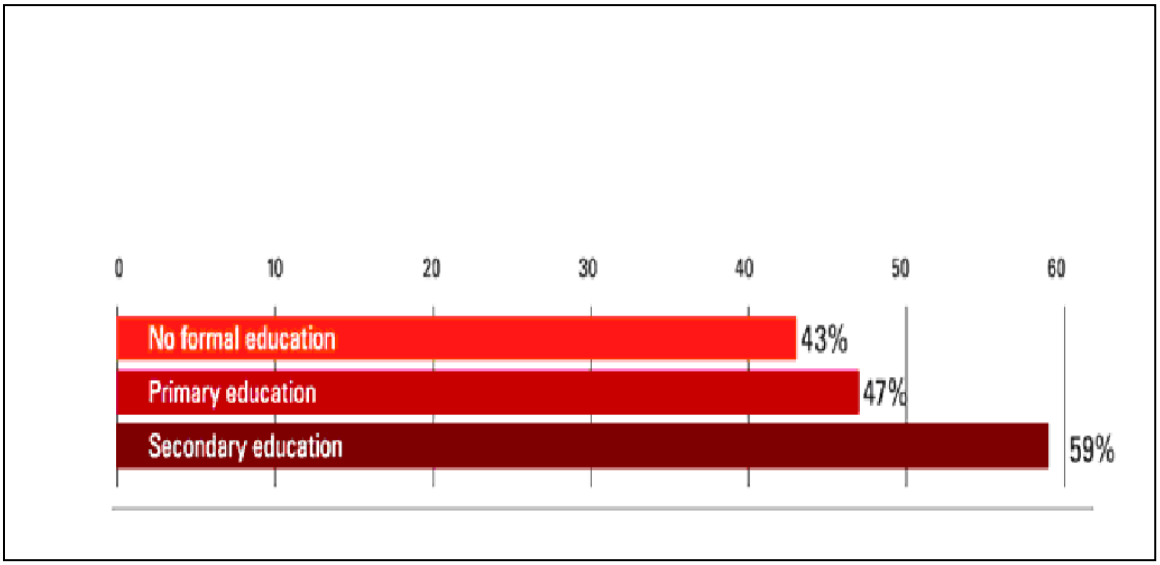
Source: UNICEF-MICS/DHS, 1996-2004

Figure showing children under five with pneumonia by locality taken to health care provider



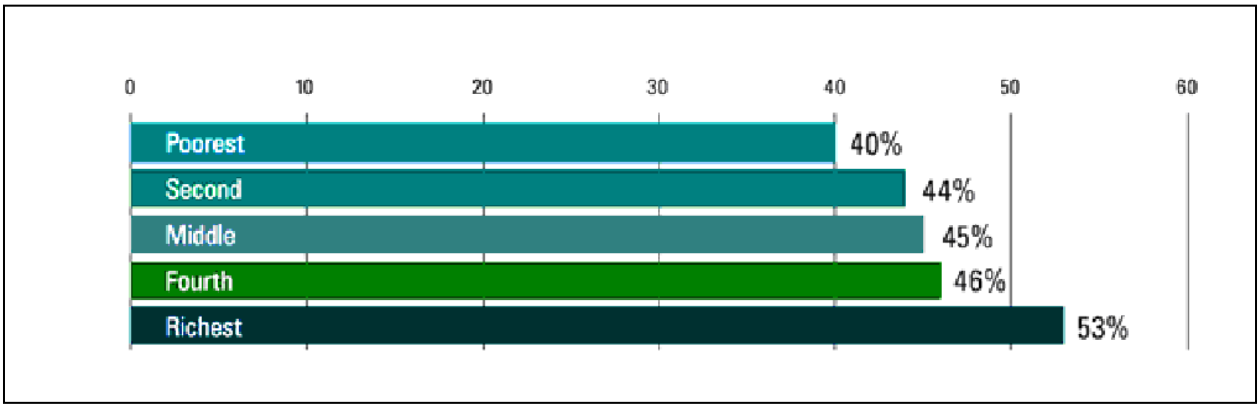
Source: UNICEF-MICS/DHS, 1996-2003

Figure showing children under five by mothers' education taken to health care provider



Source: UNICEF-MICS/DHS, 1996-2003

Figure showing children under five by socio-economic status taken to health care provider.



Source: UNICEF-MICS/DHS, 1996-2004

APPENDIX 3

Estimates of incidence and number of new cases per year of clinical pneumonia in children aged less than 5 years, by WHO Region

WHO region	Total population aged 0–4 years(millions)	Estimated incidence(e/cy)	Estimated no. of new cases per year(millions)
African	105.62	0.33	35.13
Americas	75.78	0.10	7.84
Eastern Mediterranean	69.77	0.28	19.67
European	51.96	0.06	3.03
South-East Asia	168.74	0.36	60.95
Western Pacific	133.05	0.22	29.07

WHO region	Total population aged 0–4 years(millions)	Estimated incidence(e/cy)	Estimated no. of new cases per year(millions)
Total (developing countries)	523.31	0.29	151.76
Total (developed countries)	81.61	0.05	4.08
Total	604.93	0.26	155.84

APPENDIX 4:

KEY PNEUMONIA INDICATORS: MORTALITY, PREVENTION AND TREATMENT KEY PNEUMONIA INDICATORS: MORTALITY, PREVENTION AND TREATMENT- CONTINUED.

				PNEUMONIA DEATHS		PREVENTION					TREATMENT
Countries and territories	Under-five mortality rate	Total number of under-five deaths (000s)	Total number of under-five children (000s)	% of under-five deaths due to pneumonia	Total number of under-five pneumonia deaths (000s)[a]	% of children who are underweight (0-59 months)		% of infants who are exclusively breastfed (<6 months)	% of one-year-old children immunized against:		% of under-fives with pneumonia taken to an appropriate health-care provider
						moderate & severe	severe	(1996-2004)*	measles	Hib	1998-2004*
	2004	2004	2004	2004	2004	(1996-2004)*	(1996-2004)*		2004	2004	
Afghanistan	257	359	5,329	25	89	39	12	-	61	-	28
Albania	19	1	256	11	0	14	1	6	96	-	83
Algeria	40	27	3,099	14	4	10	3	13	81	-	52
Andorra	7	0	3	-	-	-	-	-	98	95	-
Angola	260	195	2,887	25	48	31	8	11	64	-	58
Antigua and Barbuda	12	0	8	2	0	10 x	4 x	-	97	97	-
Argentina	18	12	3,350	3	0	5	1	-	95	90	-
Armenia	32	1	164	12	0	3	0	30	92	-	26
Australia	6	1	1,257	1	0	-	-	-	93	95	-
Austria	5	0	387	1	0	-	-	-	74	83	-
Azerbaijan	90	12	607	18	2	7	1	7	98	-	36
Bahamas	13	0	30	5	0	-	-	-	89	93	-
Bahrain	11	0	65	1	0	9 x	2 x	34 x, k	99	98	-
Bangladesh	77	288	17,284	18	51	48	13	36	77	-	20
Barbados	12	0	16	0	0	6 x	1 x	-	98	93	-
Belarus	11	1	444	9	0	-	-	-	99	-	-
Belgium	5	1	565	1	0	-	-	-	82	95	-
Belize	39	0	34	7	0	6 x	1 x	24 k	95	96	66
Benin	152	52	1,406	21	11	23	5	38	85	-	35
Bhutan	80	5	289	19	1	19	3	-	87	-	-
Bolivia	69	18	1,231	17	3	8	1	54	64	81	52
Bosnia and Herzegovina	15	1	194	3	0	4	1	6	88	79	80
Botswana	116	5	221	1	0	13	2	34	90	-	14
Brazil	34	127	17,946	13	17	6	1	-	99	96	46 x
Brunei Darussalam	9	0	40	1	0	-	-	-	99	92	-

Bulgaria	15	1	332	16	0	-	-	-	95	-	-
Burkina Faso	192	115	2,393	23	27	38	14	19	78	-	36
Burundi	190	63	1,270	23	14	45	13	62	75	83	40
Cambodia	141	60	1,801	21	12	45	13	12	80	-	37
Cameroon	149	84	2,434	22	18	18	4	21	64	-	40
Canada	6	2	1,705	1	0	-	-	-	95	83	-
Cape Verde	36	1	70	13	0	14 x	2 x	57 k	69	-	-
Central African Republic	193	29	636	19	5	24	6	17	35	-	32
Chad	200	91	1,804	23	21	28	9	2	56	-	22
Chile	8	2	1,246	6	0	1	-	63	95	94	-
China	31	539	86,055	13	72	8	-	51	84	-	-
Colombia	21	20	4,734	10	2	7	1	26	92	89	51
Comoros	70	2	125	16	0	25	9	21	73	-	49
Congo	108	19	727	14	3	14	3	4 k	65	-	-
Congo, Democratic Republic of the	205	572	10,829	23	132	31	9	24	64	-	36
Cook Islands	21	0	2	1	0	-	-	19 k	99	-	-
Costa Rica	13	1	393	4	0	5	0	35 x, k	88	90	-
Côte d'Ivoire	194	128	2,751	20	25	17	5	5	49	-	38
Croatia	7	0	210	1	0	1	-	23	96	93	-
Cuba	7	1	689	4	0	4	0	41	99	99	-
Cyprus	5	0	49	2	0	-	-	-	86	58	-
Czech Republic	4	0	449	4	0	1 x	0 x	-	97	98	-
Denmark	5	0	329	1	0	-	-	-	96	95	-
Djibouti	126	3	120	20	1	18	6	-	60	-	-
Dominica	14	0	7	0	0	5 x	0 x	-	99	-	-
Dominican Republic	32	7	997	13	1	5	1	10	79	71	64
Ecuador	26	8	1,449	12	1	12	-	35	99	90	-
Egypt	36	68	8,795	15	10	9	1	30	97	-	70
El Salvador	28	5	804	13	1	10	1	24	93	83	62
Equatorial Guinea	204	4	86	17	1	19	4	24	51	-	-
Eritrea	82	14	733	19	3	40	12	52	84	-	44
Estonia	8	0	63	2	0	-	-	-	96	27	-
Ethiopia	166	509	12,861	22	114	47	16	55	71	-	16
Fiji	20	0	93	9	0	8 x	1 x	47 x, k	62	71	-

Countries and territories	Under-five mortality rate	Total number of under-five deaths (000s)	Total number of under-five children (000s)	PNEUMONIA DEATHS: % of under-five deaths due to pneumonia	PNEUMONIA DEATHS: Total number of under-five pneumonia deaths (000s)[a]	PREVENTION: % of children who are underweight (0-59 months)		PREVENTION: % of infants who are exclusively breastfed (<6 months)	PREVENTION: % of one-year-old children immunized against:		TREATMENT: % of under-fives with pneumonia taken to an appropriate health-care provider
						moderate & severe	severe		measles	Hib	
	2004	2004	2004	2004	2004	(1996-2004)*	(1996-2004)*	(1996-2004)*	2004	2004	1998-2004*
Timor-Leste	80	4	160	20	1	46	15	31	55	-	24
Togo	140	33	996	17	6	25	7	18	70	-	30
Tonga	25	0	12	7	0	-	-	62 [k]	99	-	-
Trinidad and Tobago	20	0	89	2	0	7 [x]	0 [x]	2	95	94	74
Tunisia	25	4	806	8	0	4	1	47	95	97	43
Turkey	32	48	7,236	14	7	4	1	21	81	-	41
Turkmenistan	103	11	484	19	2	12	2	13	97	-	51
Tuvalu	51	0	1	14	0	-	-	-	98	-	-
Uganda	138	195	5,744	21	41	23	5	63	91	87	67
Ukraine	18	7	1,930	6	0	1	0	22	99	-	-
United Arab Emirates	8	1	325	5	0	14 [x]	3 [x]	34 [x, k]	94	94	-
United Kingdom	6	4	3,398	2	0	-	-	-	81	91	-
United States	8	33	20,243	1	0	1 [x]	0 [x]	-	93	94	-
Uruguay	17	1	283	5	0	5 [x]	1 [x]	-	95	94	-
Uzbekistan	69	42	2,815	17	7	8	2	19	98	-	57
Vanuatu	40	0	30	13	0	20 [x]	-	50 [k]	48	-	-
Venezuela (Bolivarian Republic of)	19	11	2,842	6	1	4	1	7 [k]	80	61	72
Viet Nam	23	38	7,900	12	4	28	4	15	97	-	7
Yemen	111	92	3,581	20	18	46	15	12	76	-	47
Zambia	182	85	1,987	22	19	23	-	40	84	80	69
Zimbabwe	129	50	1,756	15	7	13	2	33	80	-	50

APPENDIX 5:

CARE-SEEKING BEHAVIOUR FOR PNEUMONIA, BY SELECTED BACKGROUND CHARACTERISTICS, 1996-2003

Countries and territories	Year	% of under-fives with pneumonia taken to an appropriate health care provider	Area of residence		Gender		Mother's education			Source
			Urban	Rural	Male	Female	No formal education	Primary	Secondary[1]	
Angola	2001	58	55	64	58	59	55	58	73	MICS 2001
Armenia	2000	26	28	24	24	29	-	0	26	DHS 2000
Azerbaijan	2000	36	29	38	30	42	-	-	35	MICS 2000
Bangladesh	2000	27	48	24	29	25	24	24	38	DHS 2000
Benin	2001	35	39	33	36	34	31	49	41	DHS 2001
Bolivia	2003	52	56	45	54	49	41	48	61	DHS 2003
Botswana	2000	14	15	13	16	13	-	-	0	MICS 2000
Brazil	1996	46	50	34	47	45	25	40	54	DHS 1996
Burkina Faso	2003	36	65	32	36	36	32	51	84	DHS 2003
Burundi	2000	40	69	39	40	39	38	40	67	MICS 2000
Cambodia	2000	37	47	35	40	33	30	37	51	DHS 2000
Cameroon	2000	25	48	19	27	22	18	22	42	MICS 2000
Central African Republic	2000	32	42	27	32	32	26	38	48	MICS 2000
Chad	2000	22	36	35	22	21	17	19	51	MICS 2000
Comoros	2000	49	64	46	49	49	45	51	71	MICS 2000
Congo, Democratic Republic of the	2001	36	46	32	35	36	32	35	44	MICS 2001
Côte d'Ivoire	2000	38	46	34	37	38	35	39	53	MICS 2000
Dominican Republic	2002	63	64	63	64	63	71	64	63	DHS 2002
Egypt	2000	66	77	61	68	64	60	61	75	DHS 2000
Eritrea	2002	44	57	40	44	43	39	53	55	DHS 2002
Ethiopia	2000	16	41	14	17	14	15	17	37	DHS 2000
Gabon	2000	48	52	34	51	44	47	42	52	DHS 2000
Gambia	2000	75	93	70	71	79	72	81	100	MICS 2000
Ghana	2003	44	53	40	44	44	35	38	57	DHS 2003
Guatemala	2000	37	46	33	38	36	38	37	38	DHS 2000
Tanzania, United Republic of	1996	70	81	67	70	69	74	68	82	DHS 1996
Togo	2000	30	62	25	35	24	28	35	37	MICS 2000
Uganda	2000	67	80	65	68	65	61	67	77	DHS 2000
Viet Nam	2002	71	75	71	76	65	88	66	72	DHS 2002
Yemen	1997	32	43	29	33	31	29	44	51	DHS 1997
Zambia	2002	69	73	67	68	70	64	69	74	DHS 2002
Zimbabwe	1999	50	55	48	50	50	39	49	52	DHS 1999
Average (67 countries)		**46**	**56**	**43**	**46**	**45**	**43**	**47**	**59**	

[1] Data from DHS refer to secondary education or higher.

MICS: Multiple Indicator Cluster Survey
DHS: Demographic and Health Survey

APPENDIX 6:

CAREGIVERS WHO KNOW THAT FAST BREATHING IS A SIGN TO SEEK CARE

IMMEDIATELY, BY BACKGROUND CHARACTERISTICS, 1999-2001

Countries and territories	Year	% of caregivers who know that fast breathing is a sign to seek care immediately	Area of residence		Mother's education			Wealth quintiles					Source
			Urban	Rural	No formal education	Primary	Secondary	Poorest	Second	Middle	Fourth	Richest	
Angola	2001	37	35	40	37	38	32	40	39	33	36	37	MICS 2001
Azerbaijan	2000	5	5	6	-	4	6	6	6	4	5	6	MICS 2000
Bolivia	2000	1	1	1	0	1	1	1	0	1	1	1	MICS 2000
Bosnia and Herzegovina	2000	33	32	34	-	35	32	-	-	-	-	-	MICS 2000
Burundi	2000	47	55	47	47	53	63	46	46	45	48	51	MICS 2000
Cameroon	2000	4	5	4	3	4	5	3	3	5	5	5	MICS 2000
Central African Republic	2000	15	17	14	16	15	13	17	15	15	14	15	MICS 2000
Chad	2000	11	12	11	14	10	10	15	10	10	12	11	MICS 2000
Comoros	2000	13	18	10	13	10	16	11	13	10	14	15	MICS 2000
Congo, Democratic Republic of the	2001	32	27	34	68	69	56	36	36	35	26	26	MICS 2001
Cote d'Ivoire	2000	9	11	7	8	9	13	8	7	6	10	16	MICS 2000
Dominican Republic	2000	5	4	6	4	6	4	5	8	3	4	6	MICS 2000
Gambia	2000	18	25	13	17	17	21	11	14	15	24	25	MICS 2000
Guinea-Bissau	2000	39	55	29	36	48	57	19	29	40	46	65	MICS 2000
Guyana	2000	17	30	14	9	16	18	-	-	-	-	-	MICS 2000
Indonesia	2000	25	24	25	21	21	-	-	-	-	-	-	MICS 2000
Lao People's Democratic Republic	2000	15	22	13	12	17	21	11	16	14	17	21	MICS 2000
Lesotho	2000	33	26	35	32	34	31	38	35	33	30	30	MICS 2000
Madagascar	2000	3	3	3	3	3	2	3	3	3	3	2	MICS 2000
Mongolia	2000	11	13	10	13	10	21	8	12	13	13	11	MICS 2000
Myanmar	2000	10	8	11	14	11	9	11	11	10	9	8	MICS 2000
Niger	2000	6	7	5	5	8	10	6	4	4	5	7	MICS 2000
Rwanda	2000	19		20	19	19	19	18	21	20	18	17	MICS 2000
Sao Tome and Principe	2000	7	9	4	6	5	9	3	3	7	8	12	MICS 2000
Senegal	2000	6	8	5	5	8	6	3	7	6	6	6	MICS 2000
Sierra Leone	2000	24	17	27	26	19	17	23	24	20	29	25	MICS 2000
Sudan	2000	26	26	26	25	36	26	24	25	25	29	29	MICS 2000
Suriname	2000	7	2	7	12	12	3	1	5	5	5	15	MICS 2000
Swaziland	2000	14	22	12	12	13	15	13	12	14	15	16	MICS 2000
Tajikistan	2000	48	57	46	35	30	49	54	47	46	44	51	MICS 2000
Togo	2000	8	8	8	9	5	4	19	-	5	-	13	MICS 2000
Viet Nam	2000	21	20	22	18	18	46	22	20	21	25	18	MICS 2000
Zambia	1999	7	9	6	7	7	8	6	7	4	7	12	MICS 1999
Average (33 countries)		**17**	**19**	**17**	**17**	**18**	**20**	**16**	**16**	**16**	**17**	**19**	

APPENDIX 7:

CAREGIVERS WHO KNOW THAT DIFFICULT BREATHING IS A SIGN TO SEEK CARE IMMEDIATELY, BY SELECTED BACKGROUND CHARACTERISTICS, 1999-2001

Countries and territories	Year	% of caregivers who know that difficult breathing is a sign to seek care immediately	Area of residence		Mother's education			Wealth quintiles					Source
			Urban	Rural	No formal education	Primary	Secondary	Poorest	Second	Middle	Fourth	Richest	
Angola	2001	31	29	34	29	32	29	32	30	28	33	30	MICS 2001
Azerbaijan	2000	11	13	9	-	7	16	10	12	11	10	12	MICS 2000
Bolivia	2000	3	4	2	1	2	4	2	3	3	2	5	MICS 2000
Bosnia and Herzegovina	2000	40	42	40	-	38	42	-	-	-	-	-	MICS 2000
Burundi	2000	54	53	54	52	59	61	48	52	58	55	58	MICS 2000
Cameroon	2000	8	8	8	7	8	9	6	10	8	9	8	MICS 2000
Central African Republic	2000	15	15	15	16	15	13	17	16	14	15	12	MICS 2000
Chad	2000	17	16	17	17	17	16	22	15	13	16	16	MICS 2000
Comoros	2000	16	21	14	16	13	19	15	14	17	15	18	MICS 2000
Congo, Democratic Republic of the	2001	33	31	35	70	73	60	36	37	38	29	28	MICS 2001
Côte d'Ivoire	2000	10	14	9	9	11	18	10	8	9	12	17	MICS 2000
Dominican Republic	2000	19	19	19	18	19	20	18	23	17	18	20	MICS 2000
Gambia	2000	19	25	15	17	27	23	16	11	17	24	27	MICS 2000
Guinea-Bissau	2000	38	57	26	34	49	63	12	25	40	48	67	MICS 2000
Guyana	2000	25	31	24	17	25	25	-	-	-	-	-	MICS 2000
Indonesia	2000	35	36	35	34	31	-	-	-	-	-	-	MICS 2000
Lao People's Democratic Republic	2000	25	34	22	21	26	32	20	25	23	27	31	MICS 2000
Lesotho	2000	29	23	30	34	28	28	29	34	27	28	25	MICS 2000
Madagascar	2000	7	7	7	6	7	7	7	6	8	7	6	MICS 2000
Mongolia	2000	12	12	11	12	9	24	11	13	12	11	11	MICS 2000
Myanmar	2000	14	12	14	17	14	13	14	12	20	13	9	MICS 2000
Niger	2000	10	15	7	9	13	19	6	7	8	9	14	MICS 2000
Rwanda	2000	20	-	20	20	19	24	19	19	18	22	28	MICS 2000
Sao Tome and Principe	2000	6	8	5	6	6	7	4	4	5	5	14	MICS 2000
Senegal	2000	8	9	7	7	8	8	7	9	8	8	6	MICS 2000
Sierra Leone	2000	27	18	30	28	31	18	25	27	29	32	21	MICS 2000
Sudan	2000	35	36	34	34	36	36	31	34	36	39	36	MICS 2000
Suriname	2000	11	6	12	18	15	8	10	8	9	9	18	MICS 2000
Swaziland	2000	12	16	10	11	10	13	10	10	12	13	17	MICS 2000
Tajikistan	2000	56	64	53	54	48	56	60	57	51	52	59	MICS 2000
Togo	2000	15	17	14	16	12	16	33	-	13	-	30	MICS 2000
Viet Nam	2000	39	42	38	29	37	82	35	41	41	45	37	MICS 2000
Zambia	1999	8	10	6	8	8	8	7	6	4	8	13	MICS 1999
Average (33 countries)		**21**	**23**	**20**	**21**	**23**	**26**	**19**	**20**	**20**	**21**	**23**	