RISK FACTORS AND CASE MANAGEMENT OF ACQUIRED PNEUMONIA IN CHILDREN UNDER FIVE YEARS AT SELECTED HEALTH CENTRE IVS IN UGANDA

BY

KAWOOYA GEORGE WILLIAM

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DECLARATION

I Kawooya George William, declare that this thesis is my original work and has not been presented for a degree in any other university.

NAME: Kawooya George William

SIGNATURE: …….

DATE: …….....

APPROVAL

This thesis has been submitted for examination with our approval as University Supervisors.

NAME: Dr. Nampala Hasifa

PhD (Mathematical biology, MAK)

Department of Mathematics and Statistics

Kyambogo University

SIGNATURE …….

DATE: …….

NAME: Dr. Mbabazi Ssebuliba Doreen

PhD (Mathematics, Stellenbosch)

Department of Mathematics and Statistics

Kyambogo University

SIGNATURE: …….

DATE: …….

NAME: Dr. Asio Santa Maria

PhD (Epidemiology, Copenhagen)

Department of Biological sciences

Kyambogo University

SIGNATURE: …….

DATE: ……

DEDICATION

This thesis is dedicated to my parents KAKANDE LIVINGSTONE and NAUME NAMATOVU. Mummy and Dad's vision has been supporting me to attain high quality education, amidst financial constraints to realise my dreams. Mum and Dad stayed on, and together with others, have struggled to educate me by providing financial resources, advice, courage which gave me the inspiration to work hard at all levels of my education.

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LIST OF ACRONYMS

AIDS	Acquired Immunodeficiency Syndrome
AOR	Adjusted Odds Ratio
CAP	Community Acquired Pneumonia
CDC	Centres for Disease Control and Prevention
CHERG:	Child Health Epidemiology Reference Group
CI	Confidence Interval
ETS	Environmental Tobacco Smoke
HIV	Human Immunodeficiency Virus
ICCM	Integrated Community Care Management
IIPS	International Institute of Population Sciences
IMCI	Integrated Management of Childhood Illness
OR	Odds Ratio
PCR	Polymerase Chain Reaction
PCV	Pneumococcal Conjugate Vaccine
PERCH	Pneumonia Etiology Research for Child Health
PSI	Pneumonia Severity Index
T. B	Tuberculosis
UBOS	Uganda Bureau of Statistics
UK	United Kingdom
UNICEF	The United Nations Children's Fund
STC	Save the children
HCIV	Health centre IV

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DEFINITION OF KEY TERMS

Case: An instance of a disease for example pneumonia infection

Pneumonia case: A child of five years and below with cough and fast or difficult breathing for two weeks' duration due to a problem in the chest.

Severe pneumonia case: The child of five years and below with cough for two weeks' duration with one or more of the danger signs with or without fast breathing.

Fast breathing: 50 breaths per minute or more for children aged 2 to 12 months, 40 breaths per minute or more for children aged 12 months to 5 years.

Symptoms of pneumonia: Any of the following in a child under five years: Sudden onset of chills, convulsion, in ability to drink/eat, vomiting, unconsciousness, lower chest in drawing, stridor, unusually sleepiness, high fever.

Case management: Process in which health worker identifies the risk factors of a disease and develops plans for the diagnosis and treatment of the disease as the healthcare for the patient**.**

Diagnosis: Detection and identification of the nature of an illness by examination of the signs and symptoms or presence of the pathogen in the serum.

Treatment: Medication given to a patient with an illness after diagnosis

Risk factors: Variables associated with an increased acquisition of a disease or infection or something that increases person's likelihood of developing a disease

ABSTRACT

Pneumonia is the second leading cause of death in children under five years of age in Uganda. Knowing the risk factors, diagnosis and treatment of pneumonia cases in children under five years is useful for prevention and intervention programs that are aimed at controlling the disease risk factors and disease prevalence. The objective of the study was to investigate and assess risk factors and case management of acquired pneumonia in children under five years at selected health centre IVs in Uganda, using a cross sectional design. Data was collected from close to 2,000 caretakers and 20 health workers using questionnaires. Binary logistic regression was used to identify significant risk factors associated with acquired pneumonia. Research findings indicate that, consumption of whole food for some days (OR: 1.567; 95% CI: 1.031 – 2.308), size of the house (OR: 0.530; 95% CI: 0.403 – 0.698), number of people in the family (OR: 2.130; 95% CI: 1.580 – 2.871), presence of a source of pollution in the neighbourhood (OR: 1.135; 95% CI: 1.005 – 1.282), presence of a member who smokes in the family (OR: 0.487; 95% CI: 0.309 – 0.770) and number of times the child received immunisation for pneumonia (OR: 0.585; 95% CI: 0.427 – 0.802), were the significant risk factors of acquired pneumonia. It was further found out that majority of the children received delayed diagnosis and treatment. While the most common clinical sign and symptom was rapid breathing, most health centre IVs lacked pneumonia diagnostic tools.

CHAPTER ONE: INTRODUCTION

1.1 Background

Children contract pneumonia is a kind of acute lower respiratory tract infection resulting from lung inflammation brought on by mostly bacteria making children struggle to breathe as their lungs swell with pus and fluid (Save the children, 2015). Pneumonia is the leading cause of death for children worldwide, leading to death of 800,000 of them in 2020 or one every 39 seconds (UNICEF, 2020). Despite the fact that some varieties of pneumonia are easily treatable with affordable drugs if correctly detected and that tens of millions of children remain unvaccinated, one in three children exhibiting symptoms do not obtain the necessary medical attention (UNICEF,2020).

Children and families worldwide are affected by pneumonia, although South Asia and sub-Saharan Africa have the highest rates of infection (WHO, 2019). Additionally, children from the world's poorest nations, as well as the most underprivileged and disadvantaged children are more likely to die from pneumonia (UNICEF, 2020).

Additionally, estimates indicate that between 2020 and 2030, 6.3 million kids under the age of five would die from pneumonia, with the biggest numbers of deaths projected to occur in Nigeria (1.4 million), India (880,000), the Democratic Republic of the Congo (350,000), and Ethiopia (280,000) (UNICEF, 2020).

According to reports, at least 25 kids die of pneumonia each day in Uganda, where it is estimated that pneumonia causes 10% of all under-five fatalities annually (MoH, 2020). Since 2012, the Ugandan government increased efforts to protect, prevent, and cure pneumonia in children under five. These included; encouraging breastfeeding, vaccination, vitamin supplementation, and the use of the proper medications for treating pneumonia (MoH, 2020).

Additionally, to prevent baby and child fatalities from pneumococcal illness, the government of Uganda introduced pneumococcal conjugate vaccine (PCV) into the nation's normal vaccination schedule on April 27, 2013 (WHO, 2013). Risk factors of pneumonia, diagnosis, and treatment of the illness in under five year old infants, are included in this study of case management of acquired pneumonia. According to the World Health Organization (WHO) and United Nations Children's Fund (UNICEF), bacterial aetiology, young age, low birth weight, malnutrition, household crowding, exposure to indoor air pollution, low-level education of mothers, and a lack of breastfeeding are risk factors for developing childhood pneumonia in low- and middle-income countries like Uganda (Naheed et al.,2019). According to research by Alemayehu *et al.*, (2019), variables related to poverty, such as undernutrition, a lack of access to clean water and sanitary facilities, indoor air pollution, and a lack of safe drinking water are all substantially linked to pneumonia mortality. Additionally, infants whose immune systems are weakened by inadequate nutrients and pre-existing conditions such as symptomatic HIV have a high risk of acquiring pneumonia.

For the prevention and management of pneumonia prevalence in under five year old children, early detection and diagnosis of paediatric pneumonia are essential. The hospital laboratory confirmatory procedures for examination of aetiology of pneumonia in under five year old children include radiography and use of additional pneumonia diagnostic equipment like stethoscope, pulse-oximeter, respiratory rate timer, and haematology analyser. These confirmatory methods are mostly unaffordable in the poor socio-economic countries basing on the research study by Markos et al., (2019). Acquired pneumonia is diagnosed based on the clinical presentation of symptoms and signs such as fast breathing and chest tightness. Antibiotics, such as amoxicillin, are used to treat instances of acquired pneumonia, either in hospitals or at the community level by skilled healthcare professionals (WHO, 2021). Even

though Uganda is one of the nations with health programs related to efficient early identification and treatment of pneumonia, the disease's significant child morbidity and death rates remain high (MoH, 2010). This is due to the case management of acquired pneumonia in children under the age of five, which is sometimes difficult in settings with limited resources (Sozinho et al., 2015). Due to a lack of enough data, further study is required on the risk factors for developing pneumonia as well as the prompt detection and treatment of cases. By identifying risk variables, evaluating prompt diagnosis and treatment, quantifying risk factors, and linking risk factors with acquired pneumonia cases in children at selected health centre IVs in Uganda, this study aims to close this gap.

1.2 Problem statement

Pneumonia is a universal problem of public health importance that disproportionately affects most regions in Sub-Saharan Africa including Uganda. According to Uganda Ministry of health report 2020, the mortality rate of under five year old children is high, with pneumonia responsible for approximately 10 percent of all deaths in this category. The Ministry of Health of Uganda, established the integrated case management (ICM) strategy to reduce child morbidity and mortality by increasing access to treatment for pneumonia which is among the top killers of children (MoH, 2010). The ICM, comprises of a network of service providers, that include, the community village health teams, the private health providers in private health centres and government health service providers in public health centres. This is aimed at increasing access to health services like education on the risk factors for child hood pneumonia, diagnosis, treatment of pneumonia infections, improving quality of services and increasing informed demand among children’s caregivers for appropriate treatment. Furthermore, in order to reduce infant mortality due to pneumonia, in 2013, the Ministry of Health of Uganda introduced the free pneumococcal conjugate vaccine (PCV) into the

country's routine immunization schedule at all health centres. Despite the sustained efforts, pneumonia continues to greatly contribute to mortality of children under five years in Uganda. This calls for more research on the likely risk factors, diagnosis and treatment of acquired pneumonia in children under five years.

1.3 Significance of the study

Risk factors, diagnostic tools, clinical signs and symptoms, pneumonia predictive diseases and their medication in children under five years will be identified.

1.4 Objectives of the study

1.4.1 General objective

To assess the case management of acquired pneumonia in children under five years at selected health centre IVs in Uganda.

1.4.2 Specific objectives

i. To identify risk factors for acquired pneumonia in children under five years at selected health centre IVs in Uganda.

ii. To assess how diagnosis and treatment of pneumonia cases is conducted in children under five years at selected health centre IVs in Uganda.

iii. To correlate the relationship between risk factors and acquired pneumonia in children under five years at health centre IVs in Uganda.

1.5 Research questions / Hypothesis

i. What are the risk factors for acquired pneumonia in children under five years at selected health centre IVs in Uganda?

ii. What is the nature of timely diagnosis and treatment of pneumonia cases in children under five years at selected health centre IVs in Uganda?

iii. What correlation exists between the risk factors and acquired pneumonia in children under five years at selected health centre IVs in Uganda?

1.6 Scope of the study

1.6.1 Geographical scope

The research will be carried in four regions of Uganda: Eastern, Western, Northern and Central regions. The study was carried out at the following selected health centre IVs; Kyegegwa in the Western region, Awachi in the Northern region, Kasangati in the Central region, Mayuge in the Eastern region of Uganda.

1.6.2 Content scope

The research focused on case management of acquired pneumonia that included identifying risk factors, assessing the process of timely diagnosis and treatment of pneumonia cases, quantifying and correlating the risk factors with acquired pneumonia in children under five years at selected health centre IVs in Uganda.

1.6.3 Time scope

The research will be conducted from June 2021 to September 2022. This period include time for data collection, analysis and discussion of results.

1.7 Conceptual framework for the case management.

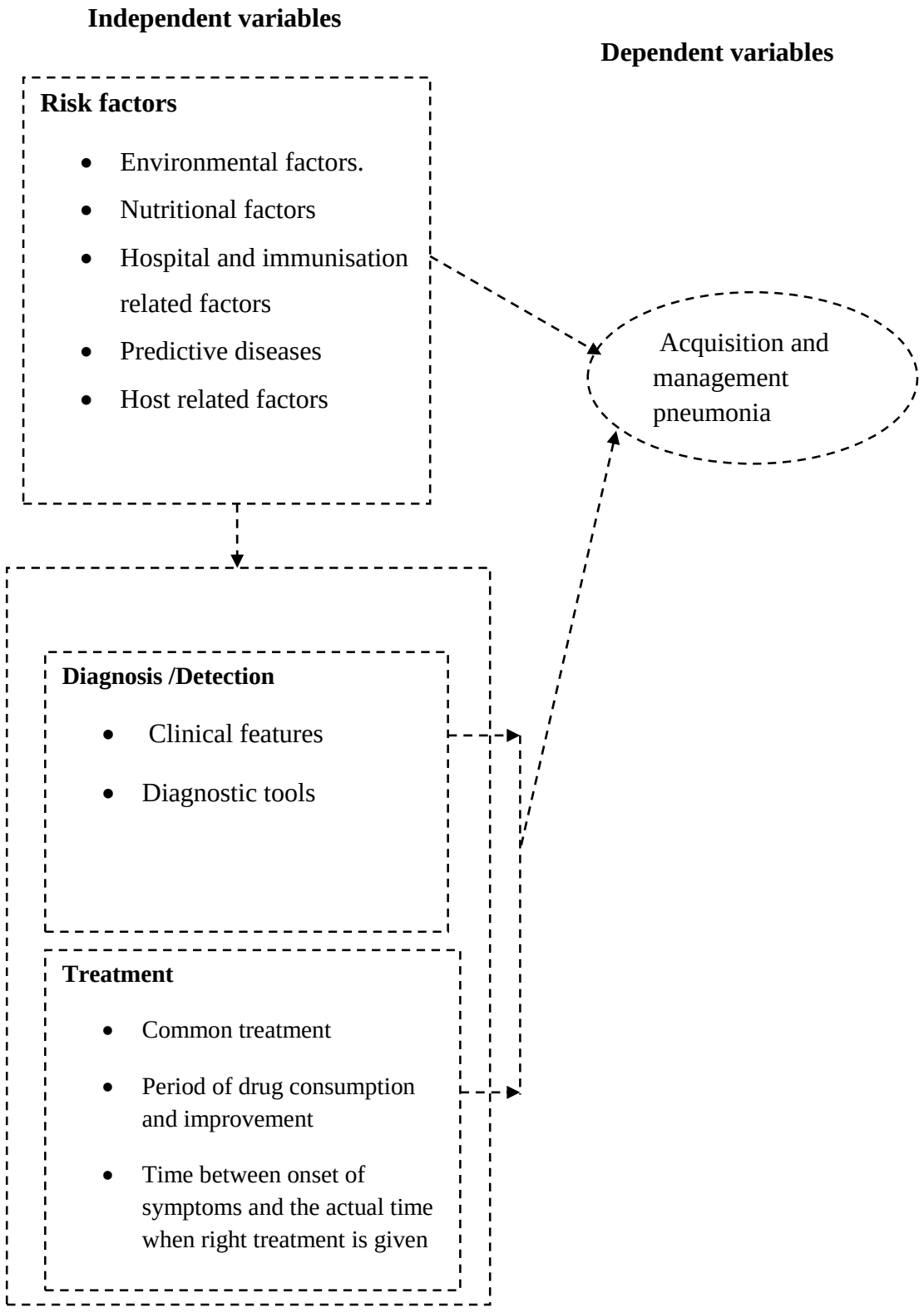

Figure 1.2: Conceptual framework

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

The second most prevalent infectious cause of mortality in children under five is pneumonia which kills almost one million of them annually, more than malaria, HIV, and measles combined (WHO, 2019). Most of these deaths occur in low- to middle-income nations (Liu et *al.,* 2010). Early detection and treatment of pneumonia can significantly reduce morbidity and death, but are frequently difficult in areas with limited resources (Sozinho *et al.,* 2015).

2.1.1 Epidemiology

An illness of the respiratory system called pneumonia affects 450 million individuals worldwide each year (Ruuskanen *et al.,* 2011). It is a significant cause of mortality for people of all ages, accounting for 3.0 million fatalities in 2019 (the fourth greatest cause of death worldwide), up from 1.4 million deaths in 2010 (7% of the global annual total) (WHO, 2020)

Pneumonia can be brought on by bacteria, viruses, or fungus. These can be contracted from a variety of places, including hospitals (Brunilda, 2020). One of the most deadly communicable illnesses is pneumonia (WHO, 2020). Children under five and those over 75 years old have the highest incidence of infection. The underdeveloped world experiences it around five times more frequently than the developed world. The two regions in the world with the highest rates of pneumonia are South Asia and Sub-Saharan Africa (WHO, 2019).

Pneumonia infections killed 156 million kids of under five year old in 2008, on average (151 million in the developing world and 5 million in the developed world). It resulted in 1.6 million deaths, or 28–34% of all deaths among children under the age of five, with 95% of those deaths taking place in underdeveloped countries (Ruuskanen *et al.,* 2011).

In addition, pneumonia caused 15% of all paediatric fatalities in 2017 among children under the age of five, which is greater than any other infectious illness (WHO, 2019).

Children in low- and middle-income nations are substantially more likely to acquire pneumonia since these risk factors are so common. These include low nutrients availability, overcrowding, and substandard housing (Naheed *et al.,* 2019). Pneumonia risk can also be increased by other conditions, such as malaria, which is common in Africa and South Asia (WHO, 2021).

Overall, age and the time of the year are the most important risk factors for pneumonia in children in poor nations. Children are especially vulnerable when they are younger during the rainy and wet seasons (Antonio *et al.,* 2016).

10% of children under the age of five in Uganda die from pneumonia. Every day, pneumonia kills at least 25 children in Uganda (MoH, 2020). Since many infants perish when some facilities fail to provide them with oxygen to aid breathing when hypoxemia sets in (lack of adequate oxygen in the blood) despite being one of the main symptoms of pneumonia. The ministry of health of Uganda launched an oxygen scale up plan in 2020 as one of the interventions to reverse this sombre picture of child mortality (Independent Paper, 2020).

2.2 Risk factors for pneumonia

Pneumonia is influenced by the children's birth weight, socioeconomic level, environment, nutritional status, behavioural patterns, and immunisation status (Wondi *et al.,* 2012). In a study by Fadl *et al,* (2020), a number of risk factors, including young age, male gender, higher birth order, low birth weight, prematurity, and place of delivery, concomitant illness, inadequate home aeration, and exposure to outdoor air pollution, were reported to be independently associated with pneumonia in children under the age of five. Furthermore,

environmental circumstances and a child's personality might both increase the risk of pneumonia, according to Maryunani (2010). Environmental variables include house ventilation, population density, and indoor air pollution from cigarette smoke, whereas child-specific factors include age, birth weight, nutritional status, vitamin A deficiency, and vaccination status. Similar to the last study, a portion of this study was devoted to identifying the important risk variables linked to acquired pneumonia in children under the age of five in order to ascertain if they were consistent with the body of existing literature.

2.2.1 Demographic risk factors

2.2.1.1 Sex.

It's unclear whether sex plays a part in pneumonia risk (Ramachandran *et al.,* 2012). Due to the increased resistance observed in females, which is explained by their stronger immune response, men are more prone than women to get lower respiratory tract infections (Muenchhoff *et al.,* 2014). Male gender was found to be a protective factor against pneumonia in research by Fonseca Lima *et al.,* (2016), indicating that sex poses a danger for children developing pneumonia. However, among the 6,856 patients hospitalised for acquired pneumonia in different research by Naheed *et al.,* (2019), a larger percentage of females (35%) than men (21.5%) were present. Female children admitted with extremely severe pneumonia had deaths that were four times greater in multivariate analysis than did male children (Naheed et al., 2019). The purpose of this study was to determine if girls in Uganda get pneumonia more frequently than males, or the opposite.

2.2.2 Age

When compared to older age groups, pneumonia risk was shown to be two times higher among infants under the age of 12 months (Abuka, 2017). In addition, Abdel *et al.,* (2020)

found that acute respiratory infections occurred 48.5% of the time in infants younger than 6 months, which is consistent with earlier research by Srinivasa *et al.,* (2015) and Boor *et al.,* (2001), which found that infants with acute respiratory pneumonia accounted for 58% and 52% of cases, respectively. This study partly aimed at finding out if age is an influencing factor for acquired pneumonia in under five year old children.

2.2.2 Socio-economic risk factors

The stark disparities in occurrences between nations show the relationship between socioeconomic conditions and pneumonia. For instance, pneumonia incidence among children under five is estimated to be 0.05 and 0.29 episodes per child-year in industrialised and developing nations, respectively (Rudan *et al.,* 2011). Around 156 million new episodes start each year, 151 million of them in poor nations, and 7–13% of them are severe enough to be life-threatening and necessitate hospitalisation (Rudan *et al.,* 2011). There is proof that there is a link between socioeconomic deprivation and pneumonia, with children from less fortunate households experiencing acquired pneumonia episodes more frequently (Fontoura *et al.,* 2012). The risk of pneumonia-related hospitalisation was shown to be higher in a different study by Thorn e*t al.,* (2011) when the family income was less than the minimum wage, a finding that has been noted by other researchers. Compared to young children in metropolitan centres, children living in distant areas with extreme poverty and malnutrition are more vulnerable to pneumonia (Nair *et al.,* 2013). The overall lack of access to healthcare services for the less fortunate or wealthy families is attributed to low financials resources that cause the delay in receiving sufficient care, which worsens their condition and increases the likelihood that their children will need to be hospitalised (Rudan *et al.,* 2013). This study sought to determine if the social-economic environment is an influencing factor of acquired pneumonia in children under the age of five.

2.2.3 Environmental risk factors

Exposure to smoking, crowded conditions and exposure to extremely cold environments are some of the environmental risk factors for respiratory infections that are most commonly researched. Environmental risk factors for pneumonia include kuccha dwellings, which are often constructed by the underprivileged and are known to increase the incidence of pneumonia in Asian nations. According to Jullien *et al.,* (2020), children who lived in kuccha households were at an elevated risk of developing severe pneumonia, whereas Nhung *et al.*, (2017) found that greater levels of outdoor pollution in metropolitan areas were linked to an increase in pneumonia cases.

Toxic chemicals included in cigarette smoke are extremely damaging to both active and passive smokers (WHO, 2020). According to a Satit (2011) research, children who are exposed to tobacco smoke over an extended length of time have reduced immune systems and are more prone to have pneumonia because of the substances like nicotine, tar, and carbon monoxide that are inhaled. One of the indoor air contaminants that lowers local defence systems and increases the risk of respiratory disease in children is environmental tobacco smoke (ETS) (Srivastava *et al.,* 2015). Another study indicated that exposing children to cigarette smoke in the home raised their risk of developing pneumonia by 1.5 times (Fadl *et al.,* 2020). According to research by Gothankar et *al., (*2018) and others, smoke has been demonstrated to negatively impact many defensive systems in the body against pathogenic organisms.

In many poor nations, biomass fuels including wood, dung, and agricultural waste are frequently used in the home due to the high costs and infrequent availability of power and fossil fuels. Like the majority of sub-Saharan African nations, Uganda mainly depends on biomass as an energy source (Dastan *et al.,* 2017and Magala, 2015). Due to the lack of

widespread access to modern energy sources like electricity, Ugandans have a propensity to rely too much on and use wood biomass (Africa energy commission, 2016, Branch, 2018). Additionally, it is said that using charcoal and wood as fuel in Uganda has an adverse effect on the health of many women, particularly those who are pregnant, as well as children in the area because of passive inhalation of smoke into the lungs (Bamwesigye *et al.,* 2020*).* Gothankar *et al.,* (2018) observed that 40–43% of families in Uganda utilised dirty fuel for cooking. This high reliance on the unclean fuel emits a lot of smoke that harms babies' respiratory tracts and raises the risk of developing pneumonia. The purpose of this study was to determine if the kind of domestic fuel used for cooking by houses and families residing close to any source of pollution, such as a sewage plant or industry, are related to pneumonia cases detected in children under the age of five at selected health centre IVs studied.

Crowding in households varies widely (Jackson et *al.,* 2013). Household congestion is characterised in this study as the presence of two or more people sleeping in the same room as the kid. In a research survey by Fonseca *et al.,* (2016), house crowding was the factor that parents' or guardians' reports of what caused their children's pneumonia were most closely related to. Additionally, Keleb *et al.*, (2020)'s community-based cross-sectional investigation, discovered that household crowding was a predictor of paediatric pneumonia. The findings from cross-sectional studies conducted in India by Agarwal *et al.,* (1993), revealed that increased pneumonia incidence in young children living in crowded situations were consistent with one another. Crowding, in accordance with Srivastava *et al.*, (2015), leads to the spread of illness from adults to children via respiratory droplets. Crowding was shown to be strongly linked to pneumonia in the same study, where it was found that it was linked to a 60% decrease in the incidence of asthma but a 2.5-fold rise in the incidence of lower respiratory tract infections. Furthermore, overcrowding in homes with inadequate ventilation

can lead to moist conditions in the home, which can lead to pneumonia in children. This is because inadequate ventilation results in restricted air circulation. This circumstance puts people at danger of contracting germs or viruses since wet houses microorganisms may readily breed in them (Maulana *et al.,* 2018). This research sought to determine if pneumonia actually diagnosed in children was influenced by environmental related variables.

2.2.4 Nutritional factors

In a research survey by Chisti *et al.,* (2009), moderate malnutrition was associated with odds ratios of 2.5 to 15.1, severe malnutrition was associated with relative risks ranging from 2.9 to 121.2. The purpose of this study was to determine whether malnutrition is one of the variables associated with pneumonia in children treated at health centre IVs in Uganda.

In undeveloped nations, breastfeeding varies in frequency. Breastfeeding lasts for a relatively short time (approximately three months) in wealthy nations, while it lasts for a long time and is ubiquitous in many impoverished rural and some poor urban regions (12–18 months), even if supplements are sometimes administered at a young age. While Roberts *et al.,* (2013)'s study found that not breastfeeding is a significant risk factor for under-five year morbidity and mortality in developing countries, Cesar *et al.,* (1999) found that supplementing breast milk with solids was associated with a relative risk of 13.4 for acquiring pneumonia in all infants. Insufficient breastfeeding was shown to be substantially linked with pneumonia-related deaths (OR = 1.8; 95% CI, 1.2-2.7), according to research by Sonego *et al.,* (2015) and severe pneumonia in children under the age of five (OR = 2.3; 95% CI, 1.4-3.9) in research by Jacksonet *al.,* (2013). Since the baby's immune system is still developing, the breast milk contains a range of immuno-protective and nutritive components that shield the child (Steller *et al.,* 2011).

Furthermore, 50.7% of patients in a hospital-based case study by Savitha *et al.,* (2007), were not breastfed, and 65% of cases had incorrect weaning. These results are in line with those of Boor *et al.,* (2001) and Savitha *et al.,* (2007), who noted a significant frequency of acute respiratory infections in kids who are not exclusively breastfed were not properly weaned. This study looked at health centre IVs in Uganda to see if characteristics related to breastfeeding were risk factors for acquired pneumonia in young children.

2.2.5 Hospital related factors

In a research by Srivastava *et al.,* (2015), pneumonia was substantially related with inadequate immunisation for age, 80% (cases) versus 38.33%. (Controls). This was due to mothers not being aware of the medical facilities and services that were accessible to children under the age of five. This also resulted in delayed consultation for children's illnesses, which led to serious sickness in young children. In different research by Agarwal *et al.,* (2003) on rural preschool children, it was shown that vaccinated children had considerably lower rates of moderate and severe acute respiratory infection-related morbidity and death than unimmunized children. The goal of the study was to determine if immunization related factors increase the risk of pneumonia in children under the age of five.

Any abnormal obstetrical condition or unfavourable occurrence that happens during pregnancy, labour, or delivery has a deleterious effect on both the mother and the child. There are a number of difficulties related to delivery that happen in a certain proportion of all pregnancies at variable rates. The possibility for catastrophic birth damage is greatest with complications that are the most challenging for medical professionals to handle. This study looked into the relationship between pneumonia acquisition and childbirth history.

2.2.6 Co-morbidities

Co-morbid illnesses are ones that have been shown to increase the risk of pneumonia. According to the Child Health Epidemiology Reference Committee (CHERG), an academic review group created by WHO in 2013, diarrheal illnesses are one of the factors that influence pneumonia in children under the age of five. In a cohort study including kids from Ghana and Brazil, diarrhoea led to acute respiratory tract infections, including pneumonia (Enarson *et al.,* 2015). Pneumonia has a known risk factor associated with measles. Measles causes immunological suppression, which increases the mortality risk from pneumonia (Jain *et al.,* 2015). This conclusion that children with a history of measles were more likely to acquire pneumonia than children with no history of measles is supported by a case-control study conducted in Pakistan (Shah *et al.,* 2011). One of the main risk factors for pneumonia in children aged 2 to 59 months is a lack of measles vaccination (Tuhebwe *et al.,* 2014). According to the CHERG, pneumonia is more common when other co-morbid conditions including HIV/AIDS, malaria, and malnutrition are present (Fox *et al.,* 2013). Additionally, it was shown that the development of pneumonia in kids was strongly related to anaemia (Lassi *et al.,* 2014). According to Onyango *et al.,* (2012), individuals who had a co-morbidity had a higher likelihood of developing severe pneumonia (OR = 3.8; 95% CI, 1.4-10.6). In Uganda's health centre IVs for children under five, the study intended to identify the co-morbidity diseases (predictive diseases) connected to pneumonia.

2.3 Diagnosis

Children under the age of five can have pneumonia diagnosed in a variety of ways. Healthcare professionals can identify pneumonia based on symptoms, a physical exam, or by requesting diagnostic tests, according to Nga (2013). Cell cultures and chest x-rays in the affected area of the body are examples of laboratory testing methods. Abdel *et al* hospital-

based's case study in 2020 revealed the pattern of acute respiratory infection dissemination. Out of 215 cases, lobar pneumonia (32%), bronchopneumonia (21%), bronchiolitis (20%), croup (6.9%), pleural effusion (10.6%), and WALR (9.3%) were the most frequent clinical diagnoses. The purpose of this study was to establish the typical clinical diagnostic standards employed by medical professionals in the confirmation of pneumonia cases in children under the age of five.

2.3.1 Clinical features

According to Uganda clinical guidelines published in 2016, pneumonia in infants up to 2 months of age is rapidly fatal and shows the following signs and symptoms: rapid breathing, severe chest pain, grunting breathing, inability to breastfeed, convulsions, drowsiness, stridor in a calm child, wheezing. While clinical signs of pneumonia in children between the ages of 2 months and 5 years include a high-grade fever, cough, rapid breathing, and slight chest wall in-drawing. However, severe pneumonia has at least one of the following symptoms in addition to the previously listed ones: incapacity to eat, central cyanosis (blue lips, oral mucosa, fingernails, or oxygen saturation below 90% using a pulse oximeter), and blue lips.

Pediatric patients under the age of five are initially diagnosed with pneumonia based on clinical symptoms and indicators. For instance, pneumonia is assumed to be present in toddlers and babies younger than five years old who cough and have rapid or laboured breathing (Nga, 2013). This is in accordance with WHO and UNICEF's Integrated Management of Childhood Illness (IMCI) recommendations, which train medical professionals and staff about typical clinical signs and efficient treatments for pneumonia in children under the age of five. Cough was the primary presenting symptom in the hospital-based case research done by Abdel *et al* in 2020, followed by fever (84.3%), dyspnea (73.9%), and tachypnea (84.9%), wheeze (55%) and chest in drawn (55% of patients) were

the most common symptoms. This study aimed to determine the common symptoms of pneumonia in under five year old children.

2.3.2 Diagnostic tools

Diagnostic tools for pneumonia in medical settings include pulse oximeters and respiratory rate counters. They include a stethoscope, an ARI timer, a fingertip pulse oximeter, a portable pulse oximeter, a smartphone app that counts breaths when the screen is touched, and a straightforward feature phone app that counts breaths (Kevin, 2019). They identify a higher respiratory rate in kids who have a cough and/or have breathing problems as a sign of pneumonia in kids under the age of five. Other diagnostic methods include a chest x-ray and PCR antigen to identify the agents that cause pneumonia. The goal of this study was to identify the most popular diagnostic equipment used at selected health centre IVs in Uganda.

2.4 Treatment

The outcome of pneumonia may be improved by using the best antibiotic as the first line treatment. Depending on the severity of the sickness, antibiotics are administered and are most effective for treating children. Antibiotics are used to treat disease efficiently while reducing antimicrobial resistance and pathogenicity (Nga, 2013). For the treatment of pneumonia, cotrimoxazole, amoxicillin, cephalosporins, and macrolides are the four antibiotic classes that are recommended. Amoxicillin oral suspension is the current recommended treatment for paediatric non-severe pneumonia, and ampicillin and gentamicin are recommended for really severe pneumonia. In this study, we looked at the most frequently prescribed drugs and how long it took between the onset of symptoms and the actual time when the proper treatment was given.

2.4.1 Treatment consumption

In children who are immunocompetent, short-course antibiotic therapy (three rather than five days) has been reported to be frequently and effectively administered for pneumonia (Sutijono *et al.,* 2011). The most effective antibiotic for treating paediatric pneumonia, according to the recommendations of WHO, amoxicillin is given twice daily for three days in environments with low HIV prevalence or five days in environments with high HIV prevalence (Nga, 2013). Utilizing the right medicines and receiving supportive care, such as oxygen, remains the cornerstone of optimal treatment uptake for paediatric pneumonia (Bhutta *et al.,* 2013). Children with hypoxic pneumonia who use oxygen devices had a 20% mortality reduction (Catto *et al.,* 2011). The World Health Organization's Integrated Management of Pediatric illness (IMCI) program's use of the pneumonia case management method has repeatedly been shown to reduce childhood mortality by about 20%, with considerably larger reductions in pneumonia-specific mortality (Sazawal *et al.,* 2003). The mortality rate from pneumonia in children may be reduced by 70% with community-based case management (Theodoratou *et al.,* 2010). According to growing research, using oral antibiotics in the community to treat severe pneumonia may be a practical and successful way to lower mortality (Soof *et al.,* 2012). The purpose of this study was to determine the effectiveness of hospital-based case management of paediatric pneumonia. This was accomplished by calculating the percentage of pneumonia patients under the age of five who recovered and the length of time taken to recover.

2.4.2 Time between onset of symptoms and the actual time when right treatment is given

In a case-series study by Tumwine *et al.,* (2009), 64 (47%) caregivers who reported difficult and rapid breathing in children under five years of age administered antibiotics at home or sought care elsewhere (private/public health facilities or hospital) within one day of

recognising the problem. In the same study, 57 (42%) of the caregivers reported that their initial response had been to administer antibiotics, others had taken the child outside the home for care before noticing the child's laboured and rapid breathing, 11 caregivers administered antibiotics at home and 40 caregivers had taken the child outside the home for care. The two symptoms that were most often present just before seeking care outside the house were prevalent cough (21/46) and fever (11/46). In this study, we looked at the duration it took the guardian to take the child for diagnosis and treatment at health centre.

CHAPTER 3: MATERIALS AND METHODS

3 .0 Introduction

The methods utilised to gather and use the data for this investigation are described in this chapter. It includes information on the study's demographic and geographic area, the research design, the process for determining sample size, data collecting techniques, data analysis, and ethical considerations.

3.1 Study area

The study was conducted in districts from four regions of Uganda; Eastern, Western, and Central and Northern region. In each region, a district was purposively selected for the study, similarly in a selected district a single health centre IV was purposively selected as shown below.

REGION OF UGANDA	DISTRICT	HEALTH CENTRE IVS
CENTRAL	Wakiso	Kasangati
WESTERN	Kyegegwa	Kyegegwa
EASTERN	Mayuge	Mayuge
NOTHERN	Gulu	Awachi

The figure 3.1 shows the location of selected districts in each region of Uganda from where a single health centre was selected purposively for the study.

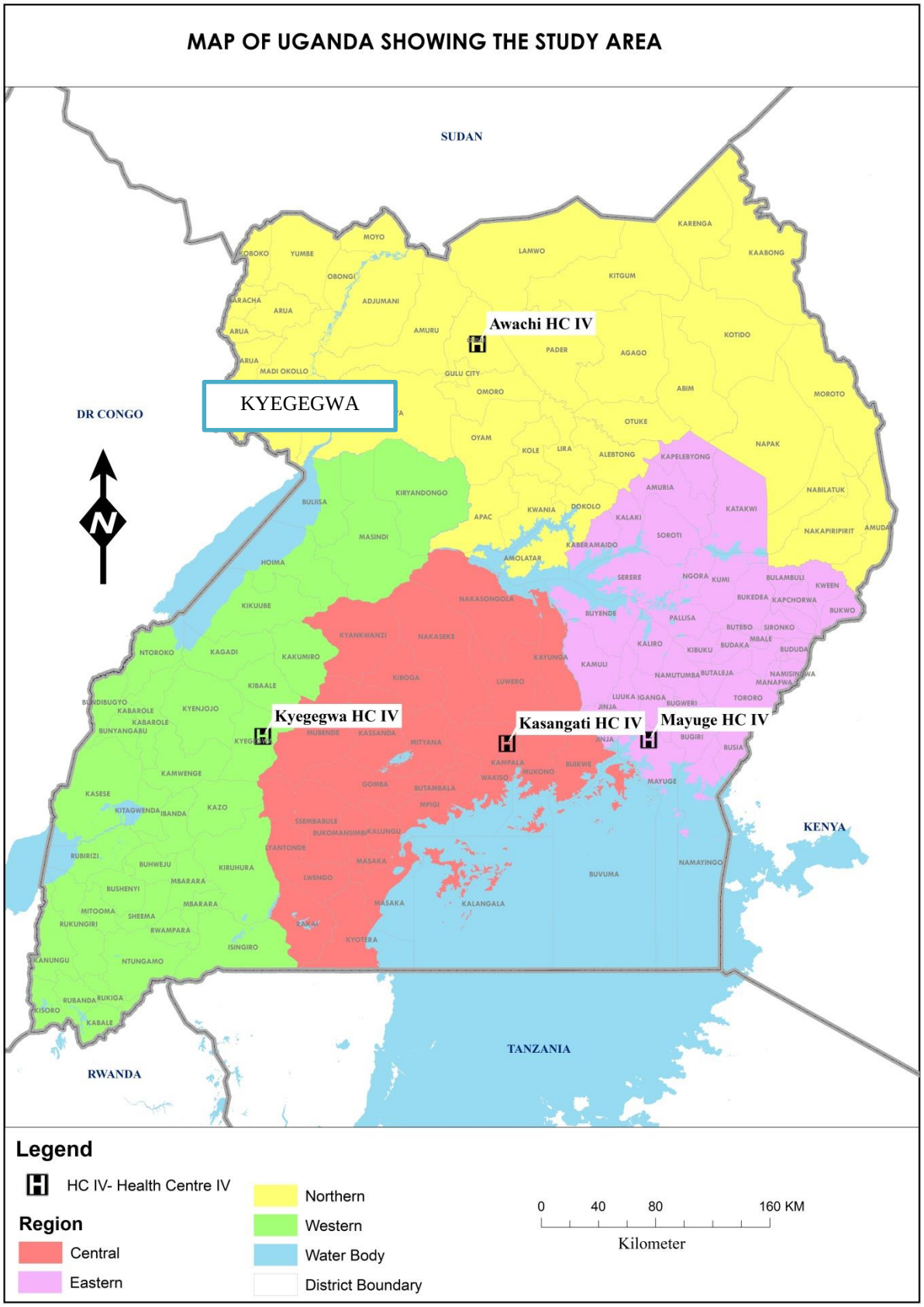

Figure 3.1: Map of Uganda showing study areas

3.2 Study population

The study consisted of caretakers of under five year old children, health workers particularly doctors and nurses at the selected health centre IVs in Uganda.

3.3 Study Design

The study used a descriptive cross-sectional design with quantitative and qualitative methods with the intent of identifying risk factors for acquired pneumonia in children under the age of five, evaluating timely diagnosis and treatment of acquired pneumonia cases, and quantifying and correlating risk factors with acquired pneumonia in children under the age of five at selected health centre IVs in Uganda.

3.4 Sample size

3.4.1 Determination of sample size

The sample size for the under five year old children was estimated by using formulae of Conchran equation (Glenn, 2003). The following assumptions were made: margin of error, e was 5% with a confidence level of 95% and the estimated proportion of pneumonia in the population of under five years was taken as p = 0.5. Implying that the initial sample size (n_1) was given by

$$n1 = \frac{\boldsymbol{z^2 p(1-p)}}{\boldsymbol{e^2}}$$

$$= \frac{1.96^2 x 0.5 x 0.5}{0.05^2} = \frac{0.9604}{0.0025}$$

$$= 384.16$$

30% non – response rate

$$= 384.16\ x\ 0.3$$

$$= 115.3$$

Response per facility

$$= 384.2 + 115.3$$

$$= 499.5$$

$$= \mathbf{500}\ \boldsymbol{respondents\ from\ each\ health\ centre\ iv}$$

At each health centre IV selected in a region, a doctor and at least 3 nurses were purposively selected to participate in the study.

3.5 Sampling techniques

These were categorized as shown below.

Table 3.2: Distribution of sampling technique

Source of information	Sampling technique
Health facilities across four districts	Purposive sampling
Doctors	Purposive sampling
Nurses	Purposive sampling
Care takers /parents/guardians	Purposive sampling

3.6 Data collection methods

These were mainly questionnaire approach methods and the procedures for data collection

3.7 Data collection instruments

These included self-administered questionnaires, for the caretakers of the children and the key informant's questionnaires for the health workers.

3.8 Piloting of the questionnaires

A pilot study was carried out to pre-test validate the questionnaires so as to ensure that they were in line with the objectives for establishing the reliability and validity of the research instruments for data collection.

3.9 Data analysis

Quantitative data was coded and analysed using Microsoft excel and SPSS version 20. For objective one, binary logistic regression analysis was run to find out the significant risk factors for acquired pneumonia, for objective two, univariate analysis with tables was run to identify the mostly used diagnostic tools, common symptoms of acquired pneumonia in children under five years, Student t- test analysis and Chi-square test analysis were run to investigate the associations between disease diagnosed in the child and treatment given by health workers, number of days of consumption of medication and child's health improvement respectively. While for objective three, Spear man's rank correlation analysis was run between the significant risk factors and acquired pneumonia in children under five year. The level of significance was 95 percent confidence interval at p-value < 0.05.

3.10 Ethical consideration

The research protocol was submitted to Uganda Christian University Research Ethics Committee for review. Upon approval, permission was sought from all district health officers in all districts where research was conducted.

Informed consent was sought from all participants through discussion of the research topic with the respondents. Confidentiality was observed by not indicating names of participants. Participation in the study was voluntary.

CHAPTER FOUR: RESULTS PRESENTATION

4.0 Introduction

The results of the data collection and analysis are reported in this chapter. Data is given in tables, histograms, and graphs along with descriptions, discussions, and analyses of the study's findings. The information gathered was entered into an excel spreadsheet created specifically for the study.

4.1 Demographic characteristics of caretakers

The age of caretakers was investigated with the aim of identifying the average age distribution across the four regions.

Table 4.1: Age of the caretakers

Age	Awachi	Kasangati	Kyegegwa	Mayuge	Total
	n (%)	n (%)	n (%)	n (%)	n (%)
<20	36 (7.0)	34 (6.7)	29 (8.8)	90 (17.8)	189 (10.2)
20 - < 25	50 (9.8)	154 (30.1)	85 (25.9)	140 (27.7)	429 (23.1)
25 - < 30	228 (44.5)	158 (30.9)	94 (28.7)	95 (18.8)	575 (31.0)
30 - < 35	156 (30.5)	82 (16.0)	57 (17.4)	101 (20.0)	396 (21.3)
>= 35	42 (8.2)	83 (16.2)	63 (19.2)	79 (15.6)	267 (14.4)

Majority of the care takers 31.0% (n = 575) that participated in the study had an average age of 25 - < 30 years and of this majority were from Awachi 39.7% (n = 228) while the least number of respondents were from Mayuge 16.5% (n = 95). The youngest caretakers with age below 20 were 10.2 % (n=189) with majority from Mayuge 47.6% (n = 90) as shown in table 4.1. From this study, Awachi has more elderly caretakers than any other region, while Mayuge had many young care takers which reflected a high percentage of teenage pregnancies.

Caretakers' level of education attainment was investigated to determine if it has a contribution on the acquired pneumonia.

Table 4.2: Highest level of education

Education	Awachi	Kasangati	Kyegegwa	Mayuge	Total
	n (%)	n (%)	n (%)	n (%)	n (%)
Primary	244 (63.0)	127 (26.2)	203 (77.8)	192 (43.3)	766 (48.6)
Secondary	140 (36.2)	261 (53.8)	53 (20.3)	202 (45.6)	656 (41.6)
Tertiary	3 (0.8)	97 (20.0)	5 (1.9)	49 (11.1)	154 (9.8)

According to the study, majority of the caretakers 48.6% (n = 766) had acquired up to primary level of education and these from Awachi 31.9 % (n=244). However; only 9.8% (n = 154) respondents reached the tertiary level of education with the highest number from Kasangati 62.98% (n = 97) followed by Mayuge 31.8% (n = 49). Education level distribution is attributed to rural urban setting that dictate availability of education institutions.

Marital status of caretakers was investigated to find out if it had contribution on the acquired pneumonia in children under five years.

Table 4.3: Marital status

Marital status	Awachi	Kasangati	Kyegegwa	Mayuge	Total
	n (%)	n (%)	n (%)	n (%)	n (%)
Single	39 (7.6)	42 (8.1)	15 (4.6)	88 (17.4)	184 (9.9)
Married/Cohabiting	397 (77.4)	433 (83.9)	249 (76.1)	359 (70.9)	1438 (77.2)
Divorced/Separated	76 (14.8)	35 (6.8)	54 (16.5)	36 (7.2)	201 (10.8)
Widowed	1 (0.2)	6 (1.2)	9 (2.8)	23 (4.5)	39 (2.1)

Majority of the caretakers 77.2% (n = 1438) were married/cohabiting. This count was comparably distributed across the health centres under the study. 9.9% (n = 184) caretakers

were single with Mayuge accounting for 48.8 % (n=184). The findings imply that Mayuge has many cases of early child pregnancies this is supported by many of its caretakers being young (Table 4.1)

Information on caretakers' family monthly income was sought to find out if it has an influence on the childhood acquired pneumonia.

Table 4.4: Family monthly income

Monthly income	Awachi	Kasangati	Kyegegwa	Mayuge	Total
	n (%)	**n (%)**	**n (%)**	**n (%)**	**n (%)**
< 5,000	72 (14.1)	51 (11.0)	71 (21.6)	44 (8.7)	238 (13.2)
5,000 - < 10,000	355 (69.7)	9 (1.9)	4 (1.2)	78 (15.5)	446 (24.7)
10,000 - < 100,000	75 (14.7)	73 (15.8)	148 (45.0)	264 (52.4)	560 (31.0)
> 100,000	7 (1.4)	330 (71.3)	106 (32.2)	118 (23.4)	561 (31.1)

Table 4.4 shows that 31.1% (n = 561) of the respondents earn a monthly income of > 100,000, of these majority were from Kasangati 58.8% (n = 330) while the least count of those that earned > 100,000 were from Awachi 1.25% (n = 7). For those that earned an income level of < 5,000 were the least 13.2% (n = 238), majority of which were from Awachi 30% (n = 72).

Distance of caretakers to the health centres in the different regions studied was investigated to determine its impact on the child's access to health care services.

Table 4.5: Distance to the health centre

Distance	Awachi	Kasangati	Kyegegwa	Mayuge	Total
	n (%)	n (%)	n (%)	n (%)	n (%)
< 500m	11 (2.b2)	107 (21.1)	58 (17.9)	44 (8.7)	220 (11.9)
500m - < 1km	63 (12.4)	208 (41.1)	125 (38.6)	128 (25.4)	524 (28.4)
1km - < 5km	240 (47.1)	113 (22.3)	46 (14.2)	216 (42.9)	615 (33.4)
> 5km	196 (38.4)	78 (15.4)	95 (29.3)	116 (23.0)	485 (26.3)

Despite the fact that majority of the caretakers of Awachi have least income levels, they travel the longest distances > 5km 40.4% (n = (196) and 1km - < 5km 39% (n = 240) to access health services. However, caretakers in Kasangat0i have quick access to health centre IV with majority 48.6% (n=107) travel < 500m. In urban regions health facilities are nearer to the people than in the rural areas of Uganda. Thus, people face difficulties of travelling long distances to access health service in the rural settings.

4.1.2 Demographic characteristics of the children

Gender of the children was investigated to determine the highest category of under five year old children that participated in the study.

Table 4.6: Gender of the children

Gender	Awachi	Kasangati	Kyegegwa	Mayuge	Total
	n (%)	n (%)	n (%)	n (%)	n (%)
Male	221 (43.5)	253 (50.6)	167 (51.1)	247 (49.6)	888 (48.4)
Female	287 (56.5)	247 (49.4)	160 (48.9)	251 (50.4)	945 (51.6)

51.6% children were girls and 48.4% boys across all the selected health centre IVs under the study.

Age of the children that participated in the study was investigated with the aim of finding the average age distribution across the four regions and its influence on the acquired pneumonia.

Table 4.7: Age of the children

Age	Awachi	Kasangati	Kyegegwa	Mayuge	Total
	n (%)	n (%)	n (%)	n (%)	n (%)
0 - < 6months	144 (28.1)	104 (20.3)	53 (16.0)	96 (19.6)	397 (21.5)
6months - < 2 yrs.	137 (26.8)	203 (39.6)	107 (32.3)	187 (38.2)	634 (34.4)
2yrs - <= 5yrs	225 (43.9)	205 (40.0)	171 (51.7)	206 (42.1)	807 (43.8)
Age not known	6 (1.2)	0 (0.0)	0 (0.0)	0 (0.0)	6 (0.3)

Majority of the children 43.8% (n = 807) were aged between 2 and 5yrs, and were comparably distributed across the health centre IVs

4.2 Objective 1: Analysis risk factors of pneumonia

4.2.1 Descriptive analysis of the risk factors

Host related factors were investigated to establish their influence on the acquired pneumonia in children under five years.

Table 4.8: Host related factors

Host related factors	Awachi	Kasangati	Kyegegwa	Mayuge	Total
	n (%)	n (%)	n (%)	n (%)	n (%)
Age at birth					
6 - < 7months	17 (3.3)	11 (2.2)	6 (1.8)	16 (3.2)	50 (2.7)
7 - 8months	57 (11.1)	42 (8.3)	13 (3.8)	14 (2.8)	126 (6.8)
> 8months	439 (85.6)	437 (86.0)	316 (93.5)	452 (89.9)	1644 (88.3)
Not known	0 (0.0)	18 (3.5)	3 (0.9)	21 (4.2)	42 (2.3)
Nature of childbirth					
Normal delivery	462 (89.9)	402 (77.9)	297 (87.6)	404 (80.6)	1565 (83.7)
Caesarean section	48 (9.3)	107 (20.7)	36 (10.6)	64 (12.8)	255 (13.6)
Not known	4 (0.8)	7 (1.4)	6 (1.8)	33 (6.6)	50 (2.7)
Status of breast feeding					
Still breast feeding	254 (50.5)	243 (47.3)	130 (38.3)	224 (44.4)	851 (45.7)
Not breast feeding	249 (49.5)	271 (52.7)	209 (61.7)	281 (55.6)	1010 (54.3)
Duration of breastfeeding					
< 6months	13 (4.9)	34 (12.2)	24 (11.7)	18 (6.7)	89 (8.7)
6months - < 1yr	11 (4.1)	37 (13.3)	14 (6.8)	69 (25.8)	131 (12.9)
1 - < 2yrs	36 (13.4)	182 (65.5)	121 (59.0)	147 (55.1)	486 (47.7)
>= 2yrs	208 (77.6)	25 (9.0)	46 (22.4)	33 (12.4)	312 (30.6)
Child feeding on anything other than breast milk					
Yes	266 (54.5)	366 (78.5)	270 (86.8)	397 (80.2)	1299 (73.8)
No	222 (45.5)	100 (21.5)	41 (13.2)	98 (19.8)	461 (26.2)
Age at which the child started feeding on solid food					
< 4months	18 (5.7)	38 (9.7)	16 (5.9)	68 (17.3)	140 (10.2)
4 - < 6months	43 (13.6)	298 (76.0)	158 (58.5)	49 (12.4)	548 (39.9)
> 6months	256 (80.8)	56 (14.3)	96 (35.6)	277 (70.3)	685 (49.9)

Across all the selected health centre IVs, majority of the children 88.3% (n = 1644) were born after 8months. Few 2.7% (n = 50) of the caretakers informed that the children were born premature (6 - < 7months) of which Awachi has the highest premature births with 34% (n = 17). From this most of the under 5-year old children studied, were produced in the normal gestation period which reflects good health status of most mothers during pregnancies. The few under five year old children born prematurely reflects a small number of pregnant mothers who experience bad health status during pregnancy as shown in the table 4.10. 54.3% (n = 1010) of the children were no longer breastfeeding and 45.7% were still breast feeding.

Majority of the children 47.7% (n = 486) breastfed for 1 to 2years, except in Awachi where 77.6% (n = 208) of the children breastfed for longer than 2years.The results show that Awachi being in rural setting with negative effects of post political instabilities, most caretakers are economically weak to afford food supplements like dairy products as feeding alternatives for their children so they entirely rely on breast milk and breast feed children for long (Table 4.8).

Nutrition factors

Caregivers were requested to provide information on how they feed their children on the different forms of food to establish the effect of the type of nutrition on acquired pneumonia. The results summarised in Table 4.9 showed that except carbohydrates that were taken daily, all other nutrients were taken occasional

Table 4.9: Nutrition factors

	Awachi	Kasangati	Kyegegwa	Mayuge	Total
	n (%)	**n (%)**	**n (%)**	**n (%)**	**n (%)**
Protein consumption					
Daily	163 (56.2)	56 (13.0)	6 (2.1)	92 (22.1)	317 (22.2)
Some days	115 (39.7)	340 (78.9)	254 (87.9)	281 (67.5)	990 (69.4)
Never	12 (4.1)	35 (8.1)	29 (10.0)	43 (10.3)	119 (8.3)
Whole food consumption					
Daily	13 (4.5)	141 (32.7)	56 (19.0)	115 (28.0)	325 (22.8)
Some days	220 (76.7)	245 (56.8)	145 (49.2)	264 (64.4)	874 (61.4)
Never	54 (18.8)	45 (10.4)	94 (31.9)	31 (7.6)	224 (15.7)
Vitamins (fruits)					
Daily	118 (41.0)	56 (13.5)	6 (2.1)	113 (27.4)	293 (21.0)
Some days	163 (56.6)	284 (68.3)	189 (67.3)	267 (64.6)	903 (64.6)
Never	7 (2.4)	76 (18.3)	86 (30.6)	33 (8.0)	202 (14.4)
Vitamins (vegetables)					
Daily	**58 (20.1)**	57 (13.8)	10 (3.7)	129 (31.5)	254 (18.4)
Some days	227 (78.5)	244 (59.1)	167 (62.5)	245 (59.9)	883 (64.1)
Never	4 (1.4)	112 (27.1)	90 (33.7)	35 (8.6)	241 (17.5)
Carbohydrates					
Daily	198 (67.3)	315 (73.3)	256 (86.8)	339 (82.1)	1108 (77.4)
Some days	92 (31.3)	91 (21.2)	30 (10.2)	63 (15.3)	276 (19.3)
Never	4 (1.4)	24 (5.6)	9 (3.1)	11 (2.7)	48 (3.4)
Carbohydrates (cookies)					
Daily	27 (9.3)	35 (8.2)	3 (1.0)	27 (6.6)	92 (6.5)
Some days	177 (60.8)	291 (68.3)	193 (65.6)	333 (81.4)	994 (70.0)
Never	87 (29.9)	100 (23.5)	98 (33.3)	49 (12.0)	334 (23.5)
Fats (Fried foods)					
Daily	46 (15.8)	137 (32.0)	15 (5.3)	114 (27.9)	312 (22.1)
Some days	100 (34.2)	228 (53.3)	205 (72.7)	252 (61.8)	785 (55.7)
Never	146 (50.0)	63 (14.7)	62 (22.0)	42 (10.3)	313 (22.2)

The study indicates that carbohydrates are the most common food nutrients in all regions since they are locally grown and some are accessed cheaply. Bad carbohydrates and fats were also consumed occasionally, an indication that resources to purchase these are not readily available.

Environmental factors

Majority of the caretakers in all the regions were staying in single rooms 48.6 % (n=899), out of this, Awachi had the highest number of 44.9% (n=404) as shown in Table 4.12 reflecting the influence of indigenous traditional culture of people in Awachi region constructing many small grass thatched houses in a homestead. In come was a great influencing factor of staying in a house with more rooms, mainly due to the high-income levels of the urban people.

In all the four regions, most care takers 49.8% (n = 921), had a family size of 4 – 6 people. Out of this, Awachi had relatively higher number compared to other regions. This is because Awachi was more in rural setting; many individuals are less knowledgeable about family planning.

58.6% (n=178) caretakers used firewood as the source of heat for cooking. From this, Awachi had the highest number of 41% (n=442) caretakers while Kasangati had the least number of caretakers 4.3% (n=79). The study shows that Awachi, Kyegegwa and Mayuge have many caretakers in rural settings with many families using firewood for cooking, unlike Kasangati which is in centrally located in urban area.

75.3 % (n=1350) reported to have had no family member smoking. This percentage count was comparably distributed in the four regions however, many caretakers in Awachi and Kyegegwa reported to have had a member in the family smoking (Table 4.10).

Table 4.10: Environmental factors

	Awachi	Kasangati	Kyegegwa	Mayuge	Total
	n (%)	n (%)	n (%)	n (%)	n (%)
Size of your house					
Single room	404 (78.8)	234 (45.8)	125 (38.6)	136 (27.2)	899 (48.6)
Double room	60 (11.7)	166 (32.5)	76 (23.5)	133 (26.6)	435 (23.5)
Three rooms	34 (6.6)	59 (11.5)	54 (16.7)	112 (22.4)	259 (14.0)
More than three rooms	15 (2.9)	52 (10.2)	69 (21.3)	119 (23.8)	255 (13.8)
Number of people in family					
< 4	77 (15.0)	194 (38.2)	77 (23.3)	177 (35.6)	525 (28.4)
4 – 6	301 (58.7)	269 (53.0)	176 (53.3)	175 (35.2)	921 (49.8)
7 – 10	106 (20.7)	41 (8.1)	69 (20.9)	111 (22.3)	327 (17.7)
> 10	29 (5.7)	4 (0.8)	8 (2.4)	34 (6.8)	75 (4.1)
Source of pollution in homestead					
Near busy roadside	346 (68.0)	218 (44.0)	167 (51.1)	326 (65.5)	1057 (57.8)
Sewage plant	9 (1.8)	27 (5.4)	4 (1.2)	28 (5.6)	68 (3.7)
Factory	3 (0.6)	29 (5.8)	2 (0.6)	24 (4.8)	58 (3.2)
Wood burning	21 (4.1)	8 (1.6)	63 (19.3)	12 (2.4)	104 (5.7)
None	130 (25.5)	214 (43.1)	91 (27.8)	108 (21.7)	543 (29.7)
Crowded homestead					
Highly crowded	75 (14.7)	182 (36.2)	157 (47.7)	133 (26.9)	547 (29.8)
Moderately crowded	361 (70.8)	250 (49.7)	118 (35.9)	305 (61.7)	1034 (56.3)
Not at all crowded	74 (14.5)	71 (14.1)	54 (16.4)	56 (11.3)	255 (13.9)
Energy source for cooking					
Firewood	442 (24.0)	79 (4.3)	294 (16.0)	263 (14.3)	1078 (58.6)
Charcoal	71 (3.9)	429 (23.3)	32 (1.7)	221 (12.0)	753 (40.9)
Electricity	0 (0.0)	2 (0.1)	2 (0.1)	6 (0.3)	10 (0.5)
Gas	0 (0.0)	13 (0.7)	1 (0.1)	11 (0.6)	25 (1.4)
Presence of a member in the family smoking					
Yes	226 (44.1)	62 (13.1)	97 (30.5)	58 (11.9)	443 (24.7)
No	287 (55.9)	413 (86.9)	221 (69.5)	429 (88.1)	1350 (75.3)

4.2.2 Analysis of risk factors for pneumonia

A binary logistic regression was run to identify from among; host, nutrition, environmental and immunisation factors, the main specific significant risk factors that caused pneumonia according to the study.

Table 4.11: Binary logistic regression to identify the significant risk factors of pneumonia

Factors	P – value	OR	95% CI for Odds ratio	
			Lower	Upper
Host related factors				
Age at which the child was born	.195	.671	.367	1.227
Nature of delivery	.819	1.073	.586	1.965
Breastfeeding	.558	1.460	.412	5.175
Duration of breast feeding	.362	1.179	.828	1.679
Child feeding on anything else other than breast milk	.273	1.726	.651	4.573
Age at which baby starts solid food	.213	1.354	.840	2.182
Nutrition factors				
Proteins	.487	.833	.497	1.396
Whole food	.035	1.567	1.031	2.380
Vitamins	.915	.974	.597	1.588
Vegetables	.643	1.117	.699	1.786
Good carbohydrates	.889	.964	.573	1.619
Bad carbohydrates (cookies)	.075	.640	.391	1.047
Fats	.567	1.130	.743	1.719
Environmental factors				
Size of the house	.000	.530	.403	.698
Number of people in the family	.000	2.130	1.580	2.871
Presence of busy road, sewage or factor in the neighbour hood	.041	1.135	1.005	1.282
Crowded homestead	.232	.797	.549	1.156
Source of energy				
Firewood	.217	4.943	.390	62.630
Charcoal	.199	5.211	.421	64.552
Electricity	.999	.000	.000	.
A member of family who smokes	.002	.487	.309	.770
Immunisation factors				
Child immunized against killer diseases	.460	1.652	.437	6.249
Child received immunization for Pneumonia	.420	1.989	.374	10.568
Age at which a child is immunized for the first time	.899	1.047	.514	2.136
Age at which the child is immunized for pneumonia for the second time	.322	.857	.632	1.163
Number of times the child received immunisation for Pneumonia	.001	.585	.427	.802

Logistic regression showed that host related factors are not risk factors to acquisition of pneumonia. However, consumption of whole food (OR: 1.567; 95% CI: 1.031 – 2.308) , size of the house (OR: 0.530; 95% CI: 0.403 – 0.698), number of people in the house (OR: 2.130; 95% CI: 1.580 – 2.871), distance to a source of pollution like a busy roadside, sewage plant, factory, wood burning in the neighbourhood (OR: 1.135; 95% CI: 1.005 – 1.282), a member of the family smoking (OR: 0.487; 95% CI: 0.309 – 0.770) and number of times the child received immunisation for Pneumonia OR: 0.585; 95% CI: 0.427 – 0.802) were, significant in acquiring pneumonia as shown in the Table 4.11. Number of people in the family was the most significant risk factor, as indicated the presence of many people in the family. The more people, the more chances of acquiring and spread of pneumonia among under five year old children. The occupancy density accelerates spread of pneumonia infections through air breathed in and out and respiratory droplets.

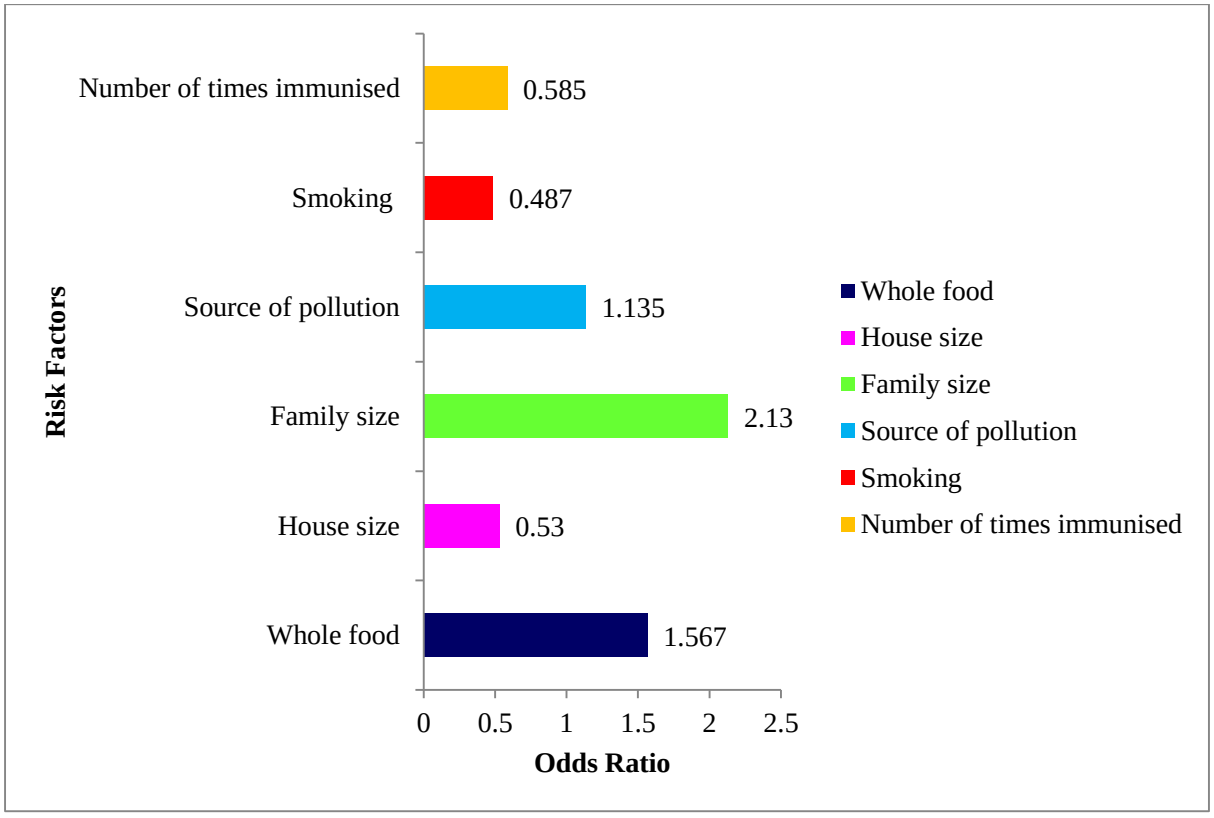

Figure 4.1: Odds ratio of the risk factors of pneumonia

4.2.2.1 Multinomial logistic regression of the significant risk factors

Multinomial logistic regression analysis was run for category of risk factors that were significant for causing pneumonia among under five year old children in the study to establish the determinant category of each of the risk factors.

Table 4.12: Multinomial logistic regression to identify the determinant category of the risk factors

Child had Pneumonia	B	Std. Error	Sig.	OR	95% Confidence Interval	
					Lower Bound	Upper Bound
Consumption of whole food						
Daily	.198	.513	.700	1.219	.445	3.334
Some days	-.375	.360	.296	.687	.340	1.390
Never	0[b]	0.	0.	0.	0.	0.
Size of the house						
Single room	-1.709	.682	.012	.181	.048	.690
Double room	-1.454	.680	.033	.234	.062	.886
Three rooms	-.918	.706	.193	.399	.100	1.592
More than three rooms	0[b]	0.	0.	0.	0.	0.
Number of people in family						
< 4	1.250	.733	.088	3.490	.830	14.683
4 – 6	.793	.643	.217	2.210	.627	7.791
7 – 10	.042	.641	.948	1.043	.297	3.665
> 10	0[b]	0.	0.	0.	0.	0.
Source of pollution in neighbourhood						
Near busy roadside	.378	.316	.232	1.460	.785	2.714
Sewage plant	1.066	1.071	.320	2.904	.356	23.691
Factory	-.535	.696	.442	.586	.150	2.292
Wood burning	-.096	.549	.861	.908	.310	2.666
None of the given	0[b]	0.	0.	0.	0.	0.
Presence of a member in a family that smoke						
Yes	-.471	.288	.102	.624	.355	1.098
No	0[b]	0.	0.	0.	0.	0.
Number of times the child received immunisation						
Once	-.422	.423	.318	.656	.286	1.501
Twice	-.322	.347	.353	.725	.367	1.430
Three times	0[b]	0.	0.	0.	0.	0.

Categories that were significant in causing pneumonia in the house size; residing in a single room (P = 0.012) and residing in a double room (P = 0.033). The children whose caretakers resided in a single room had an increased risk of acquisition of pneumonia of 1.181 times higher than those whose caretakers were residing in more than three rooms at a 95%CI: 0.048 – 0.690. The children whose caretakers resided in a double room had an increased risk of acquisition of pneumonia of 1.234 times higher than those whose caretakers were residing in more than three rooms at a 95%CI: 0.062– 0.886.

4.2.3 Indirect risk factors of pneumonia from the predictive diseases

Predictive diseases are diagnosed diseases in under five year old children at selected health centre IVs with symptoms that show a significant correlation with those of pneumonia. They included; cough, cough and flue, cough and infection, and flue. Under five year old children's immune systems are compromised by such diseases and are at higher risk of developing pneumonia hence the reason for their investigation in this study.

Correlation analysis was done between pneumonia and other diseases that were diagnosed in children under five years at health centre IVs. From this analysis, pneumonia predictive diseases had a significant correlation at p less than 0.05 as shown from the correlation table in **Appendix II.**

Binary logistic regression analysis was then run for each significant predictive disease to determine the significant risk factors causing acquisition of such a disease in a child (**Appendix I)**. The identified significant risk factors of each predictive disease were indirectly significant risk factors for acquired pneumonia in under five year old children

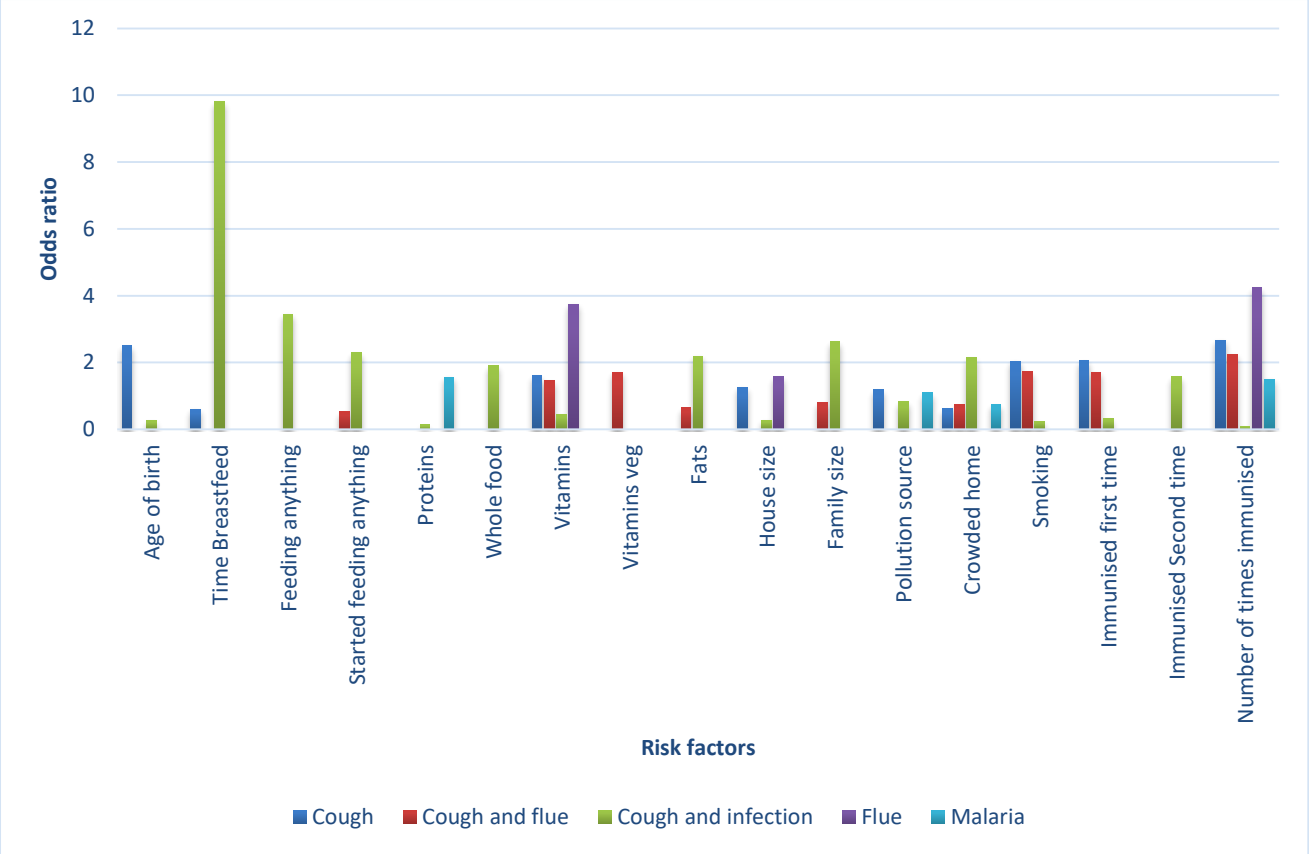

Figure 4.3: A graph showing significant risk factors of various pneumonia predictive diseases and their odds ratios

Results show that, the most significant risk factor for child's acquisition of cough and infection was time of breast feeding the child, for cough alone was number of times a child was immunised for pneumonia and child's age of birth, for cough and flue, was also the number of times a child immunised for pneumonia, for flue, were vitamins and the number of times a child immunised for pneumonia while for malaria were age of birth and number times a child immunised for pneumonia.

4.3 Objective 2: Timely diagnosis and treatment of acquired pneumonia in children under five years

In order to effectively diagnose acquired pneumonia in under five old children, a health worker is required to have knowledge regarding, causes of the disease, symptoms of the disease, how the symptoms differ from those of similar illnesses, the tools that are sufficient to identify the disease and consequently, the medication that should be prescribed.

4.3.1 Microorganisms that cause pneumonia

In this study, we investigated the knowledge of the health workers regarding etiological agents that cause pneumonia in under five year old children.

Table 4.13: Microorganisms that cause pneumonia, according to health workers at HCIVs under study

	Microorganism	Number of health workers	Percentage
	Virus	10	33.3%
	Bacteria	13	43.3%
	Fungi	6	20.0%
	Eukaryotes	1	3.3%
Total		30	100.0%

Majority of the healthcare workers across the health centres, reported bacteria and virus as the main microorganism that cause pneumonia with a respondent count of 43.3% and (n = 13). 33.3% (n = 10) respectively.

4.3.2 Knowledge about symptomatic difference between pneumonia caused by different microorganisms among health workers

We investigated how knowledgeable health workers are, regarding the symptomatic differences between the different pneumonia that is caused by varying microorganisms

Table 4.14: Symptomatic difference in the pneumonia types

	Awachi	Kasangati	Kyegegwa	Mayuge	Total
	n (%)	n (%)	n (%)	n (%)	n (%)
No	5 (100.0)	4 (100.0)	3 (60.0)	0 (0.0)	12 (75.0)
Yes	0 (0.0)	0 (0.0)	2 (40.0)	2 (100.0)	4 (25.0)

75% (n = 12) of health workers reported that there was no difference between symptoms of different pneumonia types. However, all health workers interviewed from Mayuge HCIV, seemed to believe that there is a symptomatic difference between the pneumonia according to microorganism that causes it.

4.3.3 Identifying the most commonly clinical symptoms and their rate of occurrence.

Health workers were asked the rate of occurrence of the different clinical symptoms of acquired pneumonia as they are observed in under five year old children at health centres IVs.

Table 4.15: Rating the most common symptoms of pneumonia by health workers

Symptom	Rate	Percentage
Cough	Often	47.4%
Sudden onset of chills	Sometimes	50.0%
Lower chest wall in-drawing	Always	47.4%
High fever	Often	47.4%
Rapid breathing	Always	84.2%
Loss of appetite	Sometimes	36.8%

According to results in Table 4.15, most health workers (84.2%) are able to identify that a child has pneumonia, when she/he has rapid breathing. They however, seem non-committal that loss of appetite is a clinical symptom of acquired pneumonia in children under five years at health centre IVs.

4.3.4 Identifying diseases that have similar symptoms with pneumonia.

Health workers' knowledge about other diseases that are diagnosed in under five year old children with similar symptoms as pneumonia was investigated to ascertain the which is more and least related to pneumonia.

Table 4.16: Diseases identified at various health centres with symptoms similar to pneumonia

Disease	frequency	Percentage
Malaria	6	9.7%
Asthma	15	24.2%
Lung cancer	5	8.1%
Bronchitis	15	24.2%
Influenza	7	11.3%
Upper respiratory infection	5	8.1%
Chronic obstructive pulmonary disease (COPD)	5	8.1%
Total	62	100.0%

Generally, all diseases mentioned, have some similar symptoms with pneumonia. However, most health workers 24.2% (n =15) pointed out bronchitis and asthma to have, the most similar symptoms to pneumonia. On contrary, lung cancer, upper respiratory infection and chronic obstructive pulmonary disease (COPD) were reported to have, the least similar symptoms to pneumonia by 8.1% (n = 5). The study indicates that such diseases with similar symptoms as pneumonia have a correlation with pneumonia as shown in **Appendix II.** Thus, children with pneumonia or either of the diseases are likely to be misdiagnosed.

4.3.5 Diseases that are mostly diagnosed at health centre IVs, in children under five years

Illnesses that were mostly diagnosed in under five year old children, were investigated through seeking information from the health workers at all health centre IVs. This was done

to compare the frequency of acquired pneumonia and the predictive diseases diagnosed in under five year old children across the four regions.

Table 4.17: Diseases that are mostly diagnosed by health workers at health centre IVs

Disease	Awachi	Kasangati	Kyegegwa	Mayuge	Total
	n (%)	n (%)	n (%)	n (%)	n (%)
Infection	3 (0.8)	53 (16.1)	11 (5.1)	27 (11.0)	94(8.0)
Cough	7 (1.8)	60 (18.2)	42 (19.4)	25 (10.2)	134(11.4)
Cough and flu	71 (18.6)	162 (49.2)	115 (53.2)	29 (11.8)	377(32.2)
Cough and infection	247 (64.8)	9 (2.7)	2 (0.9)	7 (2.8)	265(22.6)
Pneumonia	64 (16.8)	28 (8.5)	20 (9.3)	5 (2.0)	117(10.0)
Malaria	81 (21.3)	65 (19.8)	81 (37.5)	109 (44.3)	336(28.7)
Measles	0 (0.0)	5 (1.5)	0 (0.0)	47 (19.1)	52(4.4)
Asthma	0 (0.0)	0 (0.0)	0 (0.0)	4 (1.4)	4(0.3)
Flue	0 (0.0)	24 (7.3)	14 (6.5)	2 (0.8)	40(3.4)
Diarrhoea	0 (0.0)	0 (0.0)	7 (3.2)	0 (0.0)	7(0.6)

Results show that the most diagnosed diseases were different in Awachi, Kasangati, Kyegegwa and Mayuge that is to say, cough and infection 64.8% (n = 247), cough and flu 49.2% (n = 162), cough and flu 53.2% (n = 115), malaria 44.3% (n = 109) respectively. However, pneumonia was more diagnosed in Awachi 16.8% (n=64) and least diagnosed in Mayuge 2 % (n=2) as shown in Table 4.17. This indicates that the most diagnosed diseases in the four regions was cough and flue 32.2% (n =377) followed by malaria 28.7% (n = 336).

4.3.6 Time taken by caretakers before taking the child for diagnosis and treatment.

Caretakers were asked to provide information regarding the time they took to take the sick child for diagnosis and treatment at the health centre IV from the time of onset of the disease. This was done to investigate the delayed diagnosis and treatment of under five year old patient.

Table 4.18: Time between onset of infection and attainment of treatment

Days	Awachi	Kasangati	Kyegegwa	Mayuge	Total
	n (%)	n (%)	n (%)	n (%)	n (%)
0	0 (0.0)	1 (0.3)	0 (0.0)	2 (0.8)	3 (0.2)
1 – 5	350 (92.1)	311 (91.2)	166 (68.9)	244 (94.9)	1071 (87.9)
6 – 10	26 (6.8)	22 (6.5)	52 (21.6)	11 (4.3)	111 (9.1)
11 – 15	4 (1.1)	6 (1.8)	19 (7.9)	0 (0.0)	29 (2.4)
21 – 25	0 (0.0)	1 (0.3)	1 (0.4)	0 (0.0)	2 (0.2)
26 – 30	0 (0.0)	0 (0.0)	2 (0.8)	0 (0.0)	2 (0.2)
56 – 60	0 (0.0)	0 (0.0)	1 (0.4)	0 (0.0)	1 (0.1)
Total	380 (100.0)	341 (100.0)	241 (100.0)	257 (100.0)	1219 (100.0)

From onset of the disease, 87.9% (n = 1071) of the caretakers spent 1 – 5 days before taking the child to seek for treatment. Of these majority were from Awachi 32.7% (n = 350) and Kasangati 29% (n = 311). However only 0.2% (n =3) respondents noted that they don't spend any day before taking the children to seek for diagnosis and treatment and these were noted from Kasangati 33.3% (n = 1) and Mayuge 66.7% (n = 2) as shown in Table 4.18. Results show that most caretakers across the four regions delay to take their children for diagnosis and treatment, this could be attributed to several factors.

4.3.7.1 Investigating the diagnostic tools used by health workers

Availability of the pneumonia diagnostic tools was investigated. Health workers were interviewed to obtain information on tools used to detect pneumonia in children under five years at the selected health centre IVs.

Table 4.19: Tools used by the health workers

Tool	Awachi	Kasangati	Kyegegwa	Mayuge	$\frac{total\ n}{20}$ (%)
	n (%)	n (%)	n (%)	n (%)	
Stethoscope	5 (27.8)	4 (22.2)	5 (27.8)	4 (22.2)	18(90)
Pulse oximetre	3 (30)	1 (10)	4 (40)	2 (20)	10(50)
Respiratory rate timer	3 (33.3)	1 (11.1)	3 (33.3)	2 (22.2)	9(45)
Haematology analyser	1 (33.3)	0 (0.0)	2 (66.7)	0 (0.0)	3(15)

Across the four health centres, health workers commonly used stethoscope while least used haematology analyser. The results indicate that stethoscope was most available and ease to use diagnostic tool while tools like haematology analyser, blood test method could often be absent at some health centres as shown in Table 4.19.

4.3.7.2 Investigating the rate of frequency of usage of each diagnostic tool

The rate of using each diagnostic tool in diagnosing pneumonia was investigated, health workers were asked to provide information regarding the frequency of using each tool. This was done to find out the most and least used tools across the selected four health centres.

Table 4.20: The rate of frequency of use for each diagnostic tool

Tool	Never	Rarely	Sometimes	Often	Always	$\frac{total}{20}$ (%)
	n (%)	n (%)	n (%)	n (%)	n (%)	
Stethoscope	3 (16.7)	0 (0.0)	4 (22.2)	3 (16.7)	8 (44.4)	18 (90)
Blood test	7 (41.2)	3 (17.7)	2 (11.8)	3 (17.8)	2 (11.8)	17 (85)
Pulse oximetre	7 (17.6)	0 (0.0)	2 (11.8)	5 (29.4)	3 (17.8)	17 (85)
Respiratory rate timer	3 (17.7)	4 (23.5)	0 (0.0)	1 (5.9)	9 (52.9)	17 (85)
Haematology analyser	10 (58.8)	5 (29.4)	0 (0%)	1 (5.9)	1 (5.9)	17 (85)

According to the study results, respiratory rate timer and stethoscope were the most always used diagnostic tool by the health workers however blood test method, the pulse oximetre,

haematology analyser were used less frequently by health workers with most of them being rarely and never used in diagnosing pneumonia. The study shows that most of the pneumonia diagnostic tools, pulse oximetre, haematology analyser blood test method, are absent at different health centres across the four regions in Uganda.

4.3.7.3 Investigating how user-friendly diagnostic tools are.

Investigation was done on the ease of using each diagnostic tool, health workers were interviewed to establish the easiest pneumonia diagnostic tool in diagnosing pneumonia at the health centres.

Table 4.21: Health workers' ranking of the ease of use for each diagnostic tool across the health centres

Tool	Not easy to use n (%)	Somehow easy to use n (%)	Easy to use n (%)	$\frac{total\ n}{20}$**(%)**
Stethoscope	4 (22.2)	1(5.6)	13 (72.2)	18 (90)
Blood test	5 (35.7)	5 (35.7)	4 (28.6)	14 (70)
Pulse oximetre	3 (21.4)	7 (50)	4 (28.6)	14 (70)
Respiratory rate timer	1 (7)	6 (35.3)	10 (58.8)	17 (85)
Haematology analyser	8 (57)	3 (21.4)	3 (21.4)	14 (70)

Most health workers 72 % (n=13) across the health centre IVs, reported stethoscope as the most user-friendly diagnostic tool. However, on the contrary, most of the health workers across the four regions reported haematology analyser as the least user-friendly tool when diagnosing pneumonia in children. Findings indicate that most health workers have less skills and experience in using some diagnostic tools for example the haematology analyser. This is attributed to absence of such tools at the health centres across the four regions.

4.3.7.4 Rating the accuracy of pneumonia diagnostic tool

In this section of the study, the knowledge of health workers about accuracy for each pneumonia diagnostic tool was investigated.

Table 4.22: Health workers' rating the accuracy of each pneumonia diagnostic tool

Tool	Not accurate n (%)	Fairly accurate n (%)	Accurate n (%)	Very accurate n (%)	$\frac{total\ n}{20}$ (%)
Stethoscope	5 (27.8)	2 (11.1)	3 (1)	8 (40)	18 (90)
Blood test	3 (25)	4 (33.3)	3 (25)	2 (16.7)	12 (60)
Pulse oximetre	4 (23.5)	3 (17.7)	8 (47.1)	2 (11.8)	17 (85)
Respiratory rate timer	4 (22.2)	2 (11.1)	4 (22.2)	8 (44.4)	18 (90)
Haematology analyser	2 (17.7)	4 (33.3)	4 (33.3)	2 (16.7)	12 (60)

On average, 44.4% health workers reported stethoscope and respiratory rate timer as the most accurate diagnostic tools while haematology analyser being the least in diagnosing pneumonia. The results show that stethoscope was the most commonly used tool according to Table 4.20, most health workers regard it giving as the most accurate results. This could be due to absence of some other diagnostic tools or even the inability of health workers to use them.

4.3.8 Treatment given to children by health workers after diagnosis

Caretakers were requested to give information regarding the drugs prescribed by the health workers after diagnosing their children with the disease at health centre IVs. It was found that a number had a combination of various drugs. Table 4.23 gives a summary of the drugs that were given to the children at all HCIVs.

Table 4.23: Most common treatment

Medication	**Awachi n (%)**	**Kasangati n (%)**	**Kyegegwa n (%)**	**Mayuge n (%)**	**Total n (%)**
Antimalarial	18 (4.8)	14 (4.2)	18 (8.5)	33 (11.8)	83 (6.9)
Antibiotic	72 (19.0)	160 (48.3)	73 (34.4)	44 (15.8)	349 (29.1)
Painkiller	23 (6.1)	30 (9.1)	30 (14.2)	40 (14.3)	123 (10.2)
Antimalarial and antibiotic	86 (22.8)	3 (0.9)	3 (1.4)	15 (5.4)	107 (8.9)
Antimalarial, antibiotic and painkiller	175 (46.3)	56 (16.9)	13 (6.1)	92 (33.0)	336 (28.0)
Not known	4 (1.1)	68 (20.5)	75 (35.4)	55 (19.7)	202 (16.8)

Results showed that 29.1% (n = 349) children were mostly given antibiotics after diagnosis at health centres while 16.8% (n = 202) care takers don't know the type of medication which health workers gave to their children. The results indicate caretakers received appropriate treatment such as antibiotics with antimalarial and pain killers. This is due to the fact that most pneumonia patients of under five year old children are misdiagnosed with other diseases like cough, infections, malaria more frequently as shown in Table 4.17.

4.3.8.1 Relationship between most diagnosed disease and the medicine given to the child across the four regions

A cross tabulation was carried out between the most diagnosed diseases in the under five year old children and medicine given to them across the health centre IVs in Uganda

Table 4.24: Relationship between most diagnosed diseases and the medicine given to the child across regions.

Disease	Medication given	Awachi n (%)	Kasangati n (%)	Kyegegwa n (%)	Mayuge n (%)	Total n (%)
Cough	Antimalarial	1(14)	3(6.7)	3(10.8)	1(4.5)	8(6.5)
	Antibiotic	4(57)	32(71.1)	14(37.8)	8(36.4)	58(47.)
	Painkiller	0(0)	3(6.7)	3(10.8)	3(6.7)	9(7.3)
	Antimalarial and antibiotic	0(0)	1(2.2)	1(2.7)	1(4.5)	3(6.7)
	Antimalarial, antibiotic and painkiller	2(28.6)	13(28.9)	1(2.7)	5(11.1)	21(46.7)
	Not known	0(0)	5(11.1)	15(40.5)	4(18.2)	24(19.5)
Total		7	45	37	22	123
Infection	Antimalarial	0(0)	1(1.96)	0(0)	0(0)	1(1.1)
	Antibiotic	1(33.3)	23(45)	3(30)	11(40.7)	38(41.8)
	Painkiller	1(33.3)	8(15.7)	1(10)	0(0)	10(10.9)
	Antimalarial and antibiotic	1(33.3)	0(0)	0(0)	0(0)	1(1.1)
	Antimalarial, antibiotic and painkiller	0(0)	9(17.7)	0(0)	5(18.5)	14(15.4)
	Not known	0(0)	10(19.6)	6(60)	11(40.7)	27(29.7)
	Total	3	51	10	27	91
Cough and flu	Antimalarial	2(2.9)	1(0.64)	8(7.6)	1(3.7)	12(3.35)
	Antibiotic	34(49.3)	81(51.6)	37(35.2)	9(33.3)	161(44.97)
	Painkiller	6(8.6)	15(9.55)	18(17.1)	6(22.2)	45(12.6)
	Antimalarial and antibiotic	15(21.7)	0(0)	2(1.9)	3(11.1)	20(5.6)
	Antimalarial, antibiotic and painkiller	11(15.9)	26(16.6)	10(9.5)	5(18.5)	52(14.5)
	Not known	1(1.45)	34(21.7)	30(28.6)	3(11.1)	68(18.9)
Total		69	157	105	27	358
Cough and Infection	Antimalarial	2(0.82)	0(0)	0(0)	1(14.3)	3(1.15)
	Antibiotic	27(11.1)	4(44.4)	1(50)	3(42.9)	35(13.4)
	Painkiller	10(4.1)	0(0)	0(0)	1(14.3)	11(4.2)
	Antimalarial and antibiotic	63(25.8)	0(0)	0(0)	0(0)	63(24)
	Antimalarial, antibiotic and painkiller	141(57.8)	3(33.3)	0(0)	1(14.3)	145(55.34)

	Not known	1(0.41)	2(22.2)	1(50)	1(14.3)	5(1.9)
Total		244	9	2	7	262
Pneumonia	Antimalarial	1(1.6)	0(0)	0(0)	0(0)	1(.88)
	Antibiotic	6(9.5)	13(48)	11(57.9)	0(0)	30(26.3)
	Painkiller	2(3.17)	2(7.4)	0(0)	0(0)	4(3.5)
	Antimalarial and antibiotic	10(15.9)	0(0)	0(0)	0(0)	10(8.7)
	Antimalarial, antibiotic and painkiller	43(.68)	3(11.1)	1(5.3)	2(40)	49(42.98)
	Not known	1(1.6)	9(33.3)	7(36.84)	3(60)	20(17.54)
Total		63	27	19	5	114
Malaria	Antimalarial	13(16.5)	10(14.9)	16(20.8)	24(20.8)	63(19)
	Antibiotic	3(3.8)	8(11.94)	5(6.4)	4(3.5)	20(6.1)
	Painkiller	6(7.6)	5(7.5)	22(28.6)	11(9.6)	44(13.4)
	Antimalarial and antibiotic	3(3.8)	3(4.5)	3(3.9)	9(7.8)	18(5.5)
	Antimalarial, antibiotic and painkiller	53(67.1)	35(52.2)	12(15.6)	54(46.95)	154(46.8)
	Not known	1(1.3)	6(8.95)	19(24.7)	13(11.3)	30(9.1)
	Total	79	67	77	115	329
Asthma	Antimalarial and antibiotic	0(0)	0(0)	0(0)	1(25)	1(25)
	Antimalarial, antibiotic and painkiller	0(0)	0(0)	0(0)	1(25)	1(25)
	Not known	0(0)	0(0)	0(0)	2(50)	2(50)
Total		0	0	0	4	4
Flue	Antimalarial	0(0)	1(4.55)	2(15.4)	0(0)	3(8.1)
	Antibiotic	0(0)	13(59)	3(23.1)	0(0)	16(43.2)
	Painkiller	0(0)	2(9)	3(23.1)	1(50)	6(16.2)
	Antimalarial, antibiotic and painkiller	0(0)	3(13.6)	0(0)	0(0)	3(8.1)
	Not known	0(0)	3(13.6)	5(38.5)	1(50)	9(24.3)
Total		0	22	13	2	37
Diarrhoea	Antimalarial	0(0)	0(0)	1(14.3)	0(0)	1(14.3)
	Antibiotic	0(0)	0(0)	3(42.9)	0(0)	3(42.9)
	Not known	(0)	0(0)	3(42.9)	0(0)	3(42.9)
Total		0	0	7	0	7

According to results in Table 4.24, in all the four regions, caregivers reported that, the most commonly diagnosed diseases in under five year old children were; cough, flue, infection, cough and flue. Antibiotics, a mixture of antimalarial, antibiotic and painkiller were the mostly given drugs to children with the commonly diagnosed diseases. This type of drug combination was also given to children directly diagnosed with pneumonia as shown in Table 4.25. This generally indicates that under five year old pneumonia patients could show symptoms of predictive diseases such as malaria, flue, infections; and this could consequently imply that, it is probable that pneumonia patients are misdiagnosed and given medication that do not treat the illness at hand.

4.3.8.2 Significance of the medication given to a child after diagnosis.

A student's t- test was used to investigate the relationship between the treatment and disease (s) diagnosed so as to make conclusion on the appropriateness of medication given by health worker for the disease (s) diagnosed in a child at health centres

Table 4.25: Student's t - test for common disease (s) found and treatment given

Type of disease(s)	Standardized Coefficients Beta	T	Sig.	95.0% Confidence Interval	
				Lower Bound	Upper Bound
Cough	-.004	-.124	.902	-.378	.333
Cough and flu	.012	.299	.765	-.236	.321
Cough and infection	.214	5.668	.000	.547	1.126
Pneumonia	.104	3.325	.001	.234	.907
Malaria	.111	3.413	.001	.172	.637
Asthma	.068	2.324	.020	.292	3.464
Flue	-.012	-.389	.698	-.670	.449
Diarrhoea	.015	.527	.598	-.880	1.526

Diagnosed diseases where treatment had a significant effect (t-test at P≤ N0.05) were: Cough and infection, pneumonia, malaria and asthma. Antibiotics, a mixture of antimalarial, antibiotics and pain killers administered by health workers were appropriate for treating predictive diseases and acquired pneumonia in patients of under five year old children, as shown in Table 4.24. Therefore, the health workers are knowledgeable and prescribe appropriate medication for pneumonia and its predictive diseases in under five year patients as shown in Table 4.25.

4.3.8.3 Relationship between number of days of consumption of medication and child's health improvement

Chi – square test analysis was run to investigate the relationship between numbers of days of treatment consumption and child's health improvement after the medication so as to clarify if compliance in medicine uptake played a role in health wellbeing of children.

Table 4.26: Chi - square test for days the child took the medication and whether the child improved after the medication

Days the child took the medication	**Did the child improve after the medication**			X^2	**P - value**
	Yes n (%)	No n (%)	Total		
1 – 3	352 (61.8)	217 (38.1)	569		
4 – 6	251 (68.2)	117 (31.8)	368	6.315	0.177
7 – 9	119 (64.3)	66 (35.6)	185		
10 – 12	2 (100)	0 (0.0)	2		
13 – 15	11 (52.4)	10 (47.6)	21		
Total	735(64.2)	410(35.8)	1145		

From the chi – square test in Table 4.26, 64.2% of under five year old children improved after consumption of medication in varying number of days. The medication administered by health workers and period of medication consumption were appropriate to bring about health improvement of a child from pneumonia and pneumonia predictive diseases diagnosed as shown in Table 4.25. Child's health improvement varied according to number of days of drug consumption and there no fixed range of days of medication consumption that was significant for child's health improvement (X^2 = 6.315; P – value = 0.177). Therefore, the days of taking medication can vary with no fixed range of days since it depends on the severeness of the disease.

4.3.9: Prescribed medication for pneumonia according to health workers in HCIVs studied

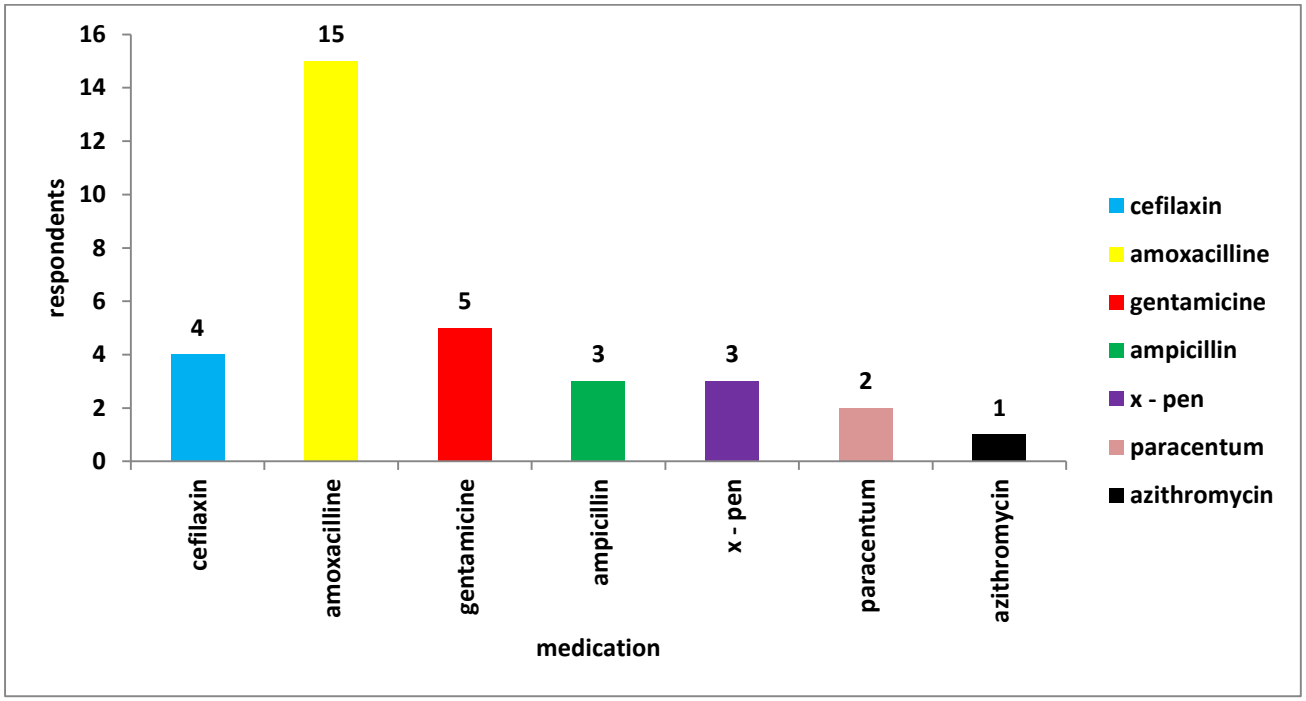

Figure 4.4: Prescribed medication for pneumonia.

Amoxicillin is the most prescribed antibiotics by health workers, followed by gentamicin, ampicillin, cefilaxin, x-pen, and azithromycin for treating pneumonia in children under five years at health centres. Results indicate that antibiotics are commonly used to treat pneumonia in under five year old children as shown in Tables 4.24 and 4.25.

4.4 Objective 3: Quantify and investigate the correlation between risk factors and acquired pneumonia in children under 5 years

4.4.1: Correlation between pneumonia and its risk factors from other diseases

The significant risk factors identified were further quantified and then correlated to pneumonia to identify their relationship as shown in **Appendix III (A – D).**

The correlation coefficient of pneumonia and feeding a child of less than 6 months on alternative food other than breast milk was found positive and significant ($r = 0.072$, $P < 0.05$). This shows that an increased feeding of a child less than 6 months of age on alternative solid food other than breast milk would result into higher chances of acquiring pneumonia.

The correlation of acquired pneumonia and time the child was immunized for pneumonia for the second time was found to be negative and significant ($r = - 0.123$, $P < 0.05$). This shows that the earlier the child immunized for pneumonia for the second time, the lower the chances of acquisition of pneumonia. The correlation of acquired pneumonia and number of times the child received immunisation for pneumonia was found negative and significant ($r = - 0.156$, $P < 0.05$). This shows that increase in the number of times the child received immunisation for pneumonia would lead to a decrease in chances of acquiring pneumonia.

The correlation of acquired pneumonia and house size where children live was negative and significant ($r = - 0.126$, $P < 0.05$). This shows that an increase in the house size would lead to a decrease in child's chances of acquiring pneumonia.

The correlation of acquired pneumonia and number of people in the family was found to be positive and statistically significant ($r = 0.127$, $P < 0.05$). This shows that an increase in the number of people in the family would lead to an increase in child's chances of acquiring pneumonia.

The correlation of acquired pneumonia and having a family member smoke was found to be negative and statistically significant ($r = -0.166$, $P < 0.05$). The study findings show that smoking is a significant risk factor for acquisition of pneumonia however the more a child lives in a family without a member smoking, the lower the child's chances of acquiring pneumonia.

CHAPTER FIVE: DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.0 Introduction

The main aim of this study was to assess the case management of acquired pneumonia in children under five years at selected health centre IVs in Uganda. The cross-sectional study design was used in the study through which data was obtained, analysed and discussed according to the specific objectives. These included; identifying risk factors for acquired pneumonia, assessing timely diagnosis and treatment of pneumonia cases, quantifying and investigating the correlation between risk factors and acquired pneumonia in children under five years at selected health centre IVs in Uganda.

Socio demographic characteristics of the caretakers of children under five 5 years of age

Majority of the caretakers 31.0% (n = 575) were aged of between 25 - 30 years, this differed from a study carried out in Ethiopia by Andualem *et al.,* (2020) where 52.4% of the respondents had an age of 25 – 30 years.

Unlike in a study by Andualem *et al.,* (2020) where majority participants 41.6% attended secondary level, in this study majority of the caretakers 48.6% had attended the primary level.

77.2% of the caretakers were married/cohabiting, unlike in the study by Getane *et al.,* (2019) in Ethiopia where 89.3% of the caretakers were married. The findings were also much higher compared to results from a study in Ethiopia by Dagne *et al.,* (2020) where 57.6% participants were married.

68.9% of the caretakers earned a low family income of less than 100,000, this was in agreement with a study by Okoko *et al.,* (2017) in republic of Congo where 79.7% of the participants had a low socio – economic status. Results of this study signify that most

caretakers in mostly rural areas had a low financial economic status which could delay access of under five year old children to health services from onset of the disease.

51.6% of the children were females while the rest were males which is in agreement with a study in Kenya by Onyango *et al.,* (2012) where 51.5% of the children were females. However, on contrary, the findings were not in accordance with a study by Nasrin *et al.,* (2022) in Bangladesh where majority of the children were males 60%.

Majority of the children 43.8% were aged between 2 to 5 years of age, which is like in a study by Andualem *et al.,* (2020) in Ethiopia where 74.3% of the children were aged between the same age range.

5.1 Risk factors for acquired pneumonia in children under five years at health centre IVs in Uganda.

There was no direct significant association between hosts-related factors and acquired pneumonia in children under five years. Host -related factors included; age at which the child was born, nature of delivery, breastfeeding, duration of breast feeding, feeding a child of below six months on solid food. However, some host related factors like duration of breastfeeding, age at which a child starts on solid food other than breast milk were directly significant for pneumonia predictive diseases. Therefore, such host-related factors were indirectly significant for acquired pneumonia in under five year old children. Results are consistent with a study by Nasrin *et al.,* (2022) in Bangladesh where breastfeeding was significantly associated with acquired pneumonia children.

The results show that there is an effect of nutritional status on the incidence of pneumonia. Children under five years who consume whole food some days have a higher risk of acquiring of pneumonia by 1.567 times than those who consume whole food daily (OR = 1.567, 95%CI = 0.497 – 2.380; P = 0.035). This study was carried out after the total

lockdown of COVID – 19 pandemic, this may have affected the nutritional behaviour of infants. These results are supported with a study by Ningsih *et al.,* (2019) in Indonesia, where disaster that broke up in community caused nutritional imbalance in children due to food insecurity and lack of resources to purchase nutritious food.

The results show that there is a significant association between house size and the acquired pneumonia. Children under five years who live single rooms have an increased risk of acquiring pneumonia of that is higher than those living in 3 bedrooms, by 0.181. Similarly, children under five years who live in double rooms are at a risk of acquiring pneumonia of 1.234 times higher compared to the same aged children who live in a house of more than three rooms.

The study findings reveal that family size/number of people at home was significantly associated with acquired pneumonia in under five year old children. Children who live in families with many numbers of people are 2.13 times more likely to acquire pneumonia compared to those who lived in families of few people (OR: 2.130; 95% CI: 1.580 – 2.871) as shown in table 4.13. The study signifies that many numbers of people in a family increase the speed of transmission of diseases in family. Results are supported with a study carried out in Indonesia by Maulana *et al.,* (2018) where high occupancy density would also affect infants' health, since sick individuals with infections caused by viruses or bacteria spread to other members through air breathed in and out or water droplets.

From Table 4.13, children who live near a busy roadside, sewage plant, factory, wood burning in their neighbourhood have 1.135 times risk of acquiring pneumonia compared to those who live in places without any of such sources of pollution (OR: 1.135; 95% CI: 1.005 – 1.282). This is similar with the study carried out in Uganda by Bamwesigye *et al.,* (2020) where pollution from use of charcoal, fuel, impacted the health of many women especially

pregnant ones and children in the region since a lot of smoke produced was passively inhaled into the lungs.

The presence of a family member smokes has an effect on acquisition of pneumonia. Children under five years who were exposed to tobacco smoke in a family had risk of 1.487 times higher than those who lived in smoking free families (OR = 0.487, 95% CI = 0.309 – 0.770; P = 0.002) as shown in Table 4.13. This is in accordance with a study where children under five years were very vulnerable to cigarette smoke (Lima et *al., 2016*). Results were also in agreement with a study by Satit, (2011) where infants exposed to tobacco smoke over longer periods of time had lowered immunity and were likely to contract pneumonia. This was because cigarette smoke contains some chemicals such as nicotine, tar and carbon monoxide which affect and damage the lining of gaseous exchange surfaces.

Children under five who are immunized many times have a lower risk of acquiring pneumonia of 0.585 times lower compared to same aged children who are immunized for a few times (OR = 0.585, 95%CI = 0.427 – 0.802; P = 0.001) as shown in Table 4.13. This was in line with a study by Luthfiyana *et al.,* (2018) which stated that children under five years with complete immunization status have a lower risk of developing pneumonia, which was 0.12 times lower compared to children with incomplete immunization status.

5.2 Timely diagnosis and treatment of pneumonia cases in children under five years.

Results show that rapid breathing is the most observed common clinical sign and symptom of acquired pneumonia in under five year old children. This is in support with Uganda clinical guide lines 2016, acquired pneumonia in children under five years of age with cough relies on the presence of fast breathing. Similarly, WHO 2014 clinical guideline highlights that the sensitivity and specificity of rapid breathing in predicting pneumonia in under five old children are 70 and 80 percent respectively (WHO, 2014). This therefore, acts as the basis for

administering antibiotics for treating pneumonia at both hospital and community levels by a trained health worker.

Diagnosis of pneumonia with tools at hospital level, is based on the on presenting clinical signs and symptoms such as fast breathing, and chest indrawing (WHO, 2021). In this study, stethoscope is the most commonly used tool in diagnosing acquired pneumonia at the health centre IVs cross the four regions in Uganda. This tool was also found to be most user-friendly and relatively very accurate. According to health workers, other tools are used with lower frequencies such as pulse oximetre, respiratory rate timer, haematology analyser, however haematology analyser was absent at Mayuge and Kasangati during. No health centre uses blood test method to diagnose pneumonia. The results are contrary to a study by WHO, 2014 where, chest radiograph tool is described as the gold standard for pneumonia diagnosis. However, this is not available in resource-poor settings where the burden of disease is the highest. Furthermore, according to who 2021, child hood pneumonia can best be diagnosed using pulse-oximetre, blood test diagnostics in addition to chest x-ray.

The findings show that very few caretakers 0.2% (n =3) took their children at the onset of the disease immediately for diagnosis and treatment at the health centres. This number of caretakers differed with a case-series study carried out in Uganda by Tumwine *et al.*, (2009), where sixty-four of 136 (47%) caretakers sought health care for their children at the onset of disease. However, on the contrary, in this study, 87.9% of the care takers and more, delayed to take their children for diagnosis and treatment, from the time of onset of the disease. This finding is consistent with a study by Kallander *et al.*, (2008) where health care was sought in seven days median duration of illness. Furthermore, the results of this study are in agreement with case control study by Onyango *et al.*, (2012) where care takers delayed to seek medical treatment for their children at the health facility by three days. These children were twice or more likely to present with severe pneumonia.

Antibiotics like amoxillin, ampicillin, cefilaxin, azithromycin were drugs given by heath workers to children with pneumonia at health centre IVs across the four regions this is similar with results from a case-series study by Tumwine *et al.*, (2009), sixty-four of 136 (47%) caretakers who reported difficult and rapid breathing in children under five years who were given antibiotics at home. Furthermore, the study results are supported with evidence from a community-based study by Soof *et al.,* (2012), where use of oral antibiotics for severe pneumonia was feasible and effective strategy for reducing mortality. Lastly the results are also in agreement another study by Bhutta *et al.,* (2013) where results showed that the cornerstone of effective treatment uptake for childhood pneumonia remains appropriate antibiotics.

64.2% of under five-year patients improved after consumption of medication in varying number of days. Results indicate that the medication administered by health workers was appropriate to cause child's health improvement. The results also signify that no fixed range of days of medication consumption by a sick child was significant for child's health improvement ($X^2 = 6.315$; P – value = 0.177). Therefore, the period of taking medication can be varied by a health care giver depending on the severeness of the disease.

5.3 Quantifying and investigation of a correlation between risk factors and acquired pneumonia in children under five years.

Feeding a child of less than 6 months of age on solid food other than breast milk was found have significant and positive correlation with acquired pneumonia ($r = 0.072$, $P < 0.05$). This shows that an increase in the child feeding on anything else other than breast milk would lead to higher chances of acquiring pneumonia.

The correlation of acquired pneumonia and age at which a child was immunized pneumonia for the second time was found to be significant and negative ($r = - 0.123$, $P < 0.05$). This

shows that the earlier a child is immunised for pneumonia for the second time, the lower the chances of acquiring pneumonia. This is consistent with a study by Srivastava *et al.,* (2015) where routine immunisation of infants built body immunity against diseases including pneumonia.

The correlation of acquired pneumonia and the number of times the child had received immunisation for Pneumonia was found have significant and negative coefficient with acquired pneumonia ($r = - 0.156$, $P < 0.05$). This showed that an increase in the number of times the child receives immunisation for Pneumonia, reduces the chances of acquiring pneumonia. Results are in agreement with a study by Agarwal et al. (2003) on rural 14 preschool children, where it was observed that the moderate and severe acute respiratory infection related morbidity and mortality was significantly reduced in fully immunized children compared to unimmunized children.

The correlation of acquired pneumonia and house size was significant and negative ($r = - 0.126$, $P < 0.05$). The study results show that children who reside in single roomed houses have higher chances of acquiring pneumonia than those who reside in houses of more than one room. This could be because single roomed house characterised with crowdedness, in case of a sick person, bacterial or viral infections spread faster through respiratory droplets.

The correlation of acquired pneumonia and number of people in the family was positive and significant ($r = 0.127$, $P < 0.05$). Results show that increased number of people at home leads to overcrowding which increase the chances of acquiring pneumonia. This is in agreement with the cross-sectional studies in northeast of Pakistan by Campbellada *et al.,* (2013) where children under five years that lived in overcrowded conditions had higher pneumonia rates.

The correlation of acquired pneumonia and having a member of the family who smokes was found to be significant and negative ($r = -0.166$, $P < 0.05$). The more the child lives in a family without a member who smokes, the lower the chances of the child acquiring pneumonia. This is supported by results in previous study by Fadl *et al.*, (2020) showed that child exposure to a household cigarette smoke increased the risk acquiring pneumonia by 1.5 folds in a child.

5.4 Conclusion

Significant risk factors for acquired pneumonia in children under five years are; Consumption of whole food for some days, feeding a child of less than 6 months on solid food other than breast milk, size of the house, family size, presence of any source of pollution in the neighbourhood, presence of a smoking member in the family, age at which a child is immunised for pneumonia for a second time, number of times the child received immunisation for pneumonia.

Stethoscope is the most commonly used tool in diagnosing pneumonia at the health centre IVs cross the four regions in Uganda. No health centre uses blood test method to diagnose pneumonia. Mayuge and Kasangati have no haematology analyser to diagnose pneumonia.

Across the four health centre IVs, rapid breathing was the most clinical symptom in children with acquired pneumonia while loss of appetite was not used as a symptom.

87.9% ($n = 1071$) of caretakers delayed in a range 1 to 5days to seek diagnosis and treatment of pneumonia for their children at the disease symptoms. Additionally, amoxillin, ampicillin cefilaxine, azithromycin, and gentamicin were the mostly prescribed antibiotics by health workers.

Quantified risk factors that had significant correlation coefficients with acquired pneumonia in children under five years were; feeding a child of less than 6months on solid food other than breast milk ($r = 0.072$, $P < 0.05$) ,the time/age the child immunized pneumonia for the second time ($r = -0.123$, $P < 0.05$),number of times the child received immunisation for Pneumonia ($r = -0.156$, $P < 0.05$), house size ($r = -0.126$, $P < 0.05$), number of people in the family/ family size ($r = 0.127$, $P < 0.05$), presence of a member smoking in a family ($r = -0.166$, $P < 0.05$.

5.5 Recommendation

5.5. 1 Caretakers

Sensitising caretakers on the risk factors at the health centres so as to create awareness aiming at discouraging some of the risk behaviours. These include; smoking, living in an environment with any source of pollution in the neighbourhood which harbours micro-organisms like bacteria, viruses that cause pneumonia. Furthermore, educating caretakers the significance of immunisation of under five year old children the as recommended by health workers.

5.5.2 Government

The government should equip the entire health centre IVs with the different pneumonia diagnostic tools to improve on the diagnosis of acquired pneumonia in children less than five years in Uganda for example the haematology analyser, blood test tools for pneumonia.

The in-service training programmes and refresh courses of health workers at health facilities should be organised and conducted regularly across all the regions in Uganda by Ministry of Health so to equip health workers with knowledge, skills and experience in using diagnostic tools to detect and treat acquired pneumonia.

The Ministry of Health should monitor and inspect regularly the hospital diagnostic tools especially those diagnosing pneumonia so as to improve and maintain their sensitivity and validity in giving very accurate results.

Further research on the factors that cause delay of caretakers to seek diagnosis and treatment for their children at the health centres especially from the onset of signs and symptoms of illnesses.

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APPENDICES

Appendix I: Pearson's Correlation for the diagnosed diseases with pneumonia to obtain the diseases predictors of pneumonia.

		Cough	Cough and flu	Cough and infection	Pneumonia	Malaria	Measles	Asthma	Flue	Diarrhoea
Cough	Pearson Correlation	1								
	Sig. (2-tailed)									
	N	1172								
Cough and flu	Pearson Correlation	-.236**	1							
	Sig. (2-tailed)	.000								
	N	1172	1172							
Cough and infection	Pearson Correlation	-.194**	-.372**	1						
	Sig. (2-tailed)	.000	.000							
	N	1172	1172	1172						
Pneumonia	Pearson Correlation	-.120**	-.199**	.079**	1					
	Sig. (2-tailed)	.000	.000	.007						
	N	1172	1172	1172	1172					
Malaria	Pearson Correlation	-.044	-.146**	-.158**	-.079**	1				
	Sig. (2-tailed)	.132	.000	.000	.007					
	N	1172	1172	1172	1172	1172				

Measles	Pearson Correlation	-.077**	-.148**	-.116**	-.058*	-.127**	1			
	Sig. (2-tailed)	.008	.000	.000	.047	.000				
	N	1172	1172	1172	1172	1172	1172			
Asthma	Pearson Correlation	-.021	-.040	-.032	-.019	-.005	-.013	1		
	Sig. (2-tailed)	.472	.168	.279	.505	.871	.666			
	N	1172	1172	1172	1172	1172	1172	1172		
Flue	Pearson Correlation	-.053	-.129**	-.102**	-.063*	-.005	-.041	-.011	1	
	Sig. (2-tailed)	.071	.000	.000	.032	.868	.166	.707		
	N	1172	1172	1172	1172	1172	1172	1172	1172	
Diarrhoea	Pearson Correlation	.007	-.006	-.042	-.026	-.049	-.017	-.005	.107**	1
	Sig. (2-tailed)	.812	.838	.152	.377	.093	.568	.877	.000	
	N	1172	1172	1172	1172	1172	1172	1172	1172	1172

Appendix II: Risk factors of pneumonia from other diseases

Disease	Factors	B	S.E.	Sig.	OR
Cough	**Host related**				
	Age the child was born	.918	.402	.022	2.505
	How baby was born	-.195	.304	.521	.823
	Still breast feeding	-.036	.506	.943	.964
	Breastfeed for how long	-.504	.161	.002	.604
	Feeding on anything	.212	.505	.675	1.236
	Age started feeding on anything	.010	.217	.962	1.010
	Nutrition factors				
	Proteins	.106	.233	.648	1.112
	Whole food	-.210	.185	.256	.811
	Vitamins	.481	.239	.044	1.618
	Vitamins vegetables	-.287	.212	.175	.750
	Carbohydrates	-.141	.240	.557	.868
	Carbohydrates cookies	-.011	.229	.963	.989
	Fats	.019	.190	.919	1.020
	Environmental factors				
	Size of your house	.235	.101	.020	1.265
	Number of people	-.104	.143	.466	.901
	Source of pollution in your neighbourhood	.180	.056	.001	1.198
	Crowded homestead	-.467	.164	.004	.627
	Any one Smoke	.713	.284	.012	2.040
	Immunisation factors				
	Child has been Immunised	.817	.610	.181	2.263
	Received Immunisation for pneumonia	-.320	1.141	.779	.726
	When was the child immunised for first time	.720	.326	.027	2.053
	Age child immunised for Second time	-.211	.129	.100	.810
	Age child received immunisation	.983	.188	.000	2.673

Cough and flu

Disease	Factors	B	S.E.	Sig.	OR
Cough	**Host related**				
and flu	Age the child was born	.260	.249	.296	1.297
	How baby was born	-.301	.221	.174	.740
	Still breast feeding	-.287	.370	.438	.750
	Breastfeed for how long	-.127	.120	.288	.881
	Feeding on anything	-.463	.393	.239	.630
	Age started feeding on anything	-.633	.154	.000	.531
	Nutrition factors				
	Proteins	.064	.165	.700	1.066
	Whole food	-.146	.128	.255	.864
	Vitamins	.368	.162	.023	1.444
	Vitamins vegetables	.541	.151	.000	1.718
	Carbohydrates	.073	.159	.646	1.076
	Carbohydrates cookies	.044	.160	.784	1.045
	Fats	-.446	.131	.001	.640
	Environmental factors				
	Size of your house	.081	.071	.256	1.084
	Number of people	-.207	.097	.032	.813
	Source of pollution in your neighbour hood	.071	.039	.065	1.074
	Crowded homestead	-.281	.111	.011	.755
	Any one Smoke	.548	.168	.001	1.730
	Immunisation factors				
	Was Child Immunised for killer disease	-.286	.550	.603	.751
	Received Immunisation for pneumonia	-.340	.842	.687	.712
	Age child immunised for first time	.541	.265	.041	1.718
	Age child immunised for Second time	-.094	.085	.266	.910
	Age child received immunisation	.810	.112	.000	2.248

Cough and infection

Disease	Factors	B	S.E.	Sig.	OR
Cough and infection	**Host related**				
	Age the child was born	-1.350	.383	.000	.259
	How baby was born	.139	.325	.668	1.150
	Still breast feeding	1.334	.843	.114	3.794
	Breastfeed for how long	2.283	.270	.000	9.804
	Feeding on anything	1.239	.532	.020	3.451
	Age started feeding on anything	.829	.267	.002	2.290
	Nutrition factors				
	Proteins	-2.005	.262	.000	.135
	Whole food	.650	.227	.004	1.916
	Vitamins	-.815	.224	.000	.443
	Vitamins vegetables	-.012	.234	.961	.989
	Carbohydrates	-.074	.292	.799	.929
	Carbohydrates cookies	.023	.239	.923	1.023
	Fats	.785	.211	.000	2.192
	Environmental factors				
	Size of your house	-1.283	.137	.000	.277
	Number of people	.966	.131	.000	2.628
	Source of pollution in your neighbourhood	-.182	.054	.001	.834
	Crowded homestead	.760	.156	.000	2.139
	Any one Smoke	-1.373	.178	.000	.253
	Immunisation factors				
	Child has been Immunised	-.104	.764	.891	.901
	Received Immunisation for pneumonia	-1.078	1.200	.369	.340
	Age the child immunised for first time	-1.118	.404	.006	.327
	Age the child immunised for Second time	.454	.131	.001	1.575
	Number of times child received immunisation	-2.318	.176	.000	.099

Flue

Disease	Factors	B	S.E.	Sig.	OR
Flue	**Host related**				
	Age the child was born	.586	.752	.436	1.796
	How baby was born	.162	.478	.735	1.176
	Still breast feeding	-.793	.798	.320	.453
	Breastfeed for how long	.068	.331	.837	1.070
	Feeding on anything	-17.931	6272.316	.998	.000
	Age started feeding on anything	-.071	.409	.862	.931
	Nutrition factors				
	Proteins	.096	.413	.815	1.101
	Whole food	-.017	.311	.956	.983
	Vitamins	-.432	.375	.250	.649
	Vitamins vegetables	1.321	.399	.001	3.748
	Carbohydrates	.190	.351	.589	1.209
	Carbohydrates cookies	-.081	.396	.837	.922
	Fats	-.178	.315	.572	.837
	Environmental factors				
	Size of your house	.465	.176	.008	1.593
	Number of people	-.432	.259	.096	.649
	Neighbourhood	.045	.102	.660	1.046
	Crowded is homestead	-.239	.286	.403	.788
	Any one Smoke	-.611	.400	.127	.543
	Immunisation factors				
	Child has been Immunised	1.554	.803	.053	4.728
	Received Immunisation for pneumonia	-18.570	12426.999	.999	.000
	Age child immunised for first time	.786	.575	.172	2.195
	Age child immunised for Second time	-.274	.225	.225	.761
	Number times child received immunisation	1.444	.428	.001	4.237

Malaria

Disease	Factors	B	S.E.	Sig.	OR
Malaria	**Host related**				
	Age the child was born	.199	.238	.404	1.220
	Nature of delivery	.077	.203	.703	1.080
	Still breast feeding	.152	.387	.695	1.164
	Breastfeed for how long	-.147	.118	.211	.863
	Feeding on anything	-.180	.385	.640	.835
	Age started feeding on anything	-.003	.154	.984	.997
	Nutrition factors				
	Proteins	.447	.164	.006	1.563
	Whole food	-.098	.128	.442	.906
	Vitamins	.237	.161	.141	1.267
	Vitamins vegetables	-.130	.146	.376	.878
	Carbohydrates	-.090	.160	.575	.914
	Carbohydrates cookies	-.103	.157	.514	.903
	Fats	-.018	.130	.888	.982
	Environmental factors				
	Size of your house	.131	.072	.069	1.140
	Number of people	-.014	.097	.887	.986
	Neighbourhood	.086	.040	.029	1.090
	Crowded is homestead	-.278	.114	.015	.758
	Any one Smoke	-.130	.162	.420	.878
	Immunisation factors				
	Child Immunised for killer diseases	-.104	.543	.848	.901
	Received Immunisation for pneumonia	-.358	.828	.666	.699
	Age the child immunised for first time	.276	.270	.306	1.318
	Age the child immunised for Second time	-.143	.088	.105	.867
	Number of times child received immunisation	.406	.105	.000	1.501

Appendix III A: Host related factors

Risk factors		Pneumonia
Age child born	**Pearson Correlation**	-.010
	Sig. (2-tailed)	.747
	N	1156
Duration of child's breastfeeding	**Pearson Correlation**	.047
	Sig. (2-tailed)	.242
	N	626
child feeding on anything other than breast milk	**Pearson Correlation**	.072*
	Sig. (2-tailed)	.017
	N	1095
Age child start feeding on anything other than breast milk	**Pearson Correlation**	.049
	Sig. (2-tailed)	.151
	N	873

Appendix III B: Nutritional risk factors

Factors		Pneumonia
Whole food (Milk, yoghurt, or bongo)	**Pearson Correlation**	.056
	Sig. (2-tailed)	.094
	N	889
Vitamins (Fruits)	**Pearson Correlation**	.002
	Sig. (2-tailed)	.951
	N	871
Vitamins (Vegetables)	**Pearson Correlation**	-.003
	Sig. (2-tailed)	.930
	N	853
Fats (Fried foods)	**Pearson Correlation**	.036
	Sig. (2-tailed)	.288
	N	880
Proteins (Meat, chicken, beans, or eggs)	**Pearson Correlation**	-.045
	Sig. (2-tailed)	.177
	N	891

Appendix III C: Immunization risk factors

Risk factors		Pneumonia
Age child immunized for pneumonia for the first time	**Pearson Correlation**	.019
	Sig. (2-tailed)	.528
	N	1095
Age child immunized for pneumonia for the second time	**Pearson Correlation**	-.123**
	Sig. (2-tailed)	.000
	N	1082
Number of times the child received immunisation for Pneumonia	**Pearson Correlation**	-.156**
	Sig. (2-tailed)	.000
	N	1068
Pneumonia	**Pearson Correlation**	1
	Sig. (2-tailed)	
	N	1172

Appendix III D: Environmental risk factors

Risk factor		Pneumonia
Size of your house	**Pearson Correlation**	-.126**
	Sig. (2-tailed)	.000
	N	1150
The number of people in your family	**Pearson Correlation**	.127**
	Sig. (2-tailed)	.000
	N	1150
Source of pollution in your neighbourhood	**Pearson Correlation**	.000
	Sig. (2-tailed)	.988
	N	1139
Member of family smoking	**Pearson Correlation**	-.166**
	Sig. (2-tailed)	.000
	N	1109
Pneumonia	**Pearson Correlation**	1
	Sig. (2-tailed)	
	N	1172

Appendix IV: **INFORMED CONSENT**

Title of the study: Case management of acquired pneumonia in children under five years at health centre IVs in Uganda

I**nvestigator:** Kawooya George William a student of master's in Public Health Kyambogo University.

Introduction

The study is a survey about the case management and risk factors of childhood pneumonia. This informed consent explains the study to you. After the study has been explained any questions, any questions you have are answered and once you have decided to participate in the study, you will be asked to sign a consent form and a copy will be given to you.

Purpose

The study seeks to identify risk factors influencing child hood pneumonia cases in under five year old children, effect of timely diagnosis and treatment on progression of pneumonia in under five year old children, quantification and correlation of risk factors with pneumonia.

Procedure

You have been chosen to participate in this study because you are a parent or guardian of a child under five years of age. The interview will last for approximately 10 minutes and almost 2000 will take part in the study

Risks/ discomforts

There is no foreseeable risk of harm will be the inconvenience in terms of time spent during the interview

Benefits

As a research participant, you will get feedback on findings and progress of the study and any new information that affects you as a study participant (including incidental findings) will be made available to you at the health centre.

Confidentiality

Your identity will not be revealed to any one as we shall only use codes to identify participants. Information obtained will only be accessible by research team. Soft copies of the data will be protected by password and hard copy will be kept under lock and key. Confidential information will only be accessed by the principal investigator.

Alternatives

You do not have to participate in this study if you are not interested. You will not lose any benefit in case of no participation.

Cost

There will be no cost incurred as a result of participating in this study.

Statement of voluntariness

Participation in the research study is voluntary and you may join on your own free will. You have a right to withdraw from the study at any time without penalty.

Statement of consent

A research assistant has described to me what is going to be, the risks. The benefits, involved and my rights as a participant in this study. I understand that my decision to participate in this study will not affect me in any way. In the use of this information, my identity will be concealed. Am aware that I may withdraw at any time. I understand that by signing this form, I do not waive any of my legal rights but merely indicate that I have been informed about the research study in which Iam voluntarily agreeing to participate. A copy of this form will be provided to me.

Name……..... signature/thumbprint of participant…… Date…….....

Name ……signature of interviewer…….. Date…….

Appendix VA: A QUESTIONNAIRE ABOUT PNEUMONIA FOR HEALTH WORKERS

1. **Pneumonia Awareness**

    a. Tick the different microorganisms that cause Pneumonia. □Virus □Bacteria □Fungi □Mycoplasma□ Algae □Eukaryotes

    b. Is there a symptomatic difference in the Pneumonia types above? □Yes □No

    c. If yes, state the difference ……

    d. On a scale of 1- 5, rate the symptoms of Pneumonia in children according to their occurrence. Where: 1- Never, 2-Rarely, 3-Sometimes, 4- Often and 5 - Always.

Symptom	**1**	**2**	**3**	**4**	**5**
Cough					
Sudden onset of chills					
Lower chest wall in-drawing					
High fever					
Rapid breathing					
Loss of appetite					

    e. Tick the diseases that have similar symptoms with Pneumonia in children.

□Malaria □Asthma □Lung cancer □Bronchitis □Measles □Influenza□Upper respiratory infection □Chronic obstructive pulmonary disease (COPD)

    f. How do you differentiate between the mentioned diseases in **1**.e above and Pneumonia? …….

2. **Diagnostic tools for Pneumonia**

    a. Which of the following tools used for diagnosing Pneumonia does your health centre have? Please tick. □ Stethoscope□Pulse oximetre□Respiratory rate timer □Haematology analyzer

    b. Have you used a Pneumonia diagnostic tool before? □Yes □No

c. If yes, which of the following have you used to diagnose Pneumonia in children? Please tick. □Stethoscope □Blood test □Pulse oximetre□Respiratory rate timer□Haematology analyzer

d. Rate the use and the frequency of use of the following tools to diagnose Pneumonia in children. Where: 1- Never, 2-Rarely, 3-Sometimes, 4- Often and 5 - Always.

Tool	**1**	**2**	**3**	**4**	**5**
Stethoscope					
Blood test					
Pulse oximetre					
Respiratory rate timer					
Haematology analyser					

e. Rate the ease of usage of the following diagnostics. Where: 1- Not easy to use, 2-Somehow easy to use and 3-Easy to use.

Tool	**1**	**2**	**3**
Stethoscope			
Blood test			
Pulse oximetre			
Respiratory rate timer			
Haematology analyzer			

f. Rate the accuracy of the following tools in diagnosing Pneumonia in children. Where:1-Not accurate, 2-Fairly accurate, 3-Accurate and 4-Very accurate.

Tool	**1**	**2**	**3**	**4**
Stethoscope				
Blood test				
Pulse oximetre				
Respiratory rate timer				
Haematology analyser				

g. Have you ever got a patient below the age of five with Pneumonia at this centre? □Yes □No

h. If yes, on average how many in a week? □1-< 5 □5- < 10 □> 10

i. What is the most common level of severity of Pneumonia at this centre?

□ Mild □ Moderate □ Severe

j. What medication do you usually prescribe for Pneumonia? …….

Appendix V: A QUESTIONNAIRE ABOUT PNEUMONIA FOR PARENTS/GUARDIANS WITH CHILDREN BELOW FIVE YEARS OF AGE

1. **Parent/Guardian's background**

   a. What is your gender? □Male □ Female

   b. How old are you? □< 20 yrs □20 -<25 yrs

      □25 -<30 yrs □30 -<35 yrs □>= 35 yrs

   c. Have you ever attended school? □Yes □No

   d. If the answer is yes in **1**c above, what is the highest level of school you attended?

      □Primary □Secondary Tertiary

   e. What is your current marital status?

      □Single □Married/Cohabiting

      □Divorced/Separated □Widowed

   f. What is your family's monthly income? □< 5000 □5000 - < 10000 □10000 -<100000

      □>100000

   g. What is the approximate distance between where you stay and this health centre? □< 500m

      □500m - <1km □ 1 km - < 5 km □> 5 km

2. **Child's background**

   a. What is the gender of the child? □Male □Female

   b. How old is the child? □0 -<6 months □6 months -<2 yrs □2 -< =5 yrs

3. **Pneumonia risk factors**

   3.1 Host related factors

      a. At which age was the child born? □6-< 7 months □7-8 months □> 8 months □I don't know

      b. How was the baby born? □Normal delivery □Caesarean Section □I don't know

      c. Is your child still breastfeeding? □Yes □No

d. If No in **3.1**. c, for how long did the child breastfeed?

□< 6 months 6 months -< 1 year

□1-<2 years □>= 2 years

e. Is your child feeding on anything other than breast milk? □Yes □No

f. If yes in **3.1** e above, at what age did the child start feeding on anything other than breast milk? □< 4 months 4-<6 months □ > 6 months

g. If yes in **3.1** d above, Tick how often your child eats either food in the following categories:

I	Proteins	Meat, chicken, beans or eggs	□Daily □Some Days □Never
Ii	Whole food	Milk, yoghurt or bongo	□ Daily □ Some Days □ Never
Iii	Vitamins	Fruits	□ Daily □ Some Days □ Never
Iv	Vitamins	Vegetables	□ Daily □ Some Days □ Never
V	Carbohydrates	porridge, rice, posho, Matooke, Sweet potatoes, Grains, cereal, bread	□ Daily □ Some Days □ Never
Vi	Carbohydrates	Cookies, cakes, sweets	□ Daily □ Some Days □ Never
Vii	Fats	Fried foods	□ Daily □ Some Days □Never

3.2 Environmental factors

a. Tick the size of your house. □Single room □double room □Three rooms □More than three rooms

b. Tick the number of people in your family. □ < 4 □4 - 6 □7 - 10 □> 10

c. Tick any of the following in your neighbourhood. □ Near busy roadside □Sewage plant □Factory □Wood burning □None of the given

d. How crowded is your homestead? □ Highly crowded □Moderately crowded □Not at all crowded

e. What do you mostly use for cooking? Tick. □Firewood □Charcoal □Electricity □Gas □Kerosene

f. Does any member of your family smoke?

□Yes □ No

4. Immunization

a. Has the child been immunized against killer diseases? □Yes □No □I don't know

b. Has the child received immunization for Pneumonia (pneumococcal vaccine)? □Yes □No □I don't know

c. If yes in **4**.b above, when was the child immunized for pneumonia for the first time? □$1\frac{1}{2}$ months □$2\frac{1}{2}$ months □$3\frac{1}{2}$ months □$> 3\frac{1}{2}$ months

d. If yes in **4**.b above, when was the child immunized for pneumonia for the second time?

□Not yet

□$2\frac{1}{2}$ months $3\frac{1}{2}$ months □$> 3\frac{1}{2}$ months

e. If yes in **4**.b above, how many times has the child received immunisation for Pneumonia?

□Once□Twice □Three times

5. Pneumonia Awareness

a. Are you aware that Pneumonia is one of the killer diseases for children under five years of age?

□Yes □No

b. Tick the danger signs for Pneumonia.

□Lower chest wall in-drawing □Incessant vomiting □Inability to feed □Fast and difficulty in breathing

6. Pneumonia case management

a. Does the child have cough? □Yes□No □I don't know

b. Has the child had cough in the last two weeks?

□Yes□No □I don't know

c. In the last two weeks did the child breathe faster than usual with short, rapid breaths or have difficulty in breathing?

□Yes □No□I don't know

d. If yes, in 6c above, was the fast or difficulty in breathing due to a problem in the chest or a blocked or runny nose? □Yes□ No □I don't know

e. In the last two weeks did the child have fever/chills?

□Yes□ No □I don't know

f. Has the child lost appetite in the last two weeks?

□Yes□ No □I don't know

g. Did you seek any medical advice or treatment for the illness from any source? □Yes □No□I don't know

h. If yes **6**.g, how many days after the illness began, did you first seek treatment for the child?

……

i. From where did you seek medical advice or treatment? □ Government facility

□Private facility □ None of the mentioned

j. Tick from below what the medical personnel diagnosed.

□Infection □Cough □Cough and flu □Cough and infection □Pneumonia □Malaria □Measles □Asthma

Any other, please specify ……

k. Was the child given any medicine to treat this illness? □Yes □No □I don't know

l. If yes in **6**.k above, what medicine was the child given? □ Antimalarial □Antibiotic □Painkiller □Antimalarial and antibiotic □Antimalarial, antibiotic and painkiller □I don't know

m. For how many days did the child take the medication? ……..

n. Did the child improve after the medication? □Yes □No

o. Why is the child back again? □New condition □ Persistent condition □Review □ Review and Persistent condition

p. Does the child have any other chronic illnesses (Asthma, TB, diabetes, cancer, heart disease, obesity, etc.)? □Yes □No □ I don't know

APENDIX VI: DIAGNOSTIC TOOLS

1. Haematology analyser

2. Stethoscope

3 Pulse oximeter

4. Respiratory rate timer.

Appendix VII: RESEARCH REVIEW COMMISSION LETTER

UGANDA CHRISTIAN UNIVERSITY

A Centre of Excellence in the Heart of Africa

17/09/2021

To: HASIFA NAMPALA

KYAMBOGO UNIVERSITY
0782376030

Type: Initial Review

Re: UCUREC-2021-174: Quantification and optimal control analysis of delayed diagnosis on the dynamics of pneumonia in Uganda, ,

I am pleased to inform you that the Uganda Christian University REC, through expedited review held on **17/09/2021** approved the above referenced study.
Approval of the research is for the period of **17/09/2021** to **17/09/2022.**

As Principal Investigator of the research, you are responsible for fulfilling the following requirements of approval:

1. All co-investigators must be kept informed of the status of the research.
2. Changes, amendments, and addenda to the protocol or the consent form must be submitted to the REC for re-review and approval **prior** to the activation of the changes.
3. Reports of unanticipated problems involving risks to participants or any new information which could change the risk benefit: ratio must be submitted to the REC.
4. Only approved consent forms are to be used in the enrollment of participants. All consent forms signed by participants and/or witnesses should be retained on file. The REC may conduct audits of all study records, and consent documentation may be part of such audits.
5. Continuing review application must be submitted to the REC **eight weeks** prior to the expiration date of **17/09/2022** in order to continue the study beyond the approved period. Failure to submit a continuing review application in a timely fashion may result in suspension or termination of the study.
6. The REC application number assigned to the research should be cited in any correspondence with the REC of record.
7. You are required to register the research protocol with the Uganda National Council for Science and Technology (UNCST) for final clearance to undertake the study in Uganda.

The following is the list of all documents approved in this application by Uganda Christian University REC:

No.	Document Title	Language	Version Number	Version Date
1	Data collection tools	English	ONE	2021-08-24
2	Data collection tools	Luo	ONE	2021-08-24
3	Data collection tools	Lusoga	ONE	2021-08-24
4	Data collection tools	Runyakitara	ONE	2021-08-24
5	Data collection tools	Luganda	ONE	2021-08-24
6	Data collection tools	English	ONE	2021-08-24
7	Informed Consent forms	English	ONE	2021-08-24

Yours Sincerely