FACTORS ASSOCIATED WITH OCCURRENCE OF ACUTE RESPIRATORY TRACT INFECTIONS AMONG CHILDREN AGED BELOW FIVE YEARS ATTENDING KINANGO SUB-COUNTY HOSPITAL, KWALE COUNTY, KENYA

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Factors Associated with Occurrence of Acute Respiratory Tract Infections among Children Aged Below Five Years Attending Kinango Sub-County Hospital, Kwale County, Kenya

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DECLARATION

This thesis is my original work and has not been presented for a degree in any other University.

Signature…………………………………. Date……………………………….

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This thesis has been submitted for examination with our approval as university supervisors.

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DEDICATION

I dedicate this thesis to the community in Kinango Sub-County in their pursuit for their health and well-being.

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ABBREVIATIONS AND ACRONYMS

aOR	Adjusted Odds Ratio
ARI	Acute Respiratory Tract Infection
CHV	Community Health Volunteer
CI	Confidence Interval
EPI	Expanded Program Immunization
ERC	Ethics Review Committee
FGD	Focus Group Discussions
GDB	Global Disease Burden
HDSS	Health and Demographic Surveillance System
HIB	*Haemophilus Influenza* type B
HIV/AIDS	Human Immunodeficiency Virus-Acquired Immunodeficiency Syndrome
IMCI	Integrated Management of Childhood Illnesses
KAP	Knowledge, Attitude and Practices
KEMRI	Kenya Medical Research Institute
KIPRA	Kenya Institute for Public Policy Research and Analysis
KNBS	Kenya National Bureau of Statistics
KNH	Kenyatta National Hospital

LRI	Lower Respiratory Infections
LRTI	Lower Respiratory Tract Infection
MCH	Maternal and Child Health
MDG	Millennium Development Goal
NUITM	Nagasaki University Institute of Tropical Medicine
OR	Odds Ratio
UNICEF	United Nations International Children's Emergency Fund
UoN	University of Nairobi
URTI	Upper Respiratory Tract Infection
USA	United States of America
WHO	World Health Organization

DEFINITION OF TERMS

Acute respiratory tract infections	Infections of the respiratory tract with a rapid or sudden onset that can be brief or prolonged, yielding mild to severe clinical signs and symptoms, that are resolved quickly by the immune system or gradually by pharmacotherapeutic options, namely the common cold, tonsilitis, otitis media and pharyngitis that affect the upper respiratory tract and bronchitis, bronchiolitis and pneumonia that affect the lower respiratory tract.
Maternal and child health	Health of a mother and a child from conception to birth and health of a child from birth to early developmental years.
No pneumonia: cough or cold	A child with a cough or difficult breathing but with no fast breathing, no chest indrawing, no stridor and no general danger sign.
Pneumonia	A child with a cough or difficult breathing, presenting with fast breathing but without chest indrawing, stridor or general danger sign.
Respiratory tract infections	Infections of any part of the respiratory tract, including the sinuses, airways, throat and the lungs.
Severe pneumonia	A child with a cough or difficult breathing, and having chest indrawing or stridor when calm and with a general danger sign.

ABSTRACT

Acute respiratory infections (ARIs) are an important cause of morbidity and mortality among children aged below five years globally. Although their impact on public health is well established, actual burden of these infections among children aged below five years is not well elucidated. This study aimed to determine factors associated with occurrence of acute respiratory tract infections among children aged below five years in Kinango Sub-County, Kwale County, Kenya. A descriptive cross-sectional study was conducted. Study participants were children aged below five years presenting for care at Kinango Sub-County hospital. Systematic sampling was used to select study participants. Data was collected using a structured questionnaire and focus group discussions were held to collect additional data. Quantitative data was analyzed using descriptive statistics and regression analysis, while thematic analysis was used to analyze qualitative data. A total of 385 children participated in this study. Majority of the children; (61.6%) were aged below two years, and 49.9% of them were male. The prevalence of ARIS was 59.2% (95% CI 54.5-64.3). Female gender [aOR 3.39 (1.21-9.46)], stunting [aOR 3.62 (1.04-12.61)], high parity [aOR 11.45 (2.38-55.09)], low maternal education [aOR 3.54 (1.10-11.32)], and recent hospitalization [aOR 8.19 (1.75-38.43)] increased the odds of infection, and normal birth weight [aOR 0.06 (0.01-0.62)] lowered the odds of infection. knowledge on causes of ARIs (p=0.026) and attitude towards signs and symptoms of ARIs were significantly associated with ARIs (P=0.024). Of the practices regarding ARIs, completing immunization was significantly associated with occurrence of ARIs (p=0.003). High prevalence of ARIs observed in this study can negatively affect health of children in this area, with negative impact on their growth and development and future health.

CHAPTER ONE

INTRODUCTION

1.1 Background

Acute respiratory infections (ARIs) remain an important cause of morbidity among children globally. It is estimated that about 1.9 million children worldwide die from ARIs every year, 70% of these deaths occurring in Africa and Southeast Asia (Jin *et al.,* 2021). ARIs account for about 30-50% of visits to the health facilities and 20-40% of admissions (Islam *et al.,* 2013, Richter et al., 2016). Pneumonia, common cold, sinusitis and bronchiolitis are among the most common ARIs with etiologies varying from viral to bacterial. Of these, pneumonia has the most serious presentation, and is among the leading causes of death among children globally (WHO, 2022). It is estimated that about 15% of deaths among children aged below five years globally are as a result of pneumonia (Liu *et al.,* 2014; Reiner *et al.,* 2019). ARIs also impose an economic burden on health care systems and households in terms of loss of earning during disease episodes in the family, both financially and time wise each time they occur (Tregoning and Schwarze, 2010; Sam *et al.,* 2021).

ARIs constitute of upper respiratory tract infections (URTI) and lower respiratory tract infections (LRTI). URTI are the most frequent among both children and adults, involving the nose, sinuses, pharynx and larynx (Marengo *et al.,* 2017; Finley *et al.,* 2018). They present as febrile illnesses with cough, sore throat, nasal congestion and sneezing, with milder course of infections, with or without complications. LRTI on the other hand have a more severe course of infection with high fatality, especially among children aged below five years (Safiri *et al.,* 2023) . Most ARIs are of viral etiology as opposed to bacterial causes, and infections, especially of the upper respiratory tract can be self-limiting (Li *et al.,* 2021; A. Ahmed *et al.,* 2022). Involvement of bacterial etiologies in infections of the upper respiratory tract however bear a substantial risk of systemic dissemination and invasion of the blood stream resulting to serious complications (Alsaeed *et al.,* 2017). Therapeutic management of ARIs has however been shown to be achieved largely through anti-bacterial drugs although reports show that antibiotics are unlikely to confer particular curative benefits (Hersh *et al.,* 2013; Godman *et al.,* 2020). Moreover, diagnosis of ARIs is rather difficult given the lack of sensitive, specific and cost-effective tests, coupled with an overlap of presentation features between bacterial and viral infections (Calderaro *et al.,* 2022).

Children aged below five years present an important risk group for ARIs, with infants and malnourished children at an even greater risk (Islam, *et al.*, 2013; Safiri *et al.*, 2023). At individual-level, the immune system of infants and young children is generally naive due to absence of previous exposure to pathogens (Tregoning and Schwarze, 2010; Harerimana *et al.,* 2016). There is therefore no immune memory hence response to an infection is rather slow. During infancy, the innate and adaptive immune responses that facilitate fast removal of pathogens are also reduced. Children acquire ARIs mostly through contact with an infected person although transmission dynamics in households are varied (Goldman, 2000; Kutter *et al.,* 2018).

ARIs are quite prevalent in Kenya, although data on burden and determinants of ARIs is minimal. Both health care associated and community acquired infections have been indicated, each causing substantial morbidity. In a hospital based survey, Katz *et al.,* (2014) recorded a total of 38,775 cases of severe ARIs and influenza like illnesses across all ages from a surveillance spanning between 2007 and 2013. The study observed a greater disease burden among children aged below five years, with significant influenza virus etiology being observed (Katz *et al.,* 2014). In yet another hospital-based survey, Ndegwa et al., (2014) observed an incidence of 9.2 respiratory health care associated infections per 10,000 patient days in three hospitals. Additionally, a community based surveillance for severe ARIs spanning between 2007 to 2011 that covered a section of Kibera slums, reported an incidence of 12.4 cases per 100 person years of observation among children aged below five years (Breiman *et al.,* 2015). Similar to other settings, pneumonia is the most common of all ARIs. It accounts for 16% of deaths among children aged below five years and has been named as the second leading cause of death in Kenya (Onyango *et al.,* 2012). Significant gains in prevention of pneumonia have however been realized following integration of the pneumonia vaccine in the expanded immunization program. Various etiologies of ARIs have been reported, viral etiologies being the most frequently observed (Feikin *et al.,* 2012; Mohammed *et al.,* 2015). Management practices of ARIs revolve around home and hospital-based care. Instances of self-medication have been observed and these at times lead to delays in seeking healthcare.

In order to achieve optimum management of ARIs, the Ministry of Health has institutionalized Integrated Management of Childhood Illnesses (IMCI) guidelines (WHO, 2005). The guidelines enable differential diagnosis of ARIs and other childhood illnesses, and provides treatment and care options. Beside application of IMCI guidelines, the Ministry of Health undertakes promotion of childhood immunization, promotion of exclusive breastfeeding and health education of mothers on child health to control and manage ARIs. The Ministry has also set up sentinel surveillance system for monitoring influenza infection, to provide early warning for influenza illness and severe acute respiratory illness (Idubor *et al.,* 2020).

Although standard clinical treatment and management guidelines are in place, morbidity due to ARIs among children aged below five years is still high. Care practices at especially at community level are not well documented too despite the importance of home-care in management of ARIs, and determinant of occurrence of ARIs are unclear. Owing to the high burden of ARIs and the self-limiting nature of most of the infections, epidemiological information is needed to aid development of evidence-based prevention, treatment and management strategies.

The study will be carried out in Kwale County, within the Nagasaki University Institute of Tropical Medicine-Kenya Medical Research Institute (NUITM-KEMRI) Health and Demographic Surveillance System (HDSS). Child health rating in Kwale County is relatively poor. Under five mortality rate is high; 30 deaths per 1,000 live births, and malnutrition is prevalent (KNBS, 2023). Poverty rate is estimated at 75% with most families living in absolute poverty (KIPRA, 2013). Access to improved sanitation is below 30% (KIPRA, 2013). Lymphatic filariasis, malaria, schistosomiasis and helminthiasis are endemic in the area. Collectively, these factors increase susceptibility of Children to ARIs and other infectious diseases.

1.2 Statement of the Problem

ARIs are among the most common causes of morbidity and mortality among children aged below five years. They account for up to 50% of all diseases that children aged below five years encounter (Mucia *et al.,* 2015). It is estimated that every child aged below five years suffers about three to five episodes of ARIs every year (Tondare *et al.,* 2014; Jin *et al.,* 2021). Of all the ARIs, infections of the upper respiratory tract are the most dominant. Over half of all diagnosis among children presenting with ARI symptoms are due to acute upper respiratory tract infections (Ahmed *et al.,* 2010; Id *et al.,* 2020). In 2019, an incidence rate of URTIs of 300,532.1 per 100,000 children aged below five years globally was reported, representing a DALY rate of 1571 per 100,000 children (Jin *et al.,* 2021). GBD 2016 LRI Collaborators, (2018) estimated that globally, children younger than five years experienced 68.06 million episodes of LRTIs, resulting to 652,572 deaths and 56,107, 300 DALYs. In Africa, an incident rate of LRTIs of 122.2 episodes per 1,000 children aged below five in 2017 was observed, resulting to about 432,000 deaths with an average mortality rate of 2.3 deaths per 1,000 children (Reiner *et al.,* 2019). The national prevalence of ARIs among children aged below five years in Kenya is about 47% (Muthoni and Ngesa, 2017), with an estimated mortality rate of 3.44 deaths per 1,000 due to LRTIs (Reiner *et al.,* 2019). During the 2016 outbreak of the severe acute respiratory illness, children were the most affected, with a case fatality rate of 11.4%, highest mortality occurring among children aged below one year (Kiptoo *et al*., 2016).

In addition to being prevalent, ARIs also exerts a significant burden on households, the healthcare systems and the society at large, beside burden due to morbidity and mortality. During school years, ARIs interfere with school attendance and hence academic performance. In a study conducted in Wisconsin and surrounding rural areas, McLean *et al.,* (2017) observed substantial absenteeism due to ARIs, with infections with influenza virus B accounting for most of the absenteeism. Further, ARIs bear a substantial economic burden on families and the health care system in direct; medical and out-of-pocket expenditure and indirect costs. Baral *et al.,* (2020) reported that the average cost of an episode of an ARI was $69.93 for inpatients and $10.17 for outpatients, 20% of the costs being household costs in a study conducted in Malawi. Additionally, a survey conducted in China to examine hospitalization costs among children suffering from pneumonia reported that average cost per child per episode was USD 1193, of which laboratory diagnosis and general medicine were the biggest spenders (Wang et al., 2022). Some families further suffer loss of income during a child's ARI episode through value of workdays lost during an episode, before and after hospitalization. In Bangladesh, Sultana *et al.,* (2021) estimated that household costs per episode of pneumonia at USD 147, mostly consisting of indirect costs.

Treatment and management of ARIs is also challenging. Diagnostic challenges exist since clinical features of bacterial and viral ARIs overlap (Brink *et al.,* 2016), making it difficult to identify patients who would benefit from and ARI. Advances in laboratory diagnostic methods such as rapid diagnostic kits and even more sophisticated approaches such as polymerase chain reaction assays are available (Calderaro *et al.*, 2022) but these are out of reach for primary health care facilities especially in developing countries (Selvaraj *et al.*, 2014; Kjærgaard *et al.,* 2019). This has resulted to overuse of antibiotics contributing to growing antibiotic resistance (Hersh *et al.*, 2013; Godman *et al.*, 2020). Chandra Deb *et al.,* (2022) for instance reported that antibiotics were prescribed unnecessarily for 402.2% of the ARI encounters in a study conducted in Upper Midwest while van Houten *et al.*, (2019) observed administration of antibiotics for viral infections for both children and adults in a large multicenter study. Further, representative information on etiologies, care and management is scanty. Zar and Ferkol (2014) observed that developing countries, which also happen to have the greatest burden of ARIs lack sufficient data on epidemiology, etiology and burden, limiting capacity of public health systems to establish and evaluate control measures.

Various socio-demographic, socio-economic, host and environmental factors influence occurrence of ARIs (Lutpiatina *et al.,* 2022; Meng *et al.*, 2021; Murarkar *et al.,* 2021; Nsele *et al.,* 2019). These factors modify occurrence of ARIs to various extents and may differ from region to region. In the study area, factors associated with ARIs are not well elucidated. Awareness and practices regarding childhood ARIs are also not well known. It is therefore necessary to examine the burden of

ARIs among children, its determinants and associated perceptions and practices in order to inform development of prevention and management strategies.

1.3 Justification

ARIs causes substantial morbidity and mortality among children, and imposes costs on the household and the health system. Although scientific research has made great advances in prevention and management through vaccine development and provision of diagnostic and therapeutic products, the prevalence of ARIs is still high. Key to prevention of ARIs is up-to-date epidemiological information.

This study will therefore identify the prevalence of ARIs among children attending Kinango sub-County hospital, and factors influencing their occurrence, that will provide a better understanding on the burden of ARIs among children and their risk factors. It will also generate information on KAP of mothers regarding ARIs, that will reveal extent of knowledge about ARIs among mothers, measures they take to protect their children against ARIs, and how they care for their children when they get an ARI. This information can be used by the County Government, Ministry of Health and other health stakeholders to develop feasible interventions and inform integrated management approaches. Information on KAP of ARIs will reveal gaps in continuum of care, that can inform health education interventions and facilitate elimination of barriers to prevention and management of ARIs.

1.4 Research Questions

i. What is the prevalence of ARIs among children aged below five years attending the outpatient clinic at Kinango Sub-County Hospital?
ii. Which are the individual level characteristics of mothers of children aged below five years attending the outpatient clinic at Kinango Sub-County Hospital that are associated with occurrence of ARIs demographic?
iii. Which socio-demographic characteristics of mothers of children aged below five years attending the outpatient clinic at Kinango Sub-County Hospital are associated with occurrence of ARIs?

iv. Which socio-economic characteristics of mothers of children aged below five years attending the outpatient clinic at Kinango sub-County Hospital are associated with occurrence of ARIs?

v. What is the KAP regarding ARIs among mothers of children aged below five years in the community around Kinango sub-County Hospital?

1.5 Objectives

1.5.1 Broad Objective

To determine factors associated with occurrence of acute respiratory tract infections among children aged below five years in Kinango Sub-County, Kwale County, Kenya.

1.5.2 Specific Objectives

i. To determine prevalence of ARIs among children aged below five years attending Kinango sub-County Hospital.

ii. To determine individual level characteristics of children aged below five years attending Kinango sub-County Hospital associated with occurrence of ARIs.

iii. To determine socio-demographic characteristics of mothers of children aged below five years attending Kinango sub-County Hospital associated with occurrence of ARIs

iv. To determine socio-economic characteristics of mothers of children aged below five years attending Kinango sub-County Hospital associated with occurrence of ARIs.

v. To establish KAP regarding childhood ARIs among mothers of children aged below five years attending Kinango Sub-County Hospital associated with occurrence of ARIs.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction to ARIs

ARIs are infections of the respiratory tract that affect the upper or lower respiratory organs. Upper respiratory tract infections affect respiratory organs above the larynx through to the nasal cavity while those of the lower respiratory tract occur below the larynx into the lungs, presenting as bronchitis, bronchiolitis and pneumonia.

2.1.1 Common Cold

Common cold is the most prevalent infection of the upper respiratory tract that affects the nose, sinuses, pharynx and larynx. They are the most common of the URTIs, accounting for 25-30% of all ARI cases (Gaude, 2016). It is mostly caused by viruses, with an incubation period of less than two days for rhinovirus (Lessler *et al.,* 2009*).* It presents as a mild to moderate disease especially in otherwise healthy individuals. Bacterial super infection may at times occur during the course of a common cold occur leading to severe infections in other parts of the respiratory tract (Hendaus *et al.,* 2015). Common symptoms are sore throat, sneezing, nasal stuffiness and discharge and cough, although cough also presents in infections of the lower respiration tract. Symptoms typically last 7-10 days although they occasionally persist for up to three weeks (Leder *et al.,* 2003; Hay *et al.,* 2019). Children aged below two years may experience about six episodes per year, but the incidence reduces with age (Jin *et al.,* 2021). Transmission of the common cold is through environmental borne aerosols and contact with an infected person or surface. Occurrence of common colds differs with seasonality, with peaks occurring in the rainy season. Common cold is at times referred to as rhinosinusitis which collectively describes illnesses that manifests through nasal symptoms including sinusitis and nasopharyngitis.

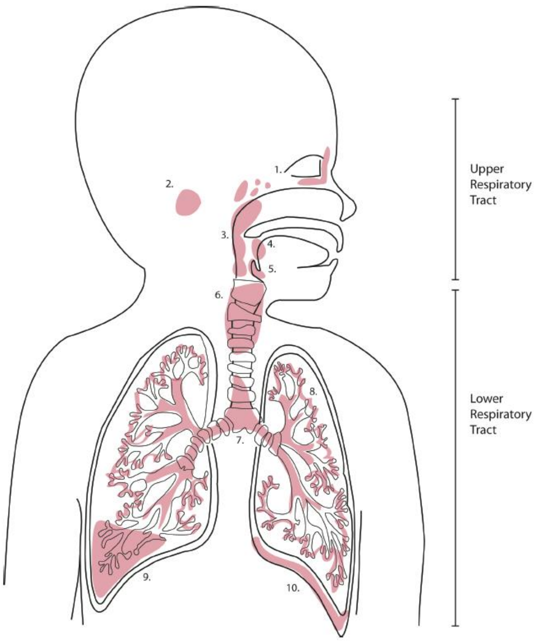

Figure 2.1: Respiratory tract infections; 1. Sinusitis, 2. Otitis media, 3. Pharyngitis, 4. Tonsilitis, 5. Epiglottitis, 6. Laryngotracheitis, 7. Bronchitis, 8. Bronchiolitis, 9. Pneumonia, 10. Parapneumonic effusion/empyema (pleuritis)

2.1.2 Tonsillitis

Tonsilitis refers to inflammation of the tonsils, an infection of the upper respiratory tract common in children. Tonsils are normally located at the back of the oral cavity. They facilitate acquisition of immunity and immune defense through antigen presentation. Tonsillitis manifests as a cough, hoarse voice, sore throat and headache, that last 3-4 days (Paul *et al.*, 2014). The infection can develop independently or as part of a generalized pharyngitis (Georgalas *et al.*, 2009).

Pharyngitis is defined as inflammation of the oropharynx and hypopharynx; the respiratory mucosa of the throat (Renner *et al.*, 2012). It is commonly referred to as ‘sore throat’ by patient description which is also indicated as the primary symptom. A sore throat is therefore a symptom due to inflammatory process in the pharynx or the tonsils (Pelucchi *et al.*, 2012). Pharyngitis may present as part of the common cold.

Although a sore throat is rarely serious, it is considered a potential risk of rheumatic fever, acute glomerunephritis and other suppurative complications (Matthys *et al.*, 2007; Pelucchi, 2012; Calderaro *et al.*, 2022) hence the caution observed in its management.

2.1.3 Otitis Media

Otitis media is a common childhood ARI infection and an important cause of morbidity among pre-scholars. Pain in the ear is the main symptom of otitis media that may or may not be accompanied by fever, with or without discharge based on the causative agent. It presents as a mild to severe disease, that at times may not require treatment (Saux *et al.*, 2016). Development of otitis media is mostly preceded by an infection of the upper respiratory tract *(Chonmaitree et al.*, 2016). The direct connection of the nasopharynx with the middle ear through the eustachian tube predispose it to infection by pathogens of the respiratory tract (Bowatte *et al.*, 2018).

2.1.4 Pneumonia

Pneumonia occurs following invasion of the lower respiratory tract by pathogenic microorganisms. It presents with rapid or fast breathing, fever and cough. Pneumonia is a major cause of death among children. 81% of pneumonia deaths occur among children aged below two years with incidence reducing with increasing age (Walker *et al.*, 2013; Koofy *et al.*, 2022). The elderly and immunocompromised individuals also bear a significant burden. Introduction of the pneumococcal conjugate vaccines has however been associated with tremendous reduction in incidence of pneumonia.

Causative pathogens can be acquired from community or hospital settings. Inhalation of airborne pathogen-laden respiratory droplets exhaled by an infected person into the respiratory tract of a susceptible person is the main mode of transmission of pneumonia, especially community acquired pneumonia (Calderaro *et al.*, 2022). Transmission can also be achieved by aspiration, following passage micro-organism laden aspirates from the trachea to the lower airways. Transmission by aspiration is mostly common in hospital settings due to heavy colonization of hospitalized patient's oropharynx with microorganisms, which together with other predisposing factors such as immunosuppression or depressed cough reflex facilitate aspiration and establishment of infection (Cillóniz *et al.,* 2018).

Dynamics of development of pneumonia vary with pathogenicity of infectious agents and host defense mechanisms. For pneumonia to develop, the of infectious pathogen in the alveoli must be sufficiently virulent or in large inoculum quantity to overwhelm the host's defense mechanism especially in healthy hosts (Alco *et al., 2005;* Quinton *et al.,* 2018). However, in immunocompromised persons, even pathogens that are not particularly virulent can cause disease.

2.1.5 Bronchitis and Bronchiolitis

Bronchitis and bronchiolitis are infections of the lower respiratory tract due to inflammation of the bronchial structures. Bronchitis results from inflammation of the bronchi. It presents with a persistent cough, fever and wheezing. Laryngo-trachea bronchitis is also common, due to inflammation of the larynx and trachea. It is preceded by a common cold, yielding fever, cough and symptoms of obstruction of the upper airway. Bronchiolitis is characterized by obstruction in the bronchiole due to accumulation of mucus with subsequent plugging of the bronchioles that results to wheezing. Fever, dry wheezy cough and nasal discharge with increased respiratory effort are its main signs and symptoms (Antonucci and Oggiano, 2015; Polack, Stein, and Custovic, 2019). Bronchiolitis is a major cause of hospitalization for infants and an important predictor of development of asthma (Beigelman & Bacharier, 2013; Calderaro *et al.*, 2022).

2.1.6 Etiologies of ARIs

Viral etiologies are more frequently encountered in ARIs as compared to bacterial causes (Kwiyolecha *et al.,* 2020; Z.-J. Li *et al.,* 2021). Respiratory Syncytial Virus (RSV) is responsible for extremely high burden of disease especially in children, implicated in 15-40% of childhood bronchiolitis and pneumonia cases in developing countries (Manikam & Lakhanpaul, 2012; Gill *et al.,* 2022). It is associated with severe disease and increased need for hospitalization especially in infants, with mild to moderate disease in older children.

Rhinoviruses are common causes of upper respiratory tract infections and are also the second leading causes of bronchiolitis after RSV (Kwiyolecha *et al.,* 2020; Ljubin-Sternak *et al.,* 2019). Rhinovirus was detected in 42% of URTI cases in a prospective birth cohort in India followed by RSV and parainfluenza viruses (Kumar *et al.,* 2017). Human parainfluenza virus have been identified as important causes of both lower and upper respiratory tract infections too, but their importance is undermined by diagnostic challenges and excess attention to pathogens that cause outbreaks (Weinberg, 2006). Types 1, 2 and 3 are prevalent. Types 1 and 2 cause croup while type 3 causes bronchiolitis and pneumonia among children aged below one year (WHO, 2009).

Influenza viruses are common causes of ARIS too. Influenza viruses A and B presents in seasonal outbreaks with potential for pandemics (Harrington *et al.,* 2021). They cause infections in both the upper and lower respiratory tract, accounting for substantial burden of infections in the lower respiratory tract with poor outcomes in all age groups. In 2017, they accounted for about 145,000 deaths among all ages, adults aged above 70 years being the most affected (Troeger *et al.,* 2019). Human metapneumovirus emerged recently, and is associated with ARIs primarily in children though it also infects adults and immunocompromised individuals. It causes both mild upper respiratory tract infections as well as severe bronchiolitis and pneumonia (Panda *et al.,* 2014). Adenoviruses and coronaviruses also play a significant role in development of ARIs. Adenoviruses account for 2-5% of all respiratory illnesses and 4-10% of pneumonia, resulting to mild diseases although acute LRTIs due to adenoviruses can be severe or even fatal (Liu *et al.,* 2015).

Viral etiologies can potentially expose children to bacterial infection of the sinuses and middle ear, as well as lower respiratory tract infections. Viral-viral co-infection occurs, and are associated with increase in morbidity and mortality, and makes accurate diagnosis even more difficult (Perezbusta-Lara1 *et al.,* 2020).

Of the bacterial etiologies, *Streptococcus pneumonia* is a frequent cause of ARIs (Li *et al.,* 2021). It inhabits the nasopharynx as a normal commensal especially in children and is an important cause of community –acquired pneumonia and otitis media. *Hemophilus influenza* type B (HIB) is also a common bacterial etiology of ARIs. Adegbola *et al.,* (2014) reported up to 70% nasopharyngeal carriage of HIB in healthy children. It is postulated that at least 1 in 200 children aged below five years develop invasive HIB disease with two-thirds of HIB infection occurring among children aged below 18 months (Boloursaz *et al.,* 2013). *Staphylococcus aureus* is also commonly isolated (Marengo *et al.*, 2017). *Klebsiella pneumonia, Enterobacter agglomerans* and *Pseudomonas aeruginosa* have also been implicated to varying extents in occurrence of ARIs (Cilloni*et al.,* 2016; Bhuyan *et al.,* 2017). *Mycoplasma pneumonia* is an atypical causative pathogen of agglomerants ARIs alongside *Chlamydia pneumonia*e and *Legionella pneumonia* (Blasi, 2004; Gao *et al.,* 2020). They are mostly implicated in lower respiratory tract infections, resulting to mild to moderate disease. It has however been indicated that introduction of the pneumococcal conjugate vaccine may have reduced colonization of nasopharyngyl by vaccine strains as well as modified the composition of nasopharyngyl microbiota (Boloursaz *et al.,* 2013; Mackenzie *et al., 2017),* altering disease development and severity.

Bacterial and viral co-infections have also been observed (Brealey *et al.,* 2015; Meskill and O'Bryant, 2020). Viral respiratory infections potentially increase bacterial load resulting to secondary complications (Cilloniz *et al.,* 2016). For instance, infection of the upper respiratory tract with RSV or influenza viruses increase binding of *S. pneumoniae* and *H. influenzae* (Jiang *et al.,* 1999; Hament *et al.,* 2004; McCullers and Bartmess 2003). It has however been postulated that other mechanisms beside preceding viral infection may be involved in development of viral-bacterial co-infections in ARIs (Morpeth *et al.,* 2018).

Fungal etiologies including *Aspergillus fumigatus*, *Fusarium* spp., and *Pneumocystis jirovecii* (Chowdhary *et al.,* 2016) among others are also important causes of ARIs. They cause asymptomatic to life-threatening disease based on intensity of exposure and immune status of the host (Benedict *et al.,* 2020) although their burden especially among children is not well established

2.2 Prevalence and Burden of ARIs

The burden of ARIs globally is substantial, resulting to high morbidity and mortality especially among children, the elderly and immunocompromised individuals. Infections of the lower respiratory tract alone have remained a leading cause of death among children aged below five years over decades. In 2017, Troeger *et al.,* (2020) estimated that they caused 808, 920 deaths among children aged below five, accounting for 15% of all deaths within this age group globally, at least half of these deaths occurring in Africa (Reiner *et al.,* 2019; Jin *et al.,* 2021). Of all the infections of the lower respiratory tract, pneumonia is the most prevalent (Troeger *et al.,* 2017; Mcallister *et al.,* 2019; Anderson & Feldman, 2023). Infections of the upper respiratory tract on the other hand are leading causes of morbidity among children aged below five years (Jin *et al.,* 2021). Actual burden of these infections is however difficult to quantify due to shortfalls in surveillance and reporting of incidences. In 2013, morbidity due to upper respiratory tract infections was estimated at 18.8 cases globally across all ages (WHO, 2015), while a multi-site study covering low-, middle-, and high-income countries reported that infections of the upper respiratory tract among children aged below five years accounted for upto 67% of all ARIs diagnosed (Kjærgaard *et al.,* 2019). Moreover, upper respiratory tract infections are a leading reason for visits to primary care globally (Finley *et al.,* 2018), especially among children (Cotton *et al.,* 2008; Kwiyolecha *et al.,* 2020)

Most cases of acute respiratory tract infections occur in low- and middle-income countries. About 70% of all ARIs occur in South Asia and sub-Saharan Africa (UNICEF, 2016). Seidu *et al.,* (2019) reported an overall prevalence of 25.3% for acute respiratory infections of the lower respiratory tract in 28 countries in sub-Saharan Africa. Distribution of disease severity also varies between high- and low-income countries due to differences in etiologies and risk factors. Children in developing countries experience more severe infections especially of the lower respiratory tract with higher case-fatality rate (Gaude, 2016).

Children, the elderly and immunocompromised individuals bear the greatest burden of ARIs. Among children, ARIs peak at two years (Sultana *et al.,* 2021; Koofy *et al.,* 2022). Children aged below 6 months are usually relatively protected from ARIs due to maternal antibodies although their susceptibility to bronchiolitis due to respiratory syncytial virus has been shown to be higher (Antonucci and Oggiano, 2015). The risk increases after 6 months onto 24 months as the child gets more exposed to various causative agents during the weaning period and with degradation of maternal antibodies (Seidu *et al.,* 2019). GBD 2016 LRI Collaborators (2018) for instance reported that most deaths due to lower respiratory tract infections occurred in the first year of life, with bronchiolitis being the leading cause of admission among infants younger than 12 months (Beigelman and Bacharier, 2013).

ARIs further impose a significant economic burden on the healthcare systems and households. Sinha *et al.,* (2012) estimated that acute infections of the lower respiratory tract cost the health care system about 28,975,000 US$ and an additional 539,000US$ borne by households annually in South Africa. In addition to direct costs of treatment, households also bear indirect costs. Children lose school days while care givers lose work hours or absenteeism from work for every episode of an ARI, in addition to impact on their emotional well-being in case of recurring ARIs (Fienemika *et al.*, 2018).

Although global and regional burden of ARIs is documented, burden in most countries especially in developing regions is not comprehensively elucidated. Moreover, studies evaluating global and regional prevalence or incidence rely on country reports or health and demographics surveillance data which may not necessarily be current (Seidu *et al.*, 2019). In Kenya for instance, the current estimate of national prevalence is about 47% (Muthoni & Ngesa, 2017), that was modelled based on KDHS 2014 data. There is therefore need to establish burden of ARIs, nationally and in different settings.

2.3 Factors Influencing Occurrence of ARIs

Huge morbidity and mortality of children due to ARIs indicates likelihood of multiple determinants. Ujunwa and Ezeonu (2014) identified age, sex, poor breastfeeding practice, overcrowding, malnutrition, poor socio-economic status, day care attendance and passive smoking as significant determining factors in a survey involving children aged below five years in a metropolis setting. Similarly, Taksande, Yeole, and Sawangi, (2016) reported a significant association between nutritional status, breastfeeding status, immunization status, socio-economic status, overcrowding and maternal literacy and ARIs among children aged below five years in a study conducted in rural central India. In Uganda, Bbaale, (2011) did not find any significant association between mother's education level and occurrence of ARIs but reported that wealth status, type of dwelling, mother's occupation , child's age and child's nutritional status were significant determining factors. Jabessa, (2015) further reported a regional variation in development of ARI symptoms among children in Ethiopia, suggesting spatial differences in occurrence of ARIs. Special clustering was further supported by Muthoni and Ngesa (2017) in a study conducted in Kenya using demographic survey data. Involvement of gender in development of ARIs has also been reported (Vlassoff, 2007; Casimir *et al.*, 2013; Ibama *et al.*, 2017) with indication of higher susceptibility among male children. Oremadegun and Myre (2017) however did not consistently observe any significant association between gender and development of ARIs in a study spanning over twenty-four years. Additionally an association between socio-economic status and development of ARIs in children has been reported in studies conducted in Ethiopia (Tekle, Worku, and Birhane, 2015; Hassen *et al.*, 2020) and India (Sharma, Kuppusamy, and Bhoorasamy, 2013; Ramani, Pattankar, and Puttahonnappa, 2016; Marufa *et al.*, 2019) among other resource limited countries (Sharma *et al.*, 2013; Yaya and Bishwajit, 2019). In concurrence, larger studies (Seidu *et al.*, 2019) continue to report higher burden of childhood ARIs in low- and middle- income countries, highlighting socio-economics as an important determinant for occurrence of ARIs in children.

Factors influencing occurrence of ARIs among children largely vary with region, season, demographics and socioeconomic characteristics. Consequently, morbidity and mortality due to ARIs are higher in developing countries relative to developed countries, probably due to socioeconomic differences (Jin *et al.*, 2021). Determinants for development of ARIs in Kwale County is not well established, despite its characteristic social and economic environments that have been shown to be risk factors for occurrence of ARIs in other settings.

2.3.1 Nutrition and Acute Respiratory Infections

Malnutrition refers to lack of essential nutrients or failure of the body to utilize available foods. It results from an imbalance between the supply of protein and energy against the body's demand for each of them for growth, presenting in form of stunting, wasting and underweight. Poor feeding practices, inadequate intake of food and repeated infections coupled with social inequalities are the most important determinants of malnutrition among children(Perez-Escamilla *et al.,* 2018*).* wasting is defined as low weight in relation to height while stunting refers to low height for age. Underweight is described by weight for age. Wasting is usually an indication of recent weight loss while stunting occurs due to chronic underweight, that results from sustained poor health or nutritional deficiencies (Rodríguez *et al.,* 2011).

Malnutrition is a core underlying factor for susceptibility to acute respiratory tract infections and generally infectious diseases. By the close of Millennium Development Goals (MDGs) the proportion of underweight children had declined globally to 15% (Akombi *et al.,* 2017). However, undernutrition is still chronic in sub-Saharan Africa, with about 39% stunted, 10% wasted and 25% underweight children aged below five years (WHO 2016).

The relationship between ARI and malnutrition is mostly bidirectional (Schlaudecker *et al.,* 2011; Govers *et al.,* 2022). ARIs are a risk factor for malnutrition due to decreased appetite and anorexia during ARI episodes. Similarly, ARIs are an outcome of malnutrition because malnutrition impairs a child's immune system at developmental stage thus predisposing the child to infection, or at the point of response where a malnourished child fails to respond to an infection effectively due to low energy stores (Cervantes and San, 2011). The later further worsens malnutrition due to high energy output coupled with low food intake. Malnourished children are particularly susceptible to respiratory infections since epithelial barriers and mucosal immune response that constitutes the first line of defence are greatly compromised by malnutrition through processes such as loss of mucus producing cells (Cervantes and San, 2011; Bhoite *et al.,* 2022)**.** Consequently, pathogens that would be ordinarily cleared away by mucoid barrier are increasingly able to penetrate the epithelium and cause an infection.

Previous studies in Kwale County have consistently reported poor nutritional status among children aged below five years (Kaneko *et al.,* 2012; Shinsugi *et al.,* 2015; Ndemwa *et al.,* 2017). Although the relationship between malnutrition and ARIs is well established, the role of nutritional disorders in development of ARIs Kwale County is not clearly elucidated.

2.4 Practices Surrounding Treatment and Management of ARIs

Diverse care practices exist in both community and health care settings. Caregivers seek care for their children at different points upon onset of symptoms of an ARI. Key determinants for health care seeking include age of the child, socioeconomic status of the caregiver, symptoms and distance to the health facility (Ocan *et al.,* 2017). In a survey along the Kenyan coast, caregivers reported that they first monitor the child's symptoms, and give antipyretics before determining need to take the child to the hospital (Abubakar *et al.,* 2013). Prior to seeking care, administration of over-the-counter medicine including antibiotics, antipyretics or antihistamines is rampant (Arroll, 2005; Ocan *et al.,* 2017). Administration of home remedies such as honey and herbs (Ben-arye et al., 2011; Ocan *et al.,* 2017; Al-noban & Elnimeiri, 2022) among others is a common practice.

Care practices for a child with an ARI mainly revolve around protecting a child from aggravating factors such as cold, dust and smoke. Most caregivers indicate keeping a child warm by dressing them warmly and giving them warm foods, and generally minimizing exposure to cold as a key care practice (Benoit et al., 2019). Care practices of greater priority such as increased hydration and enhanced breastfeeding, complementary feeding or meal frequency for non-breastfeeding children are practiced sub-optimally during ARI episodes (Paintal and Aguayo, 2016). Adherence to prescription is also poor. In a survey conducted in Uganda on medicine use practices in management of ARIs, 23.1% of the participants reported not competing a dose of prescribed medicine (Ocan *et al.,* 2017).

Of the management practices, irrational use of both prescription and over the counter antibiotics is of major concern. It is estimated that about 74.4% of all antibiotic prescriptions in health facilities are given to children for respiratory tract infections (O'Brien, *et al.,* 2015). Several reasons have been put forward for continued over-use of antibiotics for childhood ARIs. Tonkin-Crine, Yardley, and Little, (2011) observed that administration of antibiotics at times depend on how the general practitioners feel about antibiotic resistance or innate believe that their prescribing practices matches recommendations, as well as previous experience in managing ARIs especially in case of a negative experience with prescribing or withholding antibiotics. In yet another systematic review, Coxeter, Mar, & Hoffmann, (2017) concluded that most although not all parents believe that antibiotics are necessary for their child's ARI episode, with quite a number of misconceptions on perceived benefits and need that amount to parental pressure on the health care worker to prescribe an antibiotic.

Prevalence of self-medication with antibiotics remains high especially in developing countries where weak drug supply chains allow antibiotics to be dispensed without a doctor's prescription. Ekwochi *et al.,* (2014) reported that 71.1% of the caregivers administered antibiotics without a prescription to their children in a study assessing the use of non-prescribed antibiotics for management of URTIs. In Uganda, Ocan *et al.,* (2017) reported that 44.8% of children in their survey having flu, cough and undefined fever were given non-prescription antibiotics. The most commonly administered drugs are amoxicillin and co-trimoxazole. Such irrational use of antibiotics in both primary and self-care are increasingly driving development of antibiotic resistance while at the same time increasing demand for antibiotics as patients who incorrectly receive or use an antibiotic for an ARI believe that their infection was cleared by an antibiotic, increasing likelihood to request or use an antibiotic for future infections.

Self-medication with antipyretics and analgesics is also substantial especially in settings where antibiotics are not readily available. Fever is a major symptom of ARIs of both viral and bacterial etiology and a reason for administration of antipyretics especially among children (Seifert *et al.,* 2019). Although such drugs have proven capacity for management of fever, studies indicate that they can prolong the duration of illness, affect clinical outcome during infection (Schulman *et al.*, 2005) or even mask important clinical signs and symptoms during an illness which can affect treatment outcomes.

Instances where caregivers use a previous prescription to treat a current episode have also been observed (Abu-Baker *et al.*, 2013). In a survey on ARI medicine use among children aged below 12 years in Uganda, Ocan *et al.,* (2017) reported that up to 70.6% of caregivers kept medicine that was not used up for use in future episodes. This is partly driven by failure to complete a dosage, which is yet another common care practice. Caregivers tend to discontinue treatment once initial symptoms subside.

Given the range of approaches used by caregivers to manage ARIs, proper information on caregiver knowledge, attitude and practices regarding ARIs is necessary, in order to establish possible gaps in the continuum of care.

2.4.1 Treatment, Care and Management of ARIs in Children

Management of ARIs is mainly based on the IMCI guidelines. IMCI uses an integrated approach to case management since most childhood diseases present with similar signs and symptoms, with more than one condition, making it difficult to establish the precise cause of illness (Tulloch 1999). It has both health facility and community management components. IMCI classifies ARIs into no pneumonia, pneumonia and severe pneumonia or very severe disease as shown on the table below.

A child with no pneumonia: cough or cold is managed symptomatically. The caregiver is then advised on home care, with instructions to present the child for follow-up in case a cough persists or if they develop danger signs including inability to drink or breastfeed, vomiting everything, convulsing and lethargy or being unconscious. Children diagnosed with pneumonia and severe pneumonia are managed using antibiotics. IMCI guidelines are used interchangeably with the clinical guidelines and referral guidelines –Volume II (Ministry of medical services and ministry of public health and sanitation, 2009) to manage ARIs in Kenya. The common cold and broadly rhinitis is managed using analgesics to relieve febrile symptoms. Cough and cold remedies such as antihistamines, cough suppressants and expectorants are not recommended due to lack of evidence on their usefulness. Patient education is conducted for provision of appropriate home care and also to enable caregivers to recognize danger signs following which they should take the child back to the hospital. Pharyngitis and tonsillitis are managed based on presentation; incase a viral infection is suspected; symptomatic treatment is recommended. If a streptococcal infection is observed, Amoxil in is administered with indications for admission in case of a severe infection. Sinusitis is treated based on the nature of nasal discharge, using an antibiotics or antihistamines. Pneumonia is treated based on severity classification while chronic cough is managed based on underlying condition such as tuberculosis, asthma, bronchiectasis or heart disease (Ministry of medical services and ministry of public health and sanitation, 2009).

Adherence to IMCI guidelines is however relatively low in Kenya (Krüger *et al.*, 2017) despite their comprehensiveness in clinical assessment of childhood illnesses. Inadequate training, supervision and mentoring on application of IMCI, long time required to effectively and meaningfully apply IMCI in a consultation and poor planning and coordination between implementers resulting to poor clarity on roles and accountability in utilization of IMCI guidelines have been cited as reasons for poor adherence to the guidelines (Reñosa *et al.*, 2020).

2.5 Conceptual Framework

Independent variables influenced occurrence of ARIs among children aged below five years, which was the dependent variable. Characteristics of the child as the host, such as age, gender, birthweight, place of birth, breastfeeding status, period of breastfeeding, immunization status and their nutritional status can result to an ARI. Their mother's socio-demographic characteristics too, including the age of their mother, number of their siblings and education and employment status of their parents can also expose them to ARIs. Additionally, socioeconomic status of their mothers, such as nature of their built environment and exposure to biomass fuels can result to ARIs. Exposure of the child to a potentially infected person or recurring episodes of ARIs will also increase the likelihood of a child getting an ARI. Knowledge about ARIs, attitude towards them and prevention, care and management practices regarding ARIs may also influence occurrence of ARIs. Independent variables in this study influenced the dependent variable either positively or negatively, resulting to increased likelihood of a child getting an ARI or protection of the child from ARIs.

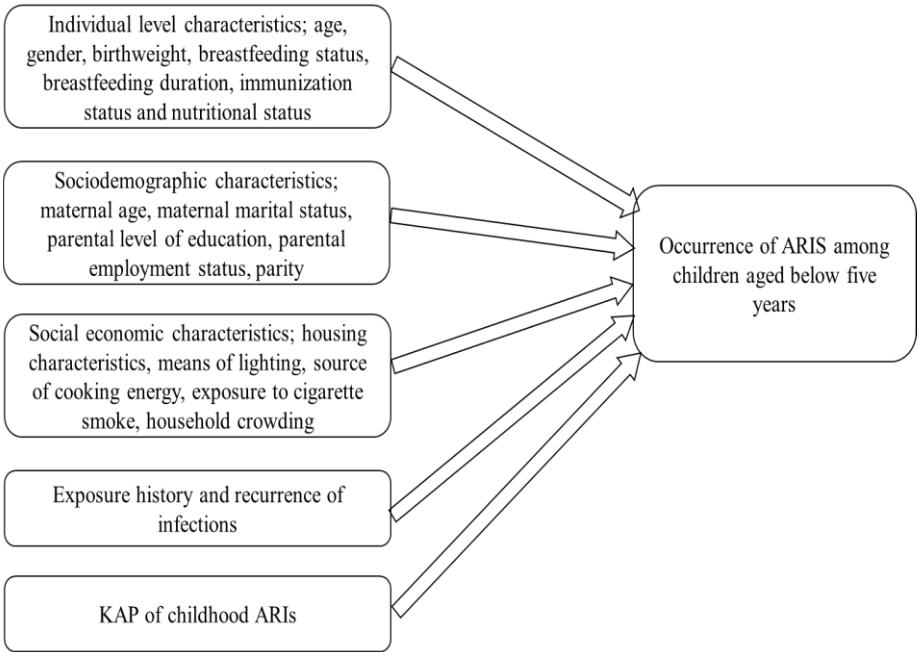

Figure 2.2: Conceptual Framework

CHAPTER THREE

MATERIALS AND METHODS

3.1 Study Site

The study was carried out at Kinango Sub-County hospital. The hospital is located within Kinango Ward of Kinango Sub-County, Kwale County. Kwale County is located in the South Coast of the Kenyan Coast. It covers an approximate area of 8,332.2 km^2 with a total population of about 649,931 (KNBS, 2009).

Kinango Sub-County hospital has a 94-bed capacity. It offers out-patient care, inpatient care, comprehensive care, maternity services, family planning, minor surgery, and pediatric care services with community integrated child health services. The facility has a maternity wing, male and female medical wards and a pediatric ward. It serves the local surrounding communities and referrals from health facilities within Kinango Sub-County. Its average patient load per day is about 100 patients. The study was conducted within the outpatient department of the hospital.

3.2 Study Design

This study adopted a sequential mixed methods approach.

3.3 Study Population

The study participants were mothers of children aged below 5 years presenting their children for care at Kinango Sub-County hospital.

3.3.1 Inclusion Criteria

i. Mothers with children aged below five years.
ii. Children aged below five years.
iii. Mothers who consented to participate in the study.

3.3.2 Exclusion Criteria

i. Mothers who declined to give written informed consent to participate in the study.
ii. Mothers with very sick children.

3.4 Sample Size Determination

The sample size was calculated using the formula by Cochran (1977). The study assumed a prevalence of 50% since neither national nor regional prevalence of ARIs are well established.

$n= z^{p(1-p) / e2}$

Where:

n= Estimated minimum sample size

Z=the standard normal deviation at 95% confidence interval (1.96)

d=margin of error

P= 50%

$n=1.96^2 * 0.5(0.5)/0.05^2$

n=384.16 ~~385

3.5 Sampling

Systematic sampling was used to select study participants. The interval size was obtained by dividing the average number of patients seen during the tentative data collection period by the sample size. Approximately 800 children were seen every month for various conditions. Data was collected over a period of three months hence

800*3/385=6.2 ~6

Every 6th mother-child pair was sampled

The first mother-child pair was chosen arbitrarily

3.6 Recruitment Procedure

Participants were recruited from the outpatient clinic with the help of the clinical officers. Participants were recruited after reporting to the health records department. The study was explained to every 6th mother-child pair. Those who were willing to participate were then consented. Data was collected after the caregiver had provided written consent.

3.7 Data Collection

Qualitative and quantitative data was collected using structured pre-tested tools.

3.7.1 Caregiver Structured Questionnaire

A questionnaire was administered to obtain data on socio-demographic, socio-economic, environmental and host characteristics that influence ARIs, and establish KAP regarding childhood ARIs. The questionnaire was developed based on the conceptual framework of the study, incorporating parameters that have been associated with occurrence of ARIs, from literature review (Benoit *et al.,* 2019; A. Ibama *et al.,* 2020; Savitha & Gopalakrishnan, 2018; Schuez-Havupalo *et al.,* 2017; Shaikh *et al.,* 2019; Tazinya *et al.,* 2018; Tekle *et al.,* 2015; Tromp *et al.,* 2017; Woldeamanuel & Gebreyesus, 2019; Yaya & Bishwajit, 2019), and in consultation with subject experts. Developed questionnaire was pretested in an area outside the study area to assess clarity of the questions, ability of the questions to answer study questions and whether resulting data could be analyzed as planned.

3.7.2 Focus group Discussion

Focus Group Discussions (FGD)s was conducted to obtain qualitative data on knowledge, attitude and practices associated with ARIs and provide more insight on ARIs in the community. An FGD guide was developed to address issues such as knowledge on types of ARIs, their signs and symptoms, causes of ARIs, transmission and prevention of ARIs, attitude towards nature, effects, risks and symptoms of ARIs, practices for protecting a child from ARIs, managing an ARI and caring for a child with an ARI. The FGD was pretested too, to ascertain clarity and comprehensiveness of the questions, and capability of the responses to validate and complement KAP quantitative data.

Each FGD consisted of 8-12 participant. Participants of FGDs were mothers with children aged below five years that were randomly selected from two community health units that represent the catchment area of Kinango Sub-County hospital. The FGDs were organized by village, including every village in the two community health units. The villages and hence the FGDs were grouped by proximity. Five FGDs were conducted since saturation of responses had been achieved by the fourth FGD. Conversations during the FGDs were recorded on a voice recorder. Pretesting of the FGD guide was done in a separate community unit to assess its validity and reliability.

3.8 Data Management

Data was entered into an MS Access database. Conversations from the FGDs were transcribed verbatim onto a word document before analysis. Data was analyzed using STATA version 14 (STATA Corporation, College Station, Texas, USA).

3.8.1 Analysis of Quantitative Data from Structured Questionnaires

Socio-demographic and socioeconomic characteristics of the study participants were summarized using descriptive statistics and measures of central tendencies. Chi square or Fisher's exact test were used to test for association where applicable. Logistic regression analysis was done to identify independent factors associated with ARIs. Odds Ratio (OR), at 95% Confidence Interval (CI) and 0.05 significant level was used to describe an association between dependent and independent variables. A multivariable regression model was also constructed by stepwise estimation, using backward selection. Variables with a P-value greater than or equal to 0.2 were removed sequentially. The model was adjusted for age of the children, gender, birthweight, immunization status, breastfeeding status, underweight, stunting, parental characteristics, exposure to school-going children, contact with an infected person in the past two weeks, previous hospitalization, household density and socio-economic status. Adjusted Odds Ratio (aOR) at 95% CI and 0.05 level of significance was used to describe an association between the independent variables and the dependent variable.

3.8.2 Analysis of Knowledge, and Attitudes and Practices

Knowledge and attitudes variables were scored using a five-point Likert scale. 1 was the lowest score for positive statements while 5 was the highest score. 5 was the highest score for negative statements while 1 was the lowest score. The maximum attainable score was 5 in both cases. Mean scores of knowledge and attitude variables were calculated. Mean scores were calculated as a total of scores of each parameter for all participants divided by the total number of participants. The mean score was then used to classify knowledge level or attitude of the respondents into knowledgeable and not knowledgeable, or positive or negative attitude. Respondents who scored above the mean score were categorized knowledgeable or as having a positive attitude while those who scored below the mean regarded not knowledgeable or as having a negative attitude. Practices were analyzed using descriptive statistics and presented in tables and graphs.

3.8.3 Analysis of Qualitative Data

Words, phrases and tones from the FGDs were recorded for reference. These were then accurately captured in Kiswahili and translated into English. Independent back translation of the statements in English to Kiswahili was done to ensure correctness of the translation. Information was analyzed by thematic analysis.

Familiarization with the data was first done by reading and re-reading the transcripts, for awareness with the data and to generate impressions. Initial codes were then generated. Parts of the data that were relevant to the study questions were noted and data was organized systematically. Themes were searched for in the coded data and the codes were grouped to fit and describe a theme. Developed themes were then reviewed to assess to ensure that data was relevant to the themes, and that the themes were sensible. Defining of themes followed, to refine them, understand their content and understand how they relate to the main theme. Finally, a write up was done to present the data and describe findings.

3.9 Ethical Consideration

Permission to conduct the study was sought from University of Nairobi-Kenyatta National Hospital Ethics Review Committee (UoN-KNH ERC). Additional permission to conduct the study was obtained from the Kwale County Health Department and the hospital administration. Written consent was then obtained from all study participants. The consent form was translated into Kiswahili. The researcher assisted participants to read and understand before signing it.

Names of participants were not recorded on the data collection sheets. Rather questionnaires were given unique identification numbers. Participation in the study was on voluntary basis, without coercion on mothers who decided not to participate. The study did not bear any risks to participants apart from time spent on responding to the questionnaire or participating in the FGD. The risk of breach of privacy was minimized by avoiding socially unacceptable questions.

CHAPTER FOUR

RESULTS

4.1 Introduction

This study was conducted between November 2017 and February 2018 at the out-patient department of Kinango Sub-County hospital. Data was collected using qualitative and quantitative techniques. Results of the study described the prevalence of ARIs among children under five years, sociodemographic characteristics of children presenting for outpatient care, their socioeconomic characteristics and knowledge, attitude and practices of mothers regarding ARIs in children aged below five years.

4.2 Demographic Characteristics of Study Participants

A total of 385 mother-children aged below five years pairs attending care at Kinango sub-County hospital were recruited into this study.

4.2.1 Individual level Characteristics of Study Participants

Of the 385 children, 50.1% were female. Mean age of the children was 22.14 ± 14.7 months. Majority of the participants (38.4%) were aged above two years. Only 15.1% of the children were aged below 6 months (Figure 4.1).

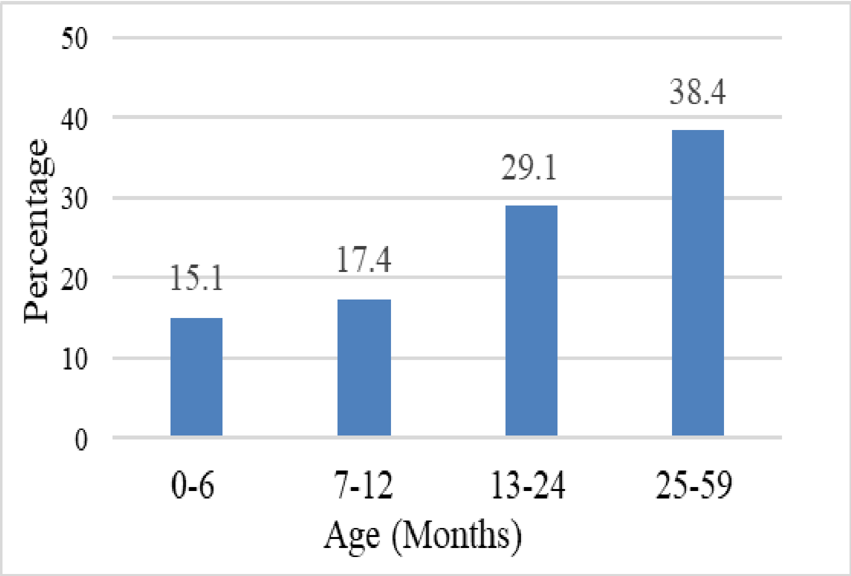

Figure 4.1: Distribution of Study Participants by Age

Most of the children (91.1%) had normal weight at birth. Majority of the children (81.7%) were exclusively breastfed. Average breastfeeding duration was 20.1±5.1 months. Over half of the children (72%) children were fully immunized as per the expanded program immunization (EPI) schedule. Stunting was the most common form of malnutrition with, 26.3% children stunted (Figure 4.2).

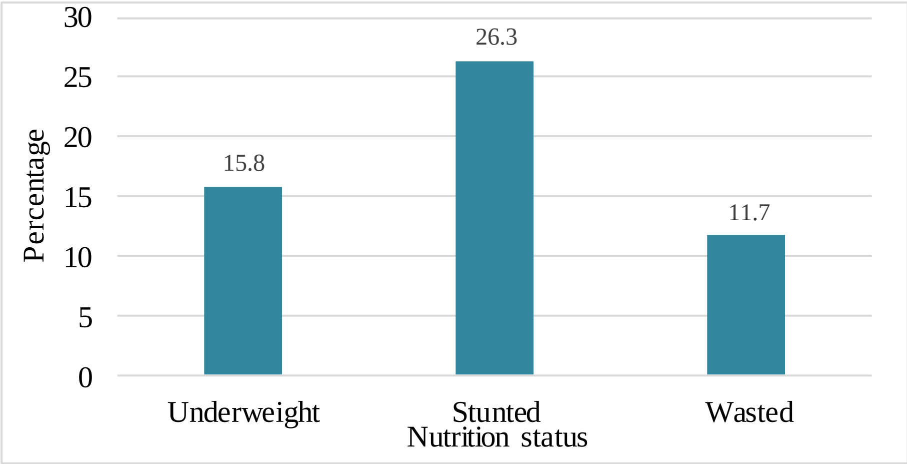

Figure 4.2: Distribution of Study Participants by Nutrition Status

4.2.2 Parental Socio-demographic Characteristics of Study's Children

Maternal age ranged from 17 years to 47 years. Average maternal age was 26±6.1 years. In regards to level of education, most mothers (47.3%) were primary level educated. Most fathers too (46.6%) had primary level of education. Only12.2% of the mothers had attended secondary education and above. Most mothers (65.5%) were unemployed, and 86.4% of their spouses were in various forms of employment (Table 4.1).

Table 4.1: Social and Demographic Characteristics of Mothers of the Children

Category	Frequency	%
Age of mother		
17-20	53	13.7
21-30	249	64.7
31-47	83	21.6
Marital status of mother		
Married	359	93.3
Single	26	6.7
Education level of mother		
No formal education	156	40.5
Primary education	182	47.3
Secondary education and above	47	12.2
Education level of mother's spouse		
No formal education	90	23.4
Primary education	177	46.0
Secondary education and above	92	23.9
Occupation of mother		
Government employee	10	2.6
Private sector employee	14	3.6
Self employed	57	14.8
Housewife	52	13.5
Unemployed	252	65.5
Occupation of mother's spouse		
Government employee	46	12.8
Private sector employee	52	14.5
Self employed	209	58.2
Forest warden volunteer	3	0.7
Unemployed	49	13.7
Parity of mother		
1	91	23.6
2	91	23.6
3	58	15.1
4	48	12.5
≥5	97	25.2

4.2.3 Residential Characteristics of Study Participants

Majority of the participants (66.0%) lived in iron sheets roofed houses, and most of those houses (77.4%) had earthen floors. At least half of the houses (50.1%) had two rooms while 43.9%) of them had three or more rooms. Average household density was 3.37±0.8. Most of the children (46.0) lived in households that had a kitchen detached from the main house, with only 9.3% of the households cooking from an open area. Firewood was the main source of cooking fuel (80.0%), while kerosene lamps were used for lighting in majority (57.7%) of the households (Table 4.2).

Table 4.2: Residential Characteristics of Study Participants

Category	Frequency	%
Roofing material		
Iron sheets	254	66.0
Grass	9	2.3
Palm leaves	122	31.7
Wall material		
Bricks/blocks	97	25.2
Mud	288	74.8
Floor material		
Cement/tiles	87	22.6
Earth	298	77.4
Number of rooms		
1	23	6.0
2	193	50.1
≥3	169	43.9
Household density		
2	3	0.8
3	68	17.7
4	100	26.0
>5	214	55.6
Type of kitchen		
Cooking from an open area	36	9.3
Kitchen detached from the main house	177	46.0
Kitchen inside the main house	172	44.7
Source of cooking energy		
Firewood	308	80.0
Charcoal	50	13.0
Charcoal, firewood	19	4.9
Charcoal, gas/paraffin	5	1.3
Gas cookers	1	0.3
Paraffin Stoves	2	0.5
Source of lighting energy		
Kerosene lamp	222	57.7
Solar	123	32.0
Electricity	40	10.4

4.3 Prevalence of ARIs

The prevalence of ARIs was 59.2 % (95% CI: 54.5-64.3; 228). According to IMCI guidelines, 90.8% of the children who had ARIs had no pneumonia: cough or cold and 9.2% had pneumonia. Severe pneumonia was not observed in this study (Figure 4.3).

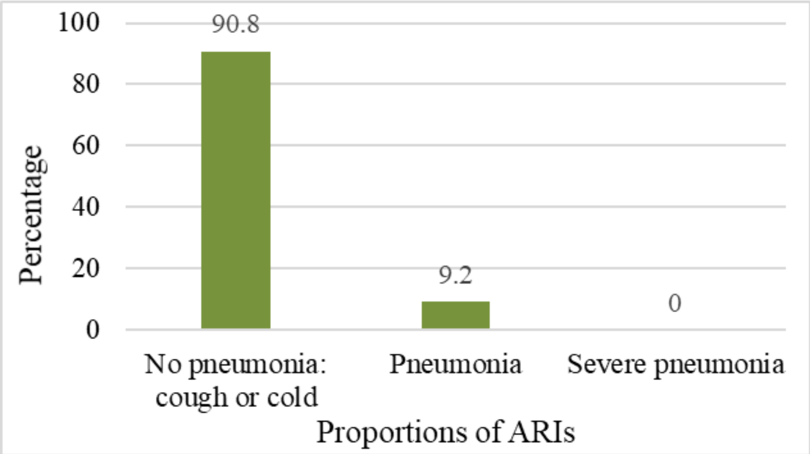

Figure 4.3: Distribution of ARIs among Study Participants

4.4 Association between Individual Level Characteristics of Study Participants and Occurrence of ARIs

Female children were significantly more likely (OR 1.59; 95% CI: 1.05-2.39) to get infected with an ARI compared to male children. Age was not significantly associated with occurrence of ARIs although odds of infection peaked at two years. Exclusive breastfeeding reduced odds of infection by 6% (OR 0.94; 95%CI 0.53-1.66) among exclusively breastfed children. Odds of infection decreased with increasing breastfeeding duration (OR 2.36; 95% CI: 0.31-17.85 to OR 1.93; 95% CI: 0.31-11.90). Nutritional factors were not significantly associated with occurrence of ARIs (Table 4.3).

Table 4.3: Association between individual level characteristics of the study children and occurrence of ARIs

Category	n(ARIs)	Prevalence % (95%CI)	Univariable analysis [OR (95%CI), p-value]
Age in months			
0-6	58(33)	56.9 (45.5-71.2)	1.06 (0.57-1.96), p=0.846
7-12	67(42)	62.7 (52.1-75.4)	1.35 (0.74-2.44), p=0.318
13-24	112(71)	63.4 (55.1-73.0)	1.39 (0.84-2.30), p=0.196
25-59	148(82)	55.4 (48.0-64.0)	Reference
Gender			
Male	192(103)	53.6 (47.0-61.2)	Reference
Female	193(125)	64.8 (58.4-71.7)	1.59 (1.05-2.39), p= 0.027*
Birth weight			
Low ≤ 2499	25(15)	60.0 (43.6-82.6)	Reference
Normal ≥ 2500	256(151)	59.0 (53.3-65.3)	0.95 (0.41-2.22), p=0.921
Place of birth			
Home	95(54)	56.8 (47.4-68.2)	Reference
Hospital	290(174)	60.0 (54.6-65.9)	1.14 (0.71-1.82), p=0.59
Breastfeeding status			
Exclusive	272(161)	59.2 (53.6-65.3)	0.94 (0.53-1.66), p=0.833
Supplemented	61(37)	60.7 (49.6-74.2)	Reference
Breastfeeding duration			
0-12 months	18(11)	61.1 (42.3-88.3)	2.36 (0.31-17.85), p=0.407
13-24 months	165(93)	56.4 (49.2-64.4)	1.93 (0.31-11.90), p=0.475
25-36 months	5(2)	40.0 (13.7-117.0)	Reference
Immunization status			
Complete	277(169)	61.0 (55.5-67.0)	Reference
In progress	87(48)	55.2 (45.6-66.7)	0.79 (0.58-1.27), p=0.333
Incomplete	21(11)	52.4 (34.8-78.7)	0.70 (0.29-1.71), p=0.438
Nutrition status			
Underweight			
Normal	324(194)	59.9 (54.8-65.4)	1.18 (0.68-2.06), p=0.547
Underweight	61(34)	55.7 (44.5-69.7)	Reference
Stunted			
Normal	284(166)	58.4 (53.0- 64.4)	0.88 (0.56-1.41), p=0.606
Stunted	101(62)	61.4 (52.6-71.6)	Reference
Wasted			
Normal	323(197)	61.0 (55.9-66.5)	2.06(1.09-3.89), p=0.026*
Over nourished	18(12)	66.7 (48.1-92.4)	2.63 (0.84-8.29), p=0.098
Wasted	44(19)	43.2 (30.8-60.6)	Reference

4.5 Association between Socio-demographic Characteristic of Mothers of the Children who Participated in the Study and Occurrence of ARIs

Primary level of education among spouses of mothers of study participants significantly lowered odds of infection with an ARI (OR 0.52; 95% CI: 0.31-0.89). Maternal age, marital status, level of education and employment status were not significantly associated with occurrence of ARIs. However, odds were lower among mothers aged above 31years (OR 1.26; 95% CI: 0.63-2.54) relative to those aged between 21 to 30 years (OR 1.45; 95% CI: 0.79-2.64). Odds decreased with increasing level of education. Employment decreased odds of acquiring an ARI (OR 1.21; 95% CI: 0.60-2.45) compared to unemployment (OR 1.48; 95%CI:0.81-2.70). Employment of the spouse of the mother of the study participants lowered odds of infection with ARIs too, (OR 0.64; 95% CI: 0.33-1.21) although not significantly. Odds of infection increased with increasing parity (Table 4.4).

Table 4.4: Association between socio-demographic characteristics of mothers of children who participated in the study and occurrence of ARIs

Category	n(ARIs)	Prevalence % (95%CI)	Univariable analysis [OR (95%CI), p-value]
Age of mother			
17-20	53 (28)	52.8 (41.0-68.1)	Reference
21-30	249 (152)	61.0 (55.3-67.4)	1.45 (0.79-2.64), p=0.225
31-47	83 (48)	57.8 (48.1-69.5)	1.26 (0.63-2.54), p=0.502
Marital status of mother			
Married	359 (209)	58.2 (53.3-63.5)	0.51 (0.21-1.25), p=0.143
Single	26 (19)	73.1 (57.9-92.3)	Reference
Education level of mother			
No formal education	156 (90)	57.7 (50.4-66.0)	Reference
Primary education	182 (110)	60.4 (53.7-68.0)	1.12 (0.73-1.73), p=0.609
Secondary education and above	47 (28)	59.6 (47.1-75.4)	1.08 (0.56-2.10), p= 0.819
Education level of spouse of mother			
No formal education	90 (58)	64.4 (55.3-75.1)	0.92 (0.50-1.70), p=792
Primary education	177 (90)	50.8 (44.0-58.8)	0.52 (0.31-0.89 p= 0.016*
Secondary education and above	92 (61)	66.3 (57.3-76.7)	Reference
Employment status of mother			
Housewife	52 (27)	51.9 (40.0-67.4)	Reference
Unemployed	252 (155)	61.5 (55.8-67.8)	1.48 (0.81-2.70), p=0.201
Employed	81 (46)	56.8 (47.0-68.7)	1.21 (0.60-2.45), p= 0.582
Employment status of spouse of mother			
Unemployed	49 (33)	67.3 (55.4-81.8)	Reference
Employed	310 (176)	56.8 (51.5-62.6)	0.64 (0.33-1.21), p= 0.166
Parity of mother			
1-2	182 (106)	58.2 (51.5-65.7)	Reference
3-4	106 (62)	58.5 (49.8-68.7)	1.01 (0.62-1.64), p=0.967
≥5	97 (60)	61.9 (52.9-72.3)	1.16 (0.70-1.92), p=0.558

4.6 Association between socio-economic characteristics of mothers of children who participated in the study and occurrence of ARIs

4.6.1 Characteristics of Residence of Mothers of Children who Participated in the Study

Roofing, wall and floor materials were not significantly associated with ARIs as shown in table 4.5. Having a detached kitchen was lowered odds of infection with an ARI (OR 0.95; 95% CI: 0.63-1.43), while odds of occurrence of an ARI increase with increasing household density although not significantly. Presence of a window on the main house lowered odd of infection too (OR 0.88; 95% CI: 0.46-1.69), and usage of biomass fuels was not significantly associated with occurrence of ARIs. Odds of infection were however high (OR 4.20; 95% CI: 0.53-32.95) if both charcoal and firewood for cooking. Using electricity for lighting also lowered odds of infection (OR 0.95; 95% CI: 0.48-1.89) although not significantly (Table 4.5).

Table 4.5: Association between residential characteristics of mothers of children who participated in the study and occurrence of ARIs

Category	n(ARIs)	Prevalence % (95%CI)	Univariable analysis [OR (95%CI), p-value]
Roofing material			
Iron sheets	254 (153)	60.2 (54.5-66.6)	Reference
Grass	9 (6)	66.7(42.0-105.8)	1.32 (0.32-5.39), p= 0.699
Palm leaves	122 (69)	56.6 (48.4-66.1)	0.86 (0.55-1.33), p=0.497
Wall material			
Bricks/blocks	97 (60)	61.9 (52.9-72.3)	1.16 (0.72-1.86), p= 0.542
Mud	288 (168)	58.3 (52.9-64.3)	Reference
Floor material			
Cement/tiles	87 (51)	58.6 (49.1-69.9)	Reference
Earth	298 (177)	59.4 (54.1-65.2)	1.03 (0.64-1.68), p= 0.897
Type of kitchen			
Kitchen inside main house	172 (103)	59.9 (53.0-67.7)	Reference
Cook from an open area	36 (24)	66.7 (52.9-84.0)	1.34 (0.63-2.86), p=0.812
Kitchen detached from main house	177 (101)	57.1 (50.2-64.8)	0.89 (0.58-1.36)
Household density			
2	3 (1)	33.3 (6.7-165.1)	Reference
3	68 (37)	54.4 (43.8-67.6)	2.39 (0.21-27.59), p =0.486
4	100 (60)	60.0 (51.1-70.3)	3.00 (0.26-34.2) P=0.376
>5	214 (130)	60.7 (54.5-67.7)	3.10 (0.28-34.67) P=0.359
Number of rooms			
1	22 (12)	54.5(37.2-79.9)	Reference
2	193 (113)	58.5 (52.0-65.9)	1.17 (0.48-2.86), p= 0.719
3	133 (79)	59.4 (51.6-68.3)	1.22 (0.49-3.02), p= 0.669
≥4	37 (24)	64.9(51.2-82.2)	1.54 (0.52-4.52), p=0.433
Number of windows			
0	215 (130)	60.5 (54.3-67.4)	1.08 (0.68-1.71), p=0.744
1	54 (30)	55.6 (43.7-70.5)	0.88 (0.46-1.69), p= 0.707
≥2	116 (68)	58.6 (50.3-68.3)	Reference
Source of cooking energy			
Firewood	308 (182)	59.1 (53.8-64.8)	2.17 (0.35-13.15), p=0.401
Charcoal	50 (27)	54.0 (41.8-69.7)	1.76 (0.27-11.46), p=0.554
Charcoal and firewood	19 (14)	73.6 (56.3-96.3)	4.20(0.53-32.95), p= 0.172
Charcoal and gas/paraffin stove	5 (2)	40.0 (13.6-117.0)	Reference
Gas/paraffin stove	3 (3)	100.0	0
Source of lighting energy			
Kerosene lamp	222 (130)	58.6 (52.4-65.4)	Reference
Solar	123 (75)	61.0 (52.9-70.2)	1.11 (0.71-1.73), p= 0.661
Electricity	40 (23)	57.5 (44.1-75.1)	0.95 (0.48-1.89) p=0.901
Exposure of the child to wood smoke			
Exposed	214 (124)	60.5 (54.1-67.6)	Reference
Not exposed	171 (93)	57.1 (49.9-65.2)	0.87 (0.57-1.32), p= 0.506
Exposure of the child to cigarette smoke			
Yes	147 (90)	61.2 (53.8-69.6)	Reference
No	238 (138)	58.0 (52.0-64.6)	0.87 (0.57-1.33), p= 0.530
Socio-economic status			
Low	132 (79)	59.8 (51.0-68.2)	Reference
Middle	116 (69)	59.5 (50.0-68.5)	0.98 (0.59-1.63), p=953
High	120 (69)	57.5 (48.2-66.5)	0.91 (0.54-1.50), p=705

4.6.2 Exposure History and Recurrence of ARIs

Absence of a school going sibling significantly lowered odds of infection with an ARI (OR 0.61; 95% CI: 0.40-0.95). Absence of contact with an infected person lowered the odds of infection (OR 0.92; 95% CI: 0.56-1.53), while being previously hospitalized with an ARI increased the odds of occurrence of a current ARI (OR 1.26; 95%CI: 0.51-3.11), although not significantly (Table 4.6).

4.6: The Relationship between Exposure History and Recurrence of ARIs among children and Occurrence of ARIs

Category	n(ARIs)	Prevalence % (95%CI)	Univariable analysis [OR (95%CI), p-value]
History of contact with an infected person			
Had contact	166 (99)	59.6 (52.6-67.5)	Reference
No contact	219 (129)	58.9 (52.7-65.8)	0.97 ((0.64-1.46)), p= 0.885
Presence of school-going siblings			
Yes	260 (164)	63.1 (57.5-69.2)	Reference
No	125 (64)	51.2 (43.1-60.8)	0.61(0.40-0.95), p= 0.027*
Hospitalization within the past three months			
Yes	79 (48)	60.7 (50.9-72.5)	Reference
No	306 (180)	58.8 (53.6-64.6)	1.08 (0.65-1.79), p= 0.755
Cause of hospitalization within the past 3 months			
Respiratory related	41 (26)	63.4 (50.3-80.1)	1.26 (0.51-3.11), p=0.616
Not respiratory related	38 (22)	57.9 (44.1-75.9)	Reference

4.7 Independent Factors Associated with Occurrence of ARIs

From the multivariable logistic regression model, gender, birth weight, nutrition status, maternal education, parity and recurrent hospitalization were independent determinants of occurrence of ARIs. Female children were three times more likely (aOR 3.39; 95%CI: 1.21-9.46) to get infected with an ARI compared to male children. Stunting posed a three-folds increase in odds of getting and ARI (aOR 3.62; 95% CI: 1.04-12.61), while primary level of education among mothers increased a child's odds of getting an ARI thrice (aOR 3.54; p5% CI: 1.10-11.32). High parity also significantly increased odds of infection, with having five and above children increasing odds of infection by 11 times (aOR 11.45; 95% CI: 2.38-55.09). Recent hospitalization significantly increased odds of getting an ARI too, increasing odds by 8 times (aOR 8.19; 95% CI: 1.75-38.43). Normal birth weight significantly lowered odds of infection by 94% (aOR 0.06; 95% CI: 0.01-0.62).

4.8 KAP of Mothers with Regard to ARIs Associated with Occurrence of ARIs

4.8.1 Knowledge of ARIs

4.8.1.1 Knowledge on Types of ARI among Mothers of Study Participants

More than half of the mothers (55.6%) had knowledge about types of ARIs. Cough was identified by 88.3% of the mothers. Knowledge of ARIs was not significantly associated with occurrence of ARIs. Odds of occurrence of ARIs was higher (OR 1.15; 95% CI: 0.77-1.73) (table 4.8) among children whose mothers had knowledge on types of ARI, although such knowledge did not significantly increase odds of occurrence of the ARIs.

Table 4.7: Knowledge of mothers on types of ARIs

Knowledge on ARIs	N	%	p-value	OR (95% CI), p-value
Yes	214	55.6%	0.4651	1.15 (0.77-1.73) p=0.495
Cough	*189*	*88.3%*		
Common cold	*142*	*75.1%*		
Pneumonia	*25*	*17.6%*		
Tonsils	*2*	*8.0%*		
No	171	44.4%		Reference

Cough and cold were named as types of ARIs in all FGDs. Only 1 FGD did not name pneumonia as a type of ARI. Tuberculosis and asthma were also identified as types of ARIS in all FGDs.

4.8.1.2 Knowledge of Signs and Symptoms of ARIs among Mothers of Study Participants

The most frequently identified signs and symptoms of ARIS were cough, fever and runny nose. Mothers either strongly agreed or agreed that cough was a sign of ARIs. Only 1.6% of the mothers strongly disagreed that fever was a symptom of ARIs. Half of the mothers (52.2%) strongly agreed that wheezing was a sign of ARIs and 59.2% others strongly agreed that runny nose was a sign of ARIs. Majority of the mothers (52.5%) strongly disagreed that pain in the ears is a symptom of ARIs (Table 4.8). Average score for knowledge on symptoms of ARI was 35.7. Over half of the mothers (60.3%) had good knowledge on symptoms of ARIs. Knowledge on symptoms was not significantly associated with occurrence of ARIs (p=0.580) (Table 4.11).

Table 4.8: Knowledge of mothers on symptoms of ARIs

	Strongly agree (%)	Agree (%)	Disagree (%)	Strongly disagree (%)	Don't know (%)	Mean score
Cough	243 (63.1)	142 (36.9)	0	0	0	4.6
Fever	146 (37.9)	211 (54.8)	22 (5.7)	6 (1.6)	0	4.3
Sore throat	151 (39.2)	118 (30.6)	74 (19.2)	35 (9.1)	7 (1.8)	4.0
Loss of appetite	42 (10.9)	128 (33.3)	169 (43.9)	41 (10.6)	5 (1.3)	3.4
Pain while swallowing	68 (17.7)	175 (45.4)	107 (27.8)	31 (8.1)	4 (1.0)	3.7
Wheezing	201 (52.2)	116 (30.1)	60 (15.6)	8 (2.1)	0	4.3
Runny nose	228 (59.2)	122 (31.7)	29 (7.5)	6 (1.6)	0	4.5
Hoarse voice	172 (44.7)	130 (33.8)	64 (16.6)	19 (4.9)	0	4.2
Pain in the ears	27 (7.0)	64 (16.6)	86 (22.3)	202 (52.5)	6 (1.6)	2.7

From the qualitative data, mothers were aware of the common signs and symptoms of ARIs. Most mothers indicated that fever, cough and cold were the main symptoms of ARIs, reporting that;

> *"If we see a child having fever, sweating and with a running nose, we know that is an ARI"* (FGD 2, 3 and 4)

Alluding to signs and symptoms of pneumonia, most of the mothers observed that;

> *"… A child will have tightened lungs hence unable to breath well…"* (FGD 2, and 5)
>
> *"Excessive crying. The baby does not stop crying even when soothed. Especially if the baby has asthma and is experiencing difficulty in breathing"* (FGD 1 and 2)

Pain in the ears was not considered a symptom of ARIs, and loss of appetite was associated with being ill, not only having an ARI.

4.8.1.3 Knowledge on Causes of ARIs among Mothers of Study Participants

Mothers mostly agreed that bacteria (55.8%) and viruses (47.0%) were causes ARIs. Over half of the mothers (52.5%) strongly disagreed that evil spirits caused ARIs. Dust, and cold weather were largely perceived as causes of ARIs, with 48.0% and 44.9% of the mothers respectively strongly agreeing that these cause ARIs. Over half of the mothers (68.6%) agreed that cold drinks can cause ARIs (Table 4.9). Average score for knowledge on causes of ARIs was 15.8. Over half of the mothers (64.2%) had good knowledge on the causes of ARIs. Knowledge on causes of ARI was significantly associated with occurrence of ARIs (p=0.026), and good knowledge lowered odds oof occurrence of ARIs (OR 0.61; 95% CI: 0.40-0.95) (Table 4.11).

Table 4.9: Knowledge of mothers on causes of ARIs

	Strongly agree (%)	Agree (%)	Disagree (%)	Strongly disagree (%)	Don't know (%)	Mean
Bacteria	65 (16.9)	215 (55.8)	14 (3.6)	26 (6.7)	65 (16.9)	3.5
Viruses	116 (30.1)	181 (47.0)	12 (3.1)	46 (12.0)	30 (7.8)	3.8
Evil spirits	9 (2.3)	46 (11.9)	105 (27.3)	202 (52.5)	23 (6.0)	3.5
Dust	185 (48.0)	181 (47.0)	13 (3.4)	3 (0.8)	3 (0.8)	1.6
Cold weather	173 (44.9)	186 (48.3)	22 (5.7)	4 (1.0)	0	1.6
Cold drinks	96 (24.9)	264 (68.6)	21 (5.5)	4 (1.0)	0	1.8

Qualitative data agreed with the above findings, with most mothers naming exposure to cold weather, giving a child cold food and dust as causes of ARIs. There was no clear consensus that bacteria and viruses cause ARIs, suggesting gaps in knowledge on causes of ARIs. Mothers unanimously agreed that evil spirits do not cause ARIs, stating that;

> *"…it's called kijicho (evil spirit). It does not cause ARIs. Hatuamini (we don't believe so*)" (FGD 2, 4 and 5)

Only a few mothers named viruses as causes of ARIs, stating that;

> *"Viruses do not cause ARIs. They cause HIV/AIDS."* (FGD 1)

Majority of the mothers were also of the opinion that engaging in manual labor while expectant increased chances of a child getting ARIs. It was observed that:

> "*A mother should not do work that involves heavy labor while pregnant because she will get TB and when the child is born, he or she will have respiratory problems"* (FGD 1 and 2)

and that;

> "*When pregnant, a mother should avoid carrying heavy things because doing so weakens her chest and that of the unborn baby…"* (FGD 3 and 4)

4.8.1.4 Knowledge on Transmission, Prevention and Danger Signs and Symptoms of ARIs among Mothers of Study Participants

Only 0.8% of the mothers did not know that ARIs can be passed from one person to another. Majority of the mothers (64.71%) agreed that some ARIs can be prevented by immunization. With regards to exclusive and prolonged breastfeeding as strategies of preventing children from ARIs, 23.6% and 15.3% of the mothers strongly agreed that exclusive breastfeeding and prolonged breastfeeding respectively can protect children against ARIs. Most mothers (78.2%) strongly agreed that fast or difficult breathing in a child who has a cough or a cold was a danger sign and only 2.9% of the mothers did not know that good nutrition can protect children against ARIs. Average score for knowledge on transmission, prevention and danger signs of ARIs was 25.4. Over half of the mothers (57.4%) had good knowledge on transmission, prevention and danger signs and symptoms ARIs.

Such knowledge was not significantly associated with occurrence of ARIs (p=0.814) (*Table 4.3).*

Table 4.10: Knowledge of mothers on transmission, prevention and danger signs and symptoms of ARIs

	Strongly agree (%)	Agree (%)	Disagree (%)	Strongly disagree (%)	Don't know (%)	Mean
ARIs can be passed from one person to another	303 (78.7)	79 (20.5)	0	0	3 (0.8)	4.8
Some ARIs can be prevented by immunization	117 (30.4)	249 (64.7)	11 (2.9)	2(0.5)	6 (1.5)	4.2
Exclusive breastfeeding can protect against ARIs	91 (23.6)	249 (64.7)	31 (8.0)	6 (1.6)	8 (2.1)	4.1
Prolonged breastfeeding can protect against ARIs	59 (15.3)	250 (64.9)	47 (12.2)	12 (3.1)	17 (4.4)	3.8
Fast/difficult breathing is a danger sign in a child who has a cough/cold	301 (78.2)	71 (18.4)	8 (2.1)	2 (0.5)	3 (0.8)	4.7
Good nutrition can protect against ARIs	43 (11.2)	260 (67.5)	63 (16.4)	8 (2.1)	11 (2.9)	3.8

From the FGDs, majority of the mothers agreed that ARISs can be transmitted. It was pointed out that;

> *"If a mother is coughing or sneezing, covering the mouth will prevent transmission form the mouth…Washing hands also helps. Because if you use your hands to cover the mouth then handle the baby, you will transmit the infection"* (FGD 4 and 5)

"Children who are in contact with infected adults. The adults will give them the disease" (FGD 1, 4 and 5)

Most mothers knew that immunizing a child and exclusively breasfeeding them can prevent ARIs. It was indicated that;

"A child should get all vaccinations. Vaccines protects the child from a lot of diseases" (FGD 1, 4 and 5)

"Don't give the baby supplementary foods before 6 months-exclusively breast *feed"* (FGD 2, 3 and 5)

Ability of mothers to identify danger signs in a child with a cough or a cold was observed. Most mothers reported that difficult breathing and chest indrawing were danger sign in a child with a cough or a cold. They observed that;

".... You will see the baby having difficulty in breathing…" (FGD 2 and 5)

"A child will have tightened lungs hence unable to breath well" (FGD 2 and 4)

Table 4.11: Knowledge of ARIs and association with ARIs

	n (%)	p-value	OR
Knowledge of signs and symptoms of ARIs		0.58	
Good knowledge	232 (60.3)		1.12 (0.74-1.70) p=0.581
Poor knowledge	153 (39.7)		Reference
Knowledge on causes of ARIs		0.026	
Good knowledge	247 (64.2)		0.61 (0.40-0.95) p=0.027
Poor knowledge	138 (35.8)		Reference
Knowledge on transmission, prevention and danger signs of ARI		0.184	
Good knowledge	221 (57.4)		1.05 (0.70-1.58) p=0.814
Poor knowledge	164 (42.6)		Reference

4.8.2 Attitude towards ARIs

4.8.2.1 Attitude of Mothers towards Nature, effects and Risk for ARIs

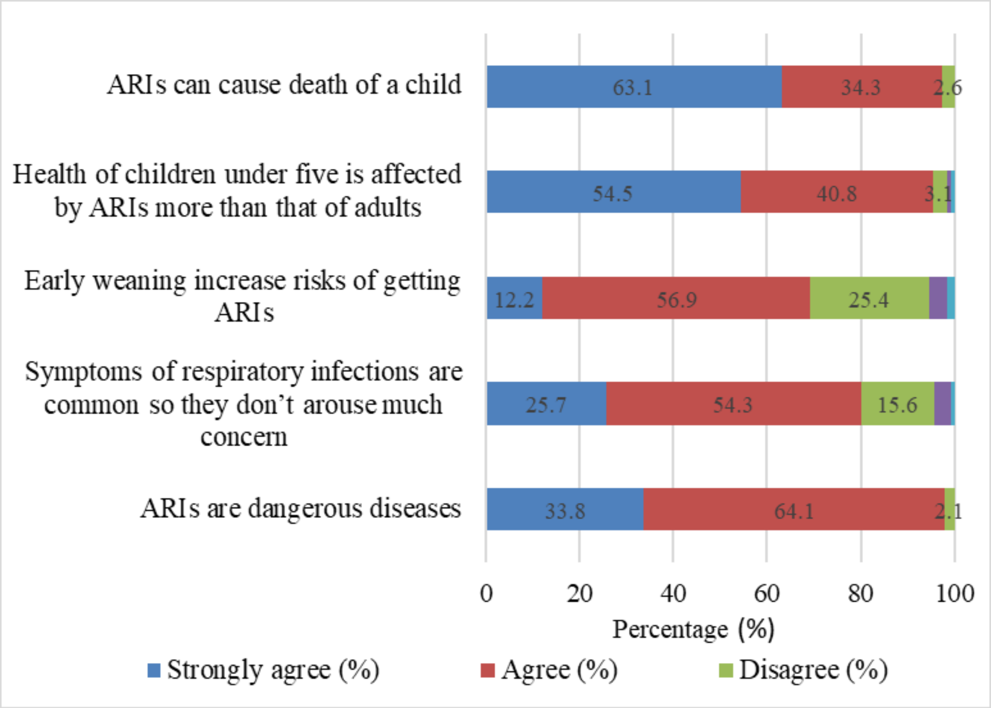

Figure 4.4: Attitude of mothers towards nature, effects and risk for ARIs

Over half of the mothers (64.1%) agreed that ARIs are dangerous diseases. Only 33.8% of the mothers strongly perceived ARIs as dangerous childhood infections. A few of the mothers (15.6%) and 3.6% of them agreed and strongly agreed respectively, that symptoms of ARIs are indeed a cause of concern. Over half of the mothers (54.5%) strongly agreed that ARIs affect the health of children more than that of adults, while 63.1% of the mothers strongly agreed that ARIs can cause death of a child (Figure 4.4). Average score for attitude towards nature of ARIs, their effects on a child and risks for getting an ARI was 25.8. Over half of the mothers (61.8%) had positive attitude towards nature, effects and risks of getting an ARI. Attitude towards nature, effects and risks of ARIs was not significantly associated with occurrence of an ARI (p=0.822) (Table 4.12).

From the qualitative data, majority of the mothers were of the opinion that ARIs are serious disease that can warrant worry and can cause death. They reported that;

> *"Mtoto atafa (the baby will die). You don't know whether the child will die or recover. So, we get worried"* (FGD 2, 4 and 5)

Most of the mothers were also of the opinion that children cannot withstand frequent ARIs. These negatively affect their health. They indicated that;

> *"…The child will not grow well. They are not like adults"* (FGD 1,3 and 4)

> *"The baby will be unable to eat and their health will deteriorate"* (FGD 2 and 5)

Non-committal attitude towards seriousness of some signs and symptoms of ARIs was observed. Majority of the mothers agreed that;

> *"If the child continues to cough for three or more days, we will take them to hospital…"* (FGD 1, 4 and 5)

> *"If the infection is not serious, we use herbs..."* (FGDs 1, 2 and 5)

4.8.2.2 Attitude Mothers towards Symptoms of ARIs

Mothers were asked how they would seek health care given particular symptoms of ARIs, in order to establish their attitude towards signs and symptoms of ARIs. Over half of the mothers (71.2%), strongly agreed that they would seek care in case their child developed a dry throat, while 80% of the mothers strongly agreed that they would seek care if their child had difficult breathing. Only 6.2 of the mothers did not consider ear pain as an important symptom to prompt seeking health care. Most mothers (49.1%, 46.5% and 62.9%) agreed that they would seek care in case of a cough, runny nose and a fever, respectively. only 29.6% of the mothers who reported that they would not seek immediate health care in case of a runny nose. (Figure 4.5). Average score for attitude towards signs and symptoms of ARIs was 26.5. Over half of the mothers (67.0%) had a positive attitude towards signs and symptoms of ARIs. Attitude towards signs and symptoms of ARIs were significantly associated with occurrence of ARIS (p=0.024) (Table 4.12).

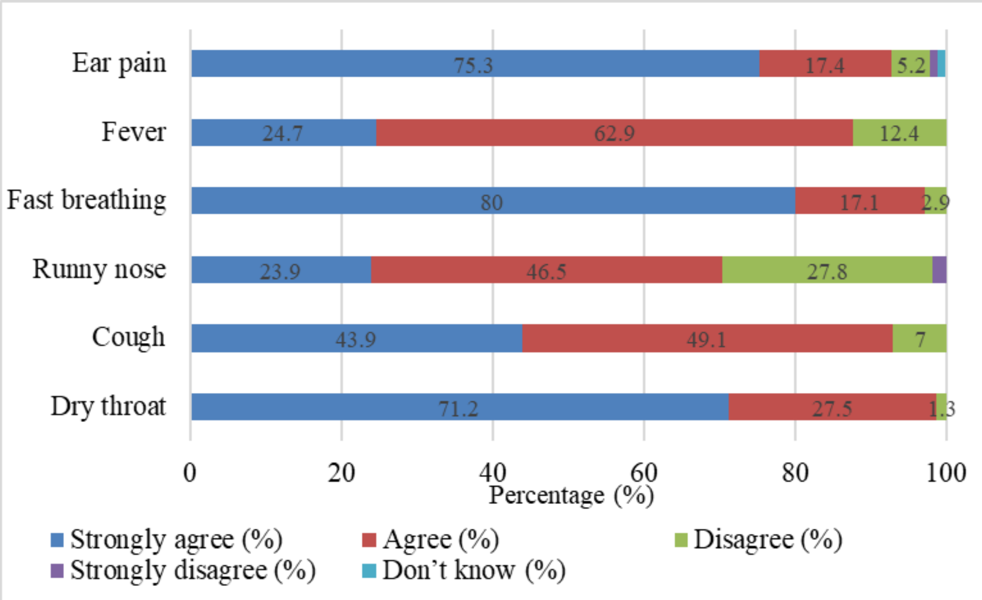

Figure 4.5: Attitude of mothers towards signs and symptoms of ARIs

From the FGDs, mothers seemed to have mixed attitude towards signs and symptoms of ARI. Response to signs and symptoms were prioritized based on their perceived seriousness or age of the child. Most mothers agreed that;

> *"If the infection is not serious, we use herbs. If there is no improvement, we take the baby to the hospital... In case the symptoms are serious we take the baby to hospital immediately without giving herbs."* (FGD 1, 3, 4 and 5)

> *"For a small child, they cannot swallow Panadol, you have to take them to hospital first because liquid medicine can only be gotten at the hospital. There, they will be examined well"* (FGD 2,4 and 5)

Table 4.12: Attitude of mothers towards ARIs and association with ARI

	n (%)	p-value	OR
Attitude towards nature, effects and risks of ARI		0.822	
Positive attitude	238 (61.8)		1.05 (0.69-1.59) p=0.822
Negative attitude	147 (38.2)		Reference
Attitude towards symptoms of ARIs		0.024	
Positive attitude	258 (67.0)		1.63 (1.06-2.52) p=0.025
Negative attitude	127 (33.0		Reference

4.8.3 Practices of ARIs

4.8.3.1 Practices to Protect a Child against ARIs

Childhood immunization was the most widely practiced (73.8%) measure for protecting children from ARIs. Exclusive breastfeeding and continued breastfeed after six months were also well observed (58.4%). Only 3.6% and 5.2% of the mothers reported that they observed good nutrition and protected children from wood smoke and secondary tobacco smoke to protect them from getting ARIs. Hand hygiene was the least practiced measure for preventing ARIs. Only 2.1%mothers reported that they wash their hands regularly in order to protect their children from ARIs (Figure 4.6).

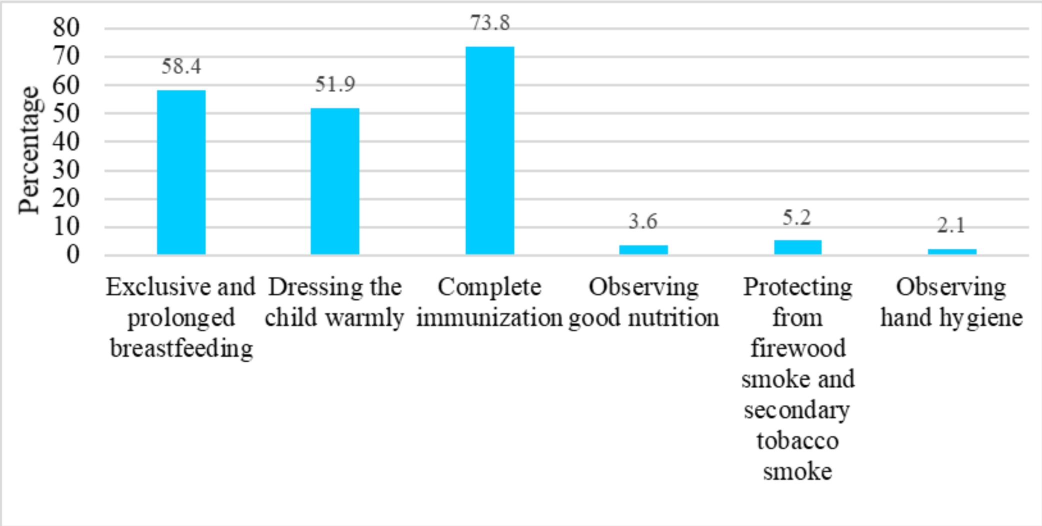

Figure 4.6: Practices observed by mothers to protect a child from ARIs

Only 3.1% of the mothers reported not practicing any preventive strategies for protecting a child from ARIs. Completing immunization schedule was significantly associated with occurrence of ARIs (p=0.003), while observing good nutrition; (OR 0.48; 95% CI: 0.15-1.54), *protecting the child from biomass smoke;* (OR 0.75; 95% CI: 0.30-1.90), *and observing hand hygiene;* (OR 0.68; 95% CI: 0.09-4.92), *lowered the odds of occurrence of ARIs (Table 4.13).*

Qualitative data agreed with the above finding. Most mothers agreed that exclusive breastfeeding can protect a child against ARIs. It was stated that;

> "*Breastfeed exclusively. It will help the child*" (FGD 1,3 and 4)

Majority of the mothers agreed that protecting a child from cold can prevent ARIs. It was indicated that;

> *"Dress the baby in warm clothes…Don't give the baby cold foods"* (FGD 2, 4 and 5"

> *"Don't leave the baby to play in the rain"* (FGD 1, 3 and 5)

Most mothers were not of the opinion that good nutrition can protect a child from ARIs. Instead, they felt that left-over food can be harmful. Majority of the mothers however agreed that immunization can protect a child from ARIs. It was indicated that;

> *"Don't give the baby left-over food. It can make them ill…."* (FGD 3 and 4)

> *"Get the baby immunized. Ni muhimu sana (it is very important)"* (FGD 3, 4 and 5)

Majority of the mothers were not of the opinion that protecting a child from smoke of biomass fuels can protect a child from ARIs. Instead, they perceived that protecting the mother was more important, since inhaling smoke can harm the unborn child. It was indicated that;

> *"When a mother is expectant, the mother should not carry water, firewood, or go near a firewood stove because the smoke goes into the lungs and the baby will be affected" (FGD 2, 4 and 5)*

Very few mothers were of the opinion that hand hygiene could protect a child from getting ARIs. It was indicated that;

> "*Washing hands protects, and when giving foods like fruits wash them too" (FGD 1)*

> *"Washing hands also helps…" (FGD 2)*

Table 4.13: Practices observed by mothers to protect a child from ARIs

	n (%)	p-value	OR
Exclusive and prolonged breastfeeding		0.126	
Mothers who practiced	219 (56.9)		1.38 (0.91-2.07) p=0.126
Mothers who did not practice	166 (43.1)		Reference
Dressing a child warmly		0.544	
Mothers who practiced	196 (50.9)		1.13 (0.75-1.70) p=0.544
Mothers who did not practice	189 (49.1)		Reference
Complete immunization		0.003	
Mothers who practiced	277 (71.9)		1.98 (1.26-3.10) p=0.003
Mothers who did not practice	108 (28.1)		Reference
Observing good nutrition		0.169	
Mothers who practiced	12 (3.1)		0.48 (0.15-1.54) p=0.218
Mothers who did not practice	373 (96.9)		Reference
Protecting the child from firewood and cigarette smoke		0.356	
Mothers who practiced	19 (4.9)		0.75 (0.30-1.90) p=0.550
Mothers who did not practice	366 (95.1)		Reference
Observing hand hygiene		0.539	
Mothers who practiced	4 (1.0)		0.68 (0.09-4.92) p=0.708
Mothers who did not practice	381 (99.0)		Reference

4.8.3.2 Healthcare Seeking Practices

Majority of the mothers (96.4%) indicated that they take their child to hospital whenever the child develops symptoms of ARIs, while 3.6% mothers reported that they first observe the child at home while treating with medicines obtained from the chemist and medicine that remained after the child's last episode of ARI. Of the mothers who reported that they would take their children to hospital first, 66.6% said they seek care immediately or within 24 hours while 33.4% of the mothers indicated that they wait until the symptoms became severe. Majority of the mothers (59.7%) reported that they give a drug or a home remedy before seeking health care services while 40.3% of the mothers reported that they do not give their children any drugs or remedies before seeking care. Over half of the mothers (77.4%) reported that they adhere to the doctor's prescription, and only 13.8% of the mothers were aware of symptoms suggestive of pneumonia in a child with a cough or a cold. Health care seeking practices were not significantly associated with occurrence of ARIs, although avoidance of self-medication or home remedies; (OR 0.84; 95% CI: 0.55-1.28)**,** ability to identify signs and symptoms suggestive of pneumonia; (OR 0.88; 95% CI: 0.49-1.58)**,** and adherence to recommended care practices for a child with a cold or a cough; (OR 0.96; 95% CI: 0.42-2.20)**,** lowered the odds of occurrence of an ARI (Table 4.14)

From the FGDs, seeking health care and timing of seeking health care was dependent on the age of the child, seriousness of the symptoms, time when the symptoms begin and availability of money to facilitate care seeking outside the home. Self-medication in this population was very prevalent. It was indicated that;

> *"When the symptoms are starting, we give Panadol. If symptoms persist, we go to hospital, for older children. But for small children, even the doctors warn you against self-medication"* (FGD 2, 4 and 5)

> *"We first buy Panadol for the baby. If they sleep and wake up with the fever, we take him to the hospital."* (FGD 2, 4 and 5)

"...In case the symptoms are serious we take the baby to hospital immediately without giving herbs" (FGD 1 and 3)

"If the illness is not severe, we don't take the baby to hospital especially when I don't have money because we will not be attended to. How will we get the clinic's card without money?" (FGD 2 and 4)

"We give the child Panadol from the shop as we observe them..." (FGD 1, 3 and 5)

4.8.3.3 Treatment Practices

Majority of the mothers (77.4%) reported that they give medicine as per the prescription, while 22.6% of the mothers reported giving children medicine until they got well (Figure 4.7). Adherence to prescription was not significantly associated with occurrence of ARIs (p=0.706) (Table 4.13).

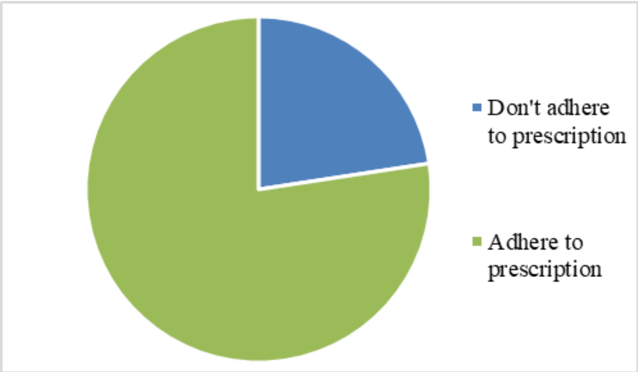

Figure 4.7: Administration of prescribed dosage to children by mothers

From the FGDs, majority of the mothers reported that they give medicine as prescribed. It was indicated that;

"Some drugs are given for three days or five days. You give as instructed even if the baby recovers" (FGD 1 and 4)

"We give the medicine for the number of days instructed by the doctor even if the baby gets better because if you don't complete the dosage, the runny nose will not clear" (FGD 2 and 4)

In case a child fails to get well after completing prescribed treatment, 89.6%) of the mothers said that they take the child back to the hospital. Only 2.1% of the mothers reported that they usually wait for the child to recover (Figure 4.8). Taking a child back to the health facility after initial consultation was not significantly associated with occurrence of ARIs (p=0.053) (Table 4.13).

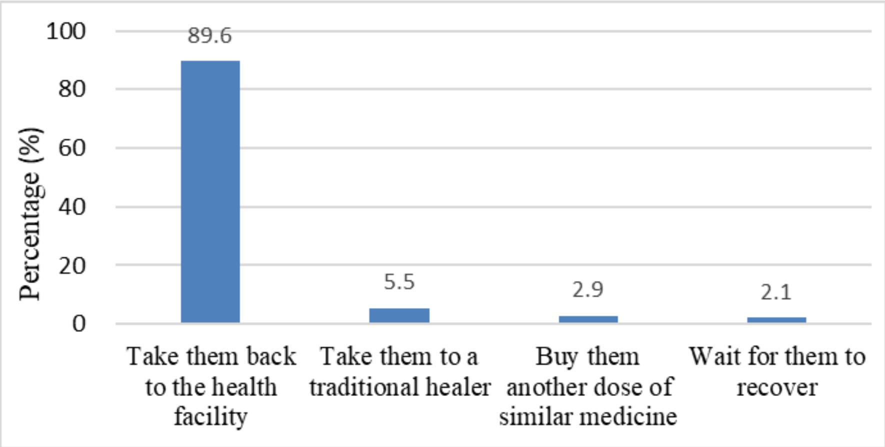

Figure 4.8: Health care seeking practices by mothers for children who fail to recover after first consultation

The FGDs agreed with follow-up consultation as portrayed above. Majority of the mothers indicated that they would take their child back to the hospital if they did not get better upon completion of initial treatment, although a few stated that they give the children herbs. It was indicated that;

"We take the baby back to the doctor for more medicine if they had been given medicine for cough." (FGD 2, 3 and 5)

"If medicine given at the hospital fails to heal the child, we give them herbs." (FGD 1 and 4)

4.8.3.4 Identification of Danger Signs in a Child with a Cough or a Cold

Mothers were asked about the signs and symptoms that would prompt them to seek additional care for a child who has a cough or cold. Only 13.8% mothers correctly identified danger signs for a child with a cough or a cold, citing difficult breathing, fast breathing, or chest indrawing. Over half of the mothers (82.1%) stated that they would take the child back to the health facility if the child became sicker, while 10.1% did not know any signs and symptoms that would cause them to seek re-consultation (Figure 4.9). Ability to identify danger signs and symptoms in a child with a cough or a cold was not significantly associated with occurrence of an ARI) p=0.676) (Table 4.13).

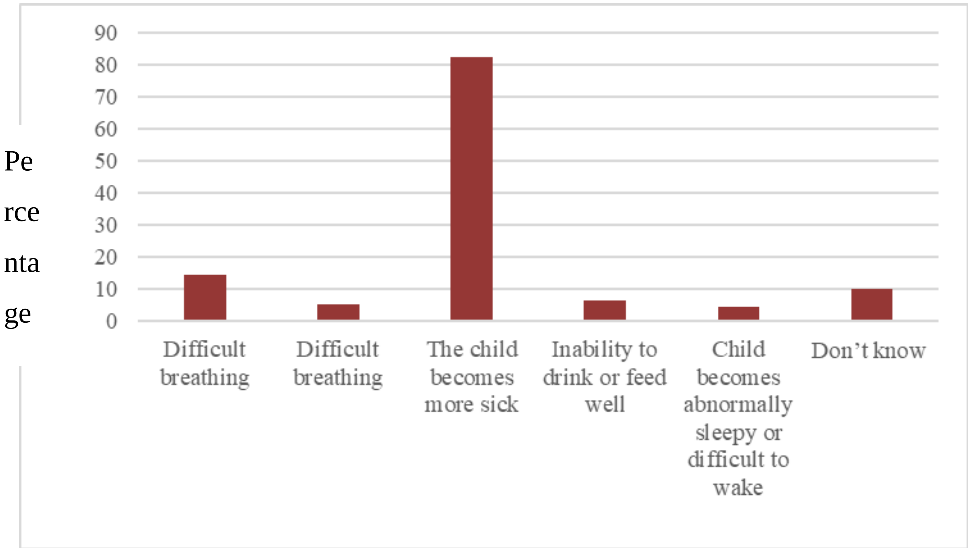

Figure 4.9: Symptoms that would prompt a mother to re-consultant for a child with a cough or cold

Regarding identification of danger signs in a child with a cough or a cold that can prompt re-consultation, few mothers accurately mentioned difficult or fast breathing. Majority of the mothers cited persisting signs and symptoms of cough and colds and lethargy. There was no mention of chest indrawing. It was indicated that;

> *"If the baby is still feverish, we take them back to hospital"* (FGD 2, 3 and 5)

"If the symptoms that prompted us to take the bay to the hospital still persist while on treatment, we take the baby back to the hospital" (FGD 2 and 4)

"…Very high fever leading to convulsion…" (FGD 2, 4 and 5)
"Difficulty breathing, it is dangerous if the baby cannot breathe well" (FGD 1 and 2)

4.8.3.5 Care for a Child with an ARI

Only 6.5% of the mothers reported that they did not practice any particular care practices for a child with an ARI. Keeping a child warm during an ARI episode was the most frequently cited care practice (87.8%). Only 15.3% mothers observed nasal clearance (Figure 4.10).

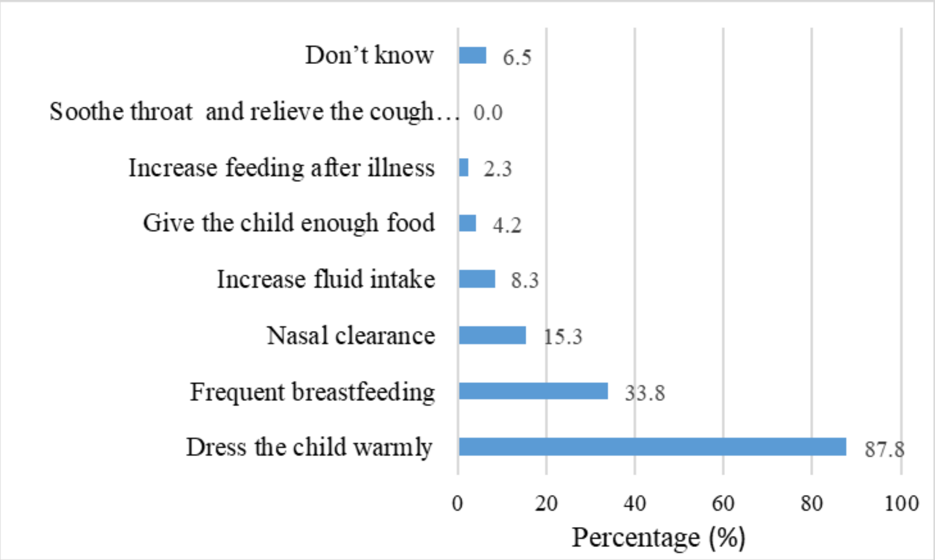

Figure 4.10: Care practices by mothers for a child with an ARI

Remedies for soothing sore throat and coughs were not used in this population as shown in Figure 4.10 above. Care practices for a child with an ARI was not significantly associated with occurrence of an ARI (p=0.935).

Table 4.14: Health care seeking practices by mothers for a child with an ARI

	N (%)	p-value	OR
Health seeking practices		0.539	
Seek health care first	371 (96.4)		1.09 (0.37-3.21) p=0.872
Observe at home before seeking care	14 (3.6)		Reference
Healthcare seeking timeline		0.571	
Immediately/within 24 hours	247 (66.6)		1.13 (0.73-1.75) p=0.571
When symptoms become severe	124 (33.4)		Reference
Self-medication		0.423	
Give drugs or home remedies	230 (59.7)		Reference
Don’t give drugs or home remedies	155 (40.3)		0.84 (0.55-1.28) p=0.423
Adherence to prescription		0.706	
Adheres to prescription	298 (77.4)		1.10 (0.68-1.78) p=0.706
Don’t adhere to prescription	87 (22.6)		Reference
Re-consultation after prior treatment		0.053	
Re-consults	34 (89.6)		1.90 (0.98-3.67) p=0.056
Do not re-consult	40 (10.4)		Reference
Identification of danger signs in a child with a cold or cough		0.676	
Could identify danger signs	53 (13.8)		0.88 (0.49-1.58) p=0.676
Could not identify danger signs	332 (86.2)		Reference
Care practices		0.935	
Practiced recommended care practices	360 (93.5)		0.96 (0.42-2.20) p=0.935
Did not practice recommended care practices	25 (6.5)		Reference

From the FGDs, keeping a child warm and minimizing exposure to cold conditions was the most common practice. Mothers stated that:

> *“At home, we take the baby to bed once they sleep to protect them from cold. We dress them in warm clothes like sweaters, hats and socks”* (FGD 1 and 2)

> *“We give the child warm foods after preheating and cooling to the right temperature. We also warm their water”* (FGD 2, 3 and 5)

"*We don't allow the baby to play with cold water because they will get sicker…"* (FGD 4)

Frequent feeding during an episode of an ARI was not sufficiently observed in this study as recommended. Most mothers felt that a child would not be able to eat much due to decreased appetite as a result of an ARI. Mothers reported that:

"The amount of food the baby eats reduces because the baby usually does not have much appetite when having a cold. We feed the child as usual schedule as they should but the quantity they eats reduces. We give the same quantities but the baby will eat less because of the sickness" (FGD 2, 3 and 5)

"We give small portions frequently because the baby has no appetite while sick" (FGD 2 and 4)

Awareness of the importance of good nutrition during an infection was observed from a few mothers. These were of the opinion that a child should feed well despite the infection. It was pointed out that:

"Don't give the baby ugali every day when they are sick. Add them a banana or biscuit or foods that they like to encourage them to eat" (FGD 2)

"Give the baby foods that will give them energy, and generally good nutrition" (FGD 3)

Increasing fluid intake was only mentioned after probing. Concerning frequency of breastfeeding, mothers observed that;

"If the baby is exclusively breastfeeding, breastfeed frequently because the baby usually doesn't want to feed... If the baby does not want food, then encourage them to breastfeed." (FGD 2 and 4)

"We leave the baby to breast feed as much as they want..." (FGD 3)

Nasal cleansing was sparingly practiced. Nasal drops were not provided in the health facility, hence knowledge on nasal cleansing as routine care for a child with an ARI was not widespread. It was mostly practiced to improve breastfeeding or aid breathing. Mothers observed that:

> *"We use cotton bud to remove dried mucus from the nose in a breastfeeding baby to help the baby to feed well"* (FGD 1)

> *"…We also clean nostrils using a piece of cloth because dried mucus prevents breast feeding"* (FGD 3)

Adequate rest as a care practice was mentioned in one FGD. A mother said that;

> *"Putting the baby on bed to rest also helps"* (FGD 3)

CHAPTER FIVE

DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.1 Discussion

5.1.1 Demographic and Socio-economic Characteristics of Study Participants

This study recruited 385 mother-child below five years pairs. About half of the children were male, depicting an almost equal ratio of male to female participants. This observation is reflected in the Kwale HDSS (Kaneko *et al.,* 2012) current demographic profile that shows a relatively equal distribution of the genders within the zero to five age group. This outcome however contradicts postulated gender bias in health care seeking for children (Vlassoff, 2007; Yadav *et al.,* 2013), which posits that some communities are more responsive to health care needs of one gender relative to another. Over half of the participants of the children were aged below two years, suggesting high vulnerability of this age group to infectious diseases, despite continued application of interventions such as childhood vaccination, bed net usage and nutrition supplementation among others. Several reports (Vissing *et al.,* 2018; Khalek and Abdel-salam, 2016) have highlighted that children aged below two years are generally susceptible to a range of infectious diseases, citing underdeveloped immunity coupled with frequent exposure to infectious agents.

Substantial home births were observed in this study. This could be due to financial hinderances or personal preference informed by factors such as age of the mother, parity or perceived poor quality of care at the health facility. Naanyu *et al.,* (2018) reported that low socioeconomic status is a major factor for home birth while Manyiwa *et al.,* (2018) concurred that, reasons such as fear of harassment by nurses, poor quality of health care and high parity may promote home births. Most of the children had normal birthweight suggesting improving birth outcomes and sustained gains from interventions such as maternal and child health packages and community health strategy. Only 72% of the children were fully immunized as per schedule, which is slightly below the universal coverage target (80%) although within the range of estimated coverage of Kwale County (77%). Disparity could be due to inaccurate recall because immunization history was based on parental recall especially for older children, and for children whom MCH booklets were not available. Beside these possibilities, this finding indicates gaps in vaccination uptake that need to be addressed due to the critical role of vaccination in prevention of childhood diseases. Poor nutritional status was observed once more in the study area reflecting the generally low nutrition ratings in Kwale County (Comitato Internazionale per lo Sviluppo dei Popoli-CISP, 2017). Consistent with previous reports (Shinsugi *et al.,* 2015; Ndemwa *et al.*, 2017) stunting was the most prevalent form of malnutrition, with 26.3% of the participants presenting with stunting. Although reasons for sustained low nutrition status rating among children in the study area and Kwale County at large are not well elucidated, breastfeeding practices, complementary feeding practices, nature or balancing of diets, food insecurity, and low socio-economic ratings are important determinants

Majority of the mothers in this study were aged below 30 years, suggesting that most mothers in the who participated in the study were young mothers. Previous studies conducted within Kwale HDSS by Shinsugi *et al.*, (2015) and Ndemwa *et al.*, (2017) reported a similar maternal age distribution. Cultural practice of early marriage characteristic of the study area accounts for this observation, alongside the problem of school dropout among girls due to factors such as lack of school fees or under motivation to pursue education. High parity was observed too, that could be as a result of early marriage or poor utilization of family planning services.

Low literacy levels were observed in the study area, tentatively as result of generally low socio-economic status that affects both school attendance and education outcomes. Most mothers were unemployed, probably since most of them were young, or due to low levels of education coupled with early marriage.

Housing characteristics were relatively homogeneous in the study area. Most houses were made of earthen floors. Mud was the main material used for making walls, and where bricks or blocks were used, mud was commonly used as a binding material instead of cement. Walls were rarely plastered. Iron sheets were the main roofing materials, with palm leaves being used especially on houses made of mud. Most houses had no windows. For houses that had windows, they are mostly small sized windows made of wood, about two to four that may or may not be opened during the day (HDSS data, unpublished). Most households had a separate small house that served as a kitchen and a few cooked from an open area. Where kitchens were located in the main house, they were in form of a cooking area that was not vented. Solar lamps were a common means of lighting since the weather in the study area is mostly sunny with high daytime temperatures. These were used interchangeably with kerosene lamps including wick lamps. Such nature of the households'-built environment could be due to low socioeconomic status

5.1.2 Prevalence of ARIs

Prevalence of ARIs in the study area was 59.2%. This prevalence was higher than the national prevalence of 47.3% estimated by Muthoni and Ngesa, (2017) but within estimated range (55-60%) for Kwale County reported in the same study based on KDHS 2014 data through a modelling approach. Such high prevalence could be due young age of mothers in this study which rendered them inexperienced in child care and coupled with their low education status, they were probably relatively unknowledgeable in childcare hence likely to expose their children to infection with ARIs. The nature of built environments of children in this could also increase susceptibility to ARIs, since poor quality building material such as observed in this study have been associated with indoor air pollution that has been linked with occurrence of ARIs (Admasie *et al.,* 2018). Further, a household survey in North Coast reported an individual risk of infection with respiratory viruses of 93.4% for any virus at household level, implying a high risk for contracting respiratory infections in the Coastal region. The study was conducted between November to January, towards the end of peak season for transmission of influenza viruses (Matheka *et al.,* 2013), and at beginning of the transmission season for other viruses especially RSV (Breiman *et al.,* 2015; Munywoki *et al.,* 2018), which are important etiologies of ARIs in the region, that may have also caused the prevalence to be high. Related studies conducted in hospital settings in India (Kumar *et al.,* 2015), Cameroon (Tazinya *et al.,* 2018) and Nepal (Koirala, 2019) observed similar rates of prevalence; 59.1%, 54.7% and 63% respectively, indicating a high burden of ARIs among children especially in developing countries.

Upper respiratory tract infections were the most commonly observed ARIs. This could be due to the fact that infections of the upper respiratory tract are the most common of the ARIs (Kjærgaard *et al.,* 2019). Moreover, introduction of pneumococcal vaccine into the routine immunization schedule has substantially reduced the incidence of pneumonia in children (Mackenzie *et al.*, 2017), and together with effective use *Hemophilus influenzae* type b vaccine and the measles vaccine, increased immunity to respiratory infections, lowering incidence of infections of the lower respiratory tract (Gaude, 2016). Differentiation of the types of infections of the upper respiratory tract in this study was not possible since the facility uses the IMCI guideline that categorize respiratory illnesses based on the signs and symptoms of pneumonia.

5.1.3 Factors Associated with Occurrence of ARI

Among the individual level characteristics, gender, birth weight and nutritional status were significantly associated with occurrence of ARIs. Odds of getting an ARI infection among female children was significantly elevated by 59%. The link between the genders and susceptibility to ARIs is not well elucidated. Strength of inflammatory response characteristic of each gender and other genetic differences have been cited as determinants of susceptibility (Naheed *et al.,* 2019), although a retrospective study on the role of gender on the burden of ARIs conducted in Nigeria spanning twenty-four years did not observe any significant and consistent link between gender and occurrence of ARIs, even after controlling for potential confounding factors (Oremadegun and Myer, 2019). In concurrence with findings of this study, a study conducted in a community setting in Nigeria reported that the odds of infection among female children was 1.3 times significantly higher compared to their male counterparts (Ibama et al., 2017), although most studies Savitha and Gopalakrishnan, 2018; Marufa, *et al.*, 2019) have reported significantly higher prevalence of ARIs among male children.

Normal birth weight was significantly associated with occurrence of ARIs, lowering odds of infection by 94%. A possible explanation could be that most of the children were of relatively young mothers who were strictly adhering to antenatal care recommendations due to lack of prior experience that may have resulted to health antenatal growth and hence normal birth weight. Alternatively, majority of the mothers in this study were aged between 21-30, which is within the optimal child bearing age that could have contributed to healthy pregnancies and healthy outcomes. Moreover, birth weight has been shown to influence occurrence of ARIs due to its impact on immune maturity and lung development and function (Cardoso, Coimbra, and Werneck, 2013; Pinzón-rondón *et al.,* 2016).

Nutrition status was significantly associated with ARIs too, with stunting increasing odds of infection 11-folds. The high rate of stunting in this population has been strongly linked with socioeconomic status (KDHS, 2022). Young maternal age and the mothers' low literacy levels may have collectively compromised quality of care, resulting to poor nutrition of the child. Alternatively, the bidirectional relationship between infection and nutrition (Govers *et al.,* 2022), stunting may have triggered occurrence of ARIs in this population. Evidence shows that stunting compromises immune function by limiting production and functional capacity of the cellular components of the immune system which increases susceptibility to infections (Morais *et al.*, 2020) . In agreement with these findings ,Cox *et al.*,(2017), Marufa *et al.,* (2019) and Calder *et al.*,(2020) equally observed an association between ARIs and stunting.

Of the socio-demographic characteristics of the mothers of children who participated in this study, education level of mothers and their parity significantly influence the odds of infection. Primary education level of mothers significantly increased the odds of infection. A possible explanation could be that primary education was too low to make mothers knowledgeable of child care and stimulate awareness on health needs of the child. These mothers were therefore not capable of adopting behavior and practices that could potentially protect because of their low level of education. Moreover, their low level of education may have limited their employability and hence their financial situation that could have limited their ability to protect their children from ARIs, employed mothers supplement household income and have significant control over household resources, increasingly improving living conditions, quality of child care and health-seeking practices. In in agreement with these findings, Sonego *et al.,* (2015) reported that low maternal education significantly increased odds of mortality from infections of the lower respiratory tract by 43%, in a meta-analysis involving 14 studies and 26130 children in low and middle income countries. Further, Merera *et al.*, (2022) reported that prevalence of ARI was highest among children whose mothers had no education in a study conducted in Ethiopia.

Parity was also significantly associated with occurrence of ARIs. Odds of infection increased with increasing parity, probably due to higher costs of providing for children, yet most mothers were young and unemployed. It is therefore likely that with increasing number of children, quality of care decreased, increasingly exposing children to ARIs. A similar observation was made by Merera, (2021) in a study conducted in rural Ethiopia where prevalence of ARIs increased with increasing parity although parity itself was not significantly associated with occurrence of ARIs.

Maternal age was not significantly associated with occurrence of ARIs although odds of infection decreased with increase in the age of the mother. This could be attributed to greater experience in child care associated with older mothers. Alternatively, this observation could be due to greater involvement of older mothers in decision making on their child's care, practices and health choices relative to younger mothers, especially in patriarchal communities such as this community, since maternal ability to make decisions and self-reliance have been shown to influence occurrence or susceptibility to childhood infections (Dev *et al.*, 2021). Additionally, teenage pregnancy and young maternal age impacts negatively on a mother's health and wellbeing too, which equally affects a child's health, growth and development. In concurrence with our findings, Mir *et al.,* (2022) observed that maternal age was protective against ARIs and that odds of infection decreased with increasing age, while Morakinyo and Akineyemi (2018) consistently observed marginal to protective odds of infection among children whose mothers were aged between 30-39 over a duration of ten years in a study conducted in Nigeria. Moreover, Tazinya *et al.*,

(2018) reported that odds of infection were elevated by 12% among children whose mothers were twenty years and younger relative to those whose mothers were aged above twenty years in a study conducted in Cameroon, suggesting that young maternal age increases susceptibility of children to ARIs.

Of the exposure related socioeconomic characteristic, recent hospitalization was significantly associated with occurrence of ARIs. Recent hospitalization significantly increased the odds of infection by 8-times. Potentially high exposure to ARIs coupled with high susceptibility probably due to insufficient immune response to infections may account for this observation. Further, most of the children who participated in this study were aged below two years, an age group that has been shown to be highly susceptible to ARIs(Hasan *et al.,* 2022). Of the children who had been hospitalized in the preceding three months, 51.3% were hospitalized for respiratory-related illnesses, suggesting recurrence of ARIs.

Other socioeconomic status of mothers of children who participated in this study were not significantly associated with occurrence of ARIs. Poor housing; houses made of earthen floors and grass thatched with unplastered walls made of bricks and compacted with mud increased the odds of infection. Housing characteristics have been shown to influence indoor environment and air quality, significantly influencing occurrence of ARIs among children (Murray, 2012; Fakunle, Oluwaseun, Adelekan, and Bello, 2017; Fakunle *et al.,* 2017; Meng *et al.,* 2021). Moreover, most of the houses did not have windows, and windows were permanently closed in the few that had, limiting ventilation of the house while concentrating pollutants within the living area.

Utilization of biomass fuels for lighting or cooking also increased the odds of infection though not significantly. Biomass pollutants negatively affects respiratory surface, interfering with primary defense mechanisms that prevent entry of pathogens and initiate immune responses (Yaya & Bishwajit, 2019). Coupled with absence of ventilation of houses or even cooking within the living area, usage of biomass fuels in this population probably increased exposure to ARIs though not significantly due to homogeneity.

5.1.4 KAP of Mothers with Regard to ARIs Associated with Occurrence of ARIs

Over half of the mothers had good knowledge on causes of ARIs, and such knowledge was significantly associated with occurrence of ARIs with good knowledge reducing odds of occurrence by 39%. Ability to identify causes of ARIs in this study was possibly due to health education administered on mothers at the sub-county hospital on clinic days and community education conducted by community health workers at the community level. Such awareness may have enabled the mothers to protect their children from ARIs, resulting to reduced odds of infection.

Bacteria and viruses were relatively well recognised as causes of ARIs in this study, although most mothers only agreed that ARIs were caused by bacteria and viruses, and 23.6% and 19.8% of the mothers respectively disagreeing that viruses and bacteria are causes of ARIs. Participants observed that *"Viruses do not cause ARIs. They cause HIV/AIDS"* representing common opinion that pathogens do not cause ARIs. In agreement with these findings, a study on public knowledge on common cold conducted in Saudi Arabia similarly reported that only 36% of their respondents knew that bacteria were causative agents for common cold (Al-Haddad *et al.*, 2016). Further, only 19.8% of the participants in a hospital based survey in a separate study in Saudi Arabia correctly answered that ARIs are of bacterial or viral causes (Alluqmani *et al.*, 2017), while Gyawali *et al.*, (2016) reported that only 14.6% of the respondents correctly answered that viruses was a main cause of ARIs in a survey conducted in Nepal. Such sub-optimal knowledge on the role of viruses and bacterial in development of ARIs may be due to low literacy levels among mothers, especially in this study where most mothers lacked formal education or were educated up to primary level. In concurrence with common opinion, cold weather and taking cold drinks were perceived as important causes of ARIS in this study by almost half of the mothers. This finding agree with results from a survey conducted in Bangalore, where 96% of the participants identified cold as a cause of ARIs (Ramegowda *et al.*, 2018). Cold weather only impairs local and systemic defence mechanisms within the respiratory tract, increasing susceptibility to respiratory viruses (Moriyama *et al.*, 2020), although it is considered an important risk factor in development of ARIs.

Dust was identified as a major cause of ARIs too. Some infectious particles exist in the environment bound onto dust particles that also transmits them to susceptible hosts (Rosa *et al.,* 2011), a reason why dust is commonly perceived as a cause of ARIs.

Good knowledge on transmission, prevention and danger signs and symptoms of ARI was observed in this study although it was not significantly associated with occurrence of ARIs. 78.7% of the participants strongly agreeing that ARIs can be passed from one person to another. Acknowledging transmissibility of ARIs, it was reported that *"If a mother is coughing or sneezing, covering the mouth will prevent transmission from her mouth."* Such knowledge promotes protection of children from exposure though human-human contact. Knowledge on prevention of ARIs was relatively sub-optimal given the importance of immunization, breastfeeding and nutrition in preventing ARIs. Possibly, this could be due to the fact that breastfeeding and immunization are routine child care practices, that mothers may only perceive as essential without understanding their implication, especially where education level is low or community health education is not well administered. This finding suggests partial knowledge on awareness of these interventions that can negatively influence adherence to them, despite evidence (Mackenzie *et al.,* 2017; Frank, 2019) that they significantly prevent occurrence of ARIs in children. A similar level of awareness was reported by Bhalla *et al.,* (2019) in India, where only 41.6% of the mothers were aware that immunization prevents some ARIs, while Abdelatty *et al.,* (2022) rated knowledge on prevention of ARI among mothers unsatisfactory in a study conducted in Egypt. Collectively, these findings suggest poor consensus on the usefulness of childhood immunization and good breastfeeding practices in preventing ARIs among mothers in this population and similar settings.

Although pneumonia was not very prevalent in this study, 78.2% of the mothers strongly agreed that fast or difficult breathing was a danger sign in a child who has a cough or a cold. Possibly, this was because of perceived danger of laboured breathing rather than actual knowledge of pneumonia, as implied by a mother who stated that "*A child will have tightened lungs hence unable to breath well"*. Moreover, mothers presented gaps in knowledge on pneumonia as an ARI, being aware of fast and difficult breathing that they indirectly referred to as pneumonia although they were not able to accurately name pneumonia as an ARI. Consequently, it was noted that *"The baby can die. Pneumonia kills. When a child shows signs of pneumonia you have to take the child to the hospital very fast"*. An equally high awareness of danger signs of an ARI was reported in a study conducted in Congo (Ndjadi *et al.*, 2020), where 95% of the mothers had good knowledge on danger signs. Chand & Mohammadnezhad, (2022) further reported that mothers were able to recognize worsening ARI from a qualitative study conducted in Fiji, suggesting capacity of mothers to recognize a case of ARI that requires further medical attention.

This study observed positive although varied attitude towards health seeking for symptoms of ARIs that was significantly associated with occurrence of ARIs. Overall attitude towards symptoms ARIs in this study was good, with over half of the mothers presenting positive attitude. Portrayed attitude was significantly associated with ARIs, possibly because it is a strong determinant for health seeking.

75.3% of the mothers strongly agreed that they would seek health care in case their child presented with ear pain. This was most probably due to the effect of such pain on hearing rather than perception of ear pain as an indicator of an ARI. 71.2% of the mothers strongly agreed that they would seek care if their child presented with a dry throat, tentatively due to discomfort caused by a dry throat to a child and potential interference with feeding, which is worrisome to mothers. Most mothers; 62.9% only agreed that they would seek treatment if their child presented with fever, tentatively because fever is a common symptom of childhood infections with non-fatal outcomes or because it can be easily managed at home using antipyretics and other remedies. It was therefore observed that *"if the child has fever that is not clearing, it is dangerous",* suggesting that a child with fever is observed first before being presented for medical care, while implying that it is not perceived as a serious sign of ARI.

Positive attitude towards fast breathing as a reason for seeking care was however observed, with 80% of the mothers strongly agreeing that they would seek care in case their child presented with fast breathing. A possible explanation could be that mothers mostly perceive breathing difficulties as dangerous to a sick child. Moreover, the mothers showed good knowledge on pneumonia that could have informed the positive attitude towards signs of pneumonia. A similar attitude towards difficult breathing was reported by Akteruzzaman *et al.,* (2018) in a survey conducted in Bangladesh, where 87% of the mothers perceived that breathing difficulty warrants immediate care. Attitude towards cough was undefined, with only 43.9% of the mothers strongly agreeing that they felt it was a serious symptom to warrant immediate treatment and 49.1% other mothers agreeing that it needed consultation. It was indicated that *"if the child continues to cough for three or more days, we will take them to hospital"* suggesting non-committal attitude towards a cough, while implying that its management is conditional. Discomfort caused by coughing to a child including restlessness and feeding difficulties especially among younger children may explain why some mothers strongly agreed that they would seek care for a cough. It was therefore indicated that *"The baby's health will deteriorate. The baby will not be able to feed well"*. Equally, ability to manage cough using over-the-counter medicines and home remedies especially among older children, or its ability to clear on its own may account for the tendency to delay of seeking care, as it was noted that *"When the symptoms are starting, we give Panadol. If symptoms persist, we go to hospital, for older children. But for small children, even the doctors warn you against self-medication"*. In concurrence with this finding, only 41.9% of mothers indicated that they would visit a physician for a child with cough and fever in a study conducted in Saudi Arabia (Alluqmani *et al.,* 2017), and 42% in a similar study conducted in Bangladesh (Akteruzzaman *et al.,* 2018).

Runny nose was not strongly perceived as a symptom that would warrant immediate treatment, with only 23.9% of the mothers strongly agreeing that they would seek care and another 27.8% actually reporting that they would not seek care. Runny nose presents with varying severity across the ages. Among infants, it could be quite uncomfortable, with sneezing, nasal congestion and lethargy warranting immediate treatment. It can also be mild, self-limiting or manageable using home remedies, hence a child can be observed at home before seeking care, or not presented for treatment at all.

For practices regarding ARIs, practices to protect a child from ARIs, health seeking practices, treatment practices, identification of danger signs and symptoms on a child with a cough or a cold, and care practices were examined. Of the practices to protect a child from ARIs, childhood immunization was the most commonly practiced and it was associated with occurrence of ARIs. Confirming perceived importance of childhood immunization for prevention of childhood illnesses, it was indicated that *"a child should get all vaccinations. Vaccines protects the child from a lot of diseases."*. Uptake was however below universal coverage, suggesting failure of mothers to fully acknowledge immunization as a protective measure, while highlighting gaps in good child care practices. Chheng and Thanattheerakul, (2021) observed equally high though sub-optimal adherence to immunization in a study conducted in Cambodia, unlike Khan *et al.,* (2022) who observed high adherence to immunization in a study conducted in Pakistan, where 98% of the mothers responded that they immunize their children in order to protect them from ARIs. Adherence to immunization varies by setting and is influenced by factors such as socio-economics and adequacy of health infrastructure. Understanding of mothers on the role of immunization on child health, growth and development is however unclear, causing mothers to perceive it as a routine practice rather than necessary for the child's well-being. Only 58.4% of the mothers reported that they practice exclusive and prolonged breastfeeding to protect their children against ARIs. Possibly, mothers perceived these as normal child care practices, not necessarily understanding their implications. This may explain why most mothers only agreed that exclusive breastfeeding and prolonged breastfeeding can protect a child from ARIs. This sub-optimal adherence to breastfeeding corresponds to expressed level of knowledge on breastfeeding, where most mothers only agreed that exclusive breastfeeding and prolonged breastfeeding are protective of ARIs.

Healthcare seeking practices were not significantly associated with occurrence of ARIs and seeking health care did not lower the odds of infection. 97.1% of the mothers reported that they seek health care for their children whenever they developed symptoms of ARIs against 2.9% who preferred home care. It was indicated that *"take the baby to hospital because he might be getting worse as you wait"* and expounded that *"if the child wakes up with a cold, we take her to the* *hospital, but if the child develops fever later in the afternoon, we buy Panadol as we wait for tomorrow"* suggesting preference of allopathic care over self-treatment or observation. This finding compares well with the results of a study conducted in Pakistan by Shaikh *et al.,* (2019), that reported that 97% of their participants chose allopathic treatment. Bham *et al.,* (2016) and Aulakh, Khan, and Sana, (2018) equally reported consulting a qualified doctor as a preferred ARI treatment option among 89.1% and 89% of their respondents respectively. Of the mothers who preferred seeking health care, 66.6% of the mothers indicated that they sought care immediately or within 24 hours. Timing was probably determined by severity of the symptoms, age of the child and time of onset of the symptoms as mothers insinuated that *"if the child wakes up with a cold, we take her to the hospital, but if the child develops fever later in the afternoon, we buy Panadol as we wait for tomorrow"*.

Treatment practices too were not significantly associated with occurrence of ARIs, although absence of self-medication lowered odds of infection. 59.7% of the mothers reported that they administered non-prescribed drugs or gave home remedies to their children during an ARI episode. Confirming this outcome, mothers said that *"Herbs are used before going to hospital because you cannot mix herbs and medicine from the hospital"* and that *"if the infection is not serious, we use herbs, if there is no improvement, we take the baby to the hospital. But if the baby appears to be improving, we don't take him to hospital. In case the symptoms are serious we take the baby to hospital immediately without giving herbs"* clarifying how and when the herbs are used. A similar trend was observed by Bham *et al.,* (2016) who reported that 58% of their respondents practiced self-medication in a survey conducted in Pakistan as well as in India, where 56.4% of participants in a survey indicated giving children medicine at home without consulting a doctor (Bhalla *et al.,* 2019). Piriton, Panadol, action, headex, asprin, menthol rub, mara moja, and septrin, alongside traditional herbs were used for self-medication in this study. Very low administration of non-prescription antibiotics was however observed in this study unlike other studies (Al-Haddad *et al.,* 2016; Ocan *et al.,* 2017; Aulakh *et al.,* 2018) mostly due to low availability of over the counter antibiotics in retail shops within the community.

Ability to identify presumptive pneumonia in a child with a cough or a cold in this study was relatively low and it was not significantly associated with occurrence of ARIs. Only 14.5% and 5.2% of the mothers correctly responded that they considered difficult and fast breathing respectively, as danger signs in a child who has a cold or a cough. This outcome was reflected in the group discussions, where mothers did not clearly identify key symptoms of pneumonia, but rather expressed them as worsening of a child's condition, stating that *"if the symptoms that prompted me to take the baby to the hospital still persist while on treatment, we take the baby back to the hospital".* Possibly, mothers were not able to state difficult and fast breathing as expected, probably due to low literacy, having expressed strong agreement to the statement that these were danger signs on a child with an ARI. Gothankar *et al.,* (2018) and Al-noban and Elnimeiri, (2022) reported equally low capability to correctly name signs and symptoms suggestive of pneumonia in surveys conducted in India and Yemen respectively, although high awareness of signs and symptoms of pneumonia has been reported in other studies (Bham et al., 2016; Aulakh et al., 2018; Ahmed et al., 2019). Disparities could be due to differences in literacy and socio-economic characteristics.

Several practices for caring for a child with ARIs were observed although such practices were not significantly associated with occurrence of ARIs. Keeping a child warm was the most common care practice for a child with an ARI. t was explained that *"At home, we take the baby to bed once they sleep to protect them from cold. We dress them in warm clothes like sweaters, hats and socks"* and that *"we bathe the baby every day in warm water and dress them in warm clothes".* This could be due to common opinion that exposure to cold causes ARIs. A similar tendency was observed in a study conducted in Congo (Ndjadi *et al.,* 2020), where 99% of the respondents indicated dressing a child in layers of clothes as a care practice for a child with an ARI. Treatment of ARIs majorly revolves around managing symptoms hence keeping a child warm and generally comfortable to get enough rest are considered key care approaches (Kauchali *et al.*, Biezen *et al.,* 2017).

Frequent breastfeeding was identified as a care practice by 36.6% of the participants in this study. It is likely that mothers in this study were unaware of the need to increase fluid intake in a child with an ARI in order to maintain normal hydration. Frequent breastfeeding in this study was lower than that reported in a study in Nepal, (Gyawali *et al.,* 2016) in which more than half of the respondents reported breastfeeding a child more frequently during an ARI episode. Frequent feeding and giving the child enough food was indicated by 27.1% of the mothers, with 3.6% reporting that they only increased food rations and feeding frequency after the child recovered. A similar tendency was reported by a study conducted in Kenya (Amuka *et al.*, 2020), where only 39.7% of the respondents indicated giving more than usual feeds, while Khalek and Abdel-salam, (2016) reported that the highest percentage of mothers gave somewhat less drinks and food, with only 9.4% and 1.8% giving much more drinks and food respectively while caring for a child with an ARI. Restriction of feeding, limiting food quantities or withdrawal of complementary feeds during an ARI episode is tendency a common practice due to perceived or real anorexia, as well as low awareness of nutrition needs of a sick child among caregivers. Consequently, it was indicated that *"the amount of food the baby eats reduces because the baby usually does not have much appetite when having a cold. We feed the child as usual on usual schedule as they should but the quantity they eats reduces. If we give the same quantities, the baby will eat less because of the sickness",* and that "*The amount of food the baby eats reduces because the baby usually does not have much appetite when unwell".* Mothers hardly increase fluids intake for the sick child too. Only 10.4% of the mothers reported that they increased fluid intake for their sick children, while another 33.8% indicated that they breastfed their child more frequently. It is likely that mothers were not aware of the need for fluid replacement during an infection and its role of lowering the risk of dehydration. In contrast, respondents in a study on practices for caring for a child with an ARI (Afrieani, 2017) indicated that they always gave more fluids to the sick child to prevent dehydration.

Nasal cleansing/clearing was only practiced by 17.7% of the mothers. Evidence suggests that nasal cleansing by saline nasal irrigation may have some beneficial effects on patients with URTIs, including relaxing symptoms, reducing nasal secretion and obstruction and improving breathing (King *et al.*, 2015; Ramalingam *et al.*, 2019). In this study, nasal clearing was achieved using cotton buds or a folded piece of cloth as indicated by an FGD that stated that *“dip a clean cloth in warm water and use it to clean the noses’’,* since nasal saline drops were not routinely prescribed at the health facility. The practice of nasal cleansing in this study was however lower that that observed in study conducted in Congo (Ndjadi *et al.*, 2020), where 78% of the respondents indicated that they cleaned a child’s nose with a cotton bud as a care practice. Administration of remedies such as honey or herbs alongside conventional medicine for soothing the throat or easing respiratory congestion during an ARI episode was not observed in this study.

This study had some limitation that may affect interpretation of its findings. The study applied a cross-sectional design that does not allow causal inferences to made and does not effectively detect small differences. The study was carried out with a health facility testing, therefore based its calculation of prevalence on persons who sought care. The prevalence might therefore not represent actual prevalence in the population since some mothers do not seek healthcare for ARIs due to various reasons. Further, by conducting the study in a hospital setting, the sample may have selectively included persons with good health seeking practices, biasing responses.

5.2 Conclusions

1. This study observed a high prevalence of seating ARIs among children aged below five years.
2. Infections of the upper respiratory tract were prevalent in this study relative to those of the lower respiratory tract.
3. Host and socio-economic characteristics were significantly associated with occurrence of ARIs in this population.
4. Good knowledge on ARIs and desirable attitude towards ARIs was observed.
5. Practices regarding ARIs were sub-optimal.

5.3 Recommendations

1. A larger study or a surveillance system for ARIs is recommended in order to understand the epidemiology of ARIs as well as associated etiologies which will inform control and prevention efforts.

2. Targeted community health education should be conducted in this community to educate mothers and the community at large on prevention and management of ARIs alongside other childhood illnesses.
3. Interventions targeting maternal and child health, such as vaccination campaigns and promotion of utilization of maternity services be strengthened.

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APPENDICES

Appendix I: Consent form- English version

Title of the study; factors influencing acute respiratory tract infections among children under the age of five attending outpatient care at Kinango sub-County hospital

Investigators; Betty K. Muriithi- Jomo Kenyatta University of Science and Technology

Study location; Kwale NUITM-KEMRI HDSS area

Introduction

I am doing research on occurrence of ARIs and factors that determine their occurrence. I would like you to participate in this research by responding to questions that I will be asking you concerning yourself and your child. You are free to decide whether you want to participate in this research or not. If you choose not to participate, this will not affect the way you are served at this clinic in any way. I will provide you with all the information you need to know about this research and feel free to ask me a question.

Growth and development of children in Kwale County is not as optimum as it should be. Infectious diseases and poor nutrition are among the reasons for poor growth and development of children. Also, false knowledge such as traditional practices and lack of correct information on child care and health is usually spread, causing mothers to use wrong child care practices. Such practices can affect growth and development of the child and cause a child to easily get sick.

This study will examine occurrence of ARIs among children aged five years and bel to establish the number of children affected by ARIs in this community. The study will also establish the reasons why children are affected by these infections. This information will help the authorities to develop strategies of preventing ARIs. I kindly request you to participate in this study, and to allow your child to participate.

Research procedure

If you agree to participate, we will ask you questions about yourself, your home and your child including whether the child was fully immunized, how many more other children you have, your child's age and sex, where you delivered your child, how you care for your child when he or she has infections like common cold or flu, among others. The questionnaire will be administered once and it will take a short while.

The information that we will get from this research will be shared with you and your community through the health facility in form of education during the growth monitoring days. The information will also be published so that other interested people like the Ministry of Health can benefit from the research.

Alternative research procedures

There will be no alternative research procedure.

Study participants

The study will recruit children aged five years and below presenting for care at the outpatient department together with their mothers, who will be willing to participate in the study voluntarily. You can choose whether you want to participate in this study or not. In case you will not be willing to participate, you will continue receiving services at this clinic as usual.

Research duration

The research will be conducted from November 2017 to February 2018 at Kizibe and Kinango health centers.

Risks

You might have to share some personal or confidential information with me as you respond to the questions, I will be asking you. However, in case you feel like the information is too personal or you are not comfortable discussing some issues, you may choose not to answer the question.

Benefits

The information you will share with me will not benefit you directly but your participation will help us to know important causes of ARIs among children. It will also help in planning for health care delivery in this area which can improve healthcare for your child at this clinic or even enable you to be given more information on how to care for your child, with or without an infection.

Confidentiality

Neither your name nor that of your child will appear on any of our records. Your details will also not appear in publications. Study records will only be accessible to the researcher.

Withdrawal from the study

Participation in the study will be on free will. You may choose not to participate. Your child will be requested to provide verbal assent if he/she agrees to participate in the study. You or your child will be free to withdraw from the study at any time without loss of benefits. if you agree to participate in the study, you will be requested to sign this form and you will be provided with a personal copy.

Contact

For any questions about the study or if you experience any problem after participating in this study, kindly contact the researcher (Betty Muriithi- 0727 558279) or her representatives for assistance. You may also contact **The Secretary, KNH-Upon ERC on uonknh_erc@uonbi.ac.ke**

I have read the above information/received explanation concerning the study and understood. My questions have been satisfactorily responded to. I agree to participate in this study and consent for participation of my child too.

Child’s name ……………………. …..…………………………………....

Name of parent/guardian: ……………………………………………..……….

Signature of parent/guardian……………….………Date…………………………

Signature of witness: ……………………………. Date ……………………..…….

Investigator’s signature:…………………Date …………………………

Appendix II: Consent form- Kiswahili version

Jina la utafiti; Tukio zinazochangia maambukizi ya magonjwa ya njia ya kupumua miongoni mwa watoto walio chini ya miaka mitano katika kituo cha afya cha Kinango

Mtafiti; Betty K. Muriithi- Chuo kikuu cha Jomo Kenyatta cha kilimo na Teknolojia

Eneo la utafiti; Kinango

Utangulizi

Ninafanya utafiti kuhusu matukio ya magonjwa ya njia ya kupumua na yanayosababisha maambukizi haya miongoni mwa watoto walio chini ya miaka mitano. Ningependa ushiriki katika utafiti huu kwa kujibu maswali nitakayokuuliza kuhusu wewe mwenyewe na mtoto wako. Jisikie huru kuamua kama unataka kushiriki katika utafiti huu au la. Kama utachagua kutoshiriki, uamuzi wako hautaathiri huduma unazopata katika kliniki hii kwa njia yoyote. Nitakupa taarifa yote unayohitaji kujua kuhusu utafiti huu. Jisikia huru kuniuliza swali lolote.

Ukuaji wa watoto katika Kaunti ya Kwale haujahitimu ubora unaohitajika. Maradhi ya kuambukizwa na lishe duni ni mojawapo ya sababu za ukuaji duni wa watoto katika eneo hii. Ujuzi duni kama vile mazoea ya kitamaduni na ukosefu wa habari sahihi kuhusu utunzaji wa watoto na afya kwa kawaida kiwaid huenea, na kusababisha akina mama kutumia mazoea yasiyofaa kuwatunza watoto. Mazoea kama haya yanaweza kuathiri ukuaji wa mtoto, na kusababisha mtoto kuugua mara kwa mara.

Utafiti huu utachunguza maradhi ya njia ya kupumua miongoni mwa watoto walio chini ya miaka mitano. Pia, utafiti utabainisha sababu za watoto kupata maradhi haya. Ujumbe huu utawawezesha viongozi wa idhara ya afya kuunda mikakati ya kukinga watoto kutokana na maradhi haya. Naomba ushiriki katika utafiti huu, na umruhusu mwanao kushiriki.

Utaratibu wa utafiti

Ukikubali kushiriki katika utafiti huu, tutakuuliza maswali na baadaye tuchambue majibu yako. Maswali yatakuwa kukuhusu wewe, hali ya unapoishi na ujumbe kuhusu mtoto wako, kama vile kama mtoto alipewa chanjo kikamilifu, idadi ya watoto ulionao, umri wa mtoto na jinsia, mahali ulijifungulia, na jinsi unavyohudumia mtoto anapopata ambukizi la njia ya kupumua.

Wewe na wakaaji wa eneo hii mtaelezwa matokeo ya utafiti huu kupitia kwa kituo hiki cha afya. Pia, ujumbe utachapishwa katika jarida la kisayansi ili wadau wengine kama Wizara ya Afya wanufaike kutokana na utafiti.

Taratibu mbadala wa utafiti

Hakutakuwa na utaratibu mbadala katika utafiti huu.

Washiriki wa utafiti

Utafiti huu utahusisha watoto walio chini ya miaka tano, watakaokuwa wakitembelea hospitali ya Kinango kwa matibabu, wakiwa na mama wao, ambao watakubali kushiriki kwa utafiti. Kushiriki katika utafiti kwa hiari yao. Unaweza kuchagua kushiriki katika utafiti huu au la. Iwapo hautakubali kushiriki, utaendelea kupokea huduma katika hospitali hii kama kawaida.

Muda wa utafiti

Utafiti utafanywa kuanzia Novemba 2017 hadi Februari 2018 katika kituo cha afya cha Kinango.

Hatari

Hatari kuu ni kwamba utahitajika kutupatia maelezo ya kibinafsi kukuhusu ama kuhusu mtoto wako. Hata hivyo, iwapo utahisi kwamba masuala mengine ni binafsi sana ama kama haitakuwa rahisi kwako kuyajadili, unaweza kuchagua kutojibi maswali hayo.

Faida

Kushiriki kwako katika utafiti huu hautakufaidi moja kwa moja lakini kutatusaidia kujua matukio muhimu yanayosababisha maambukizi ya njia ya kupumua miongoni mwa watoto. Pia kutasaidia katika kupanga huduma za afya zinazotolewa na serikali na hivyo basi kutaweza kuboresha afya ya mtoto wako katika hospitali hii au hata kukakuwezesha wewe kupewa habari zaidi juu ya jinsi ya kuhudumia mtoto wako apatapo maambukizi haya na mengineyo.

Usiri

Hatutarecordi jina lako wala la mtoto wako. Kwa hivyo haitawezekana kukuambatanisha na utafiti huu, ama kujua yakwamba ulishiriki. Hakuna mtu mwingine atakayeweza kuona rekodi hizi isipokuwa watafiti pekee.

Uondoaji kutoka utafiti

Uko na uhuru wa kuchagua kushiriki au kutoshiriki katika utafiti huu. Wewe au mtoto wako atakuwa huru kujiondoa katika utafiti huu wakati wowote bila hasara yoyote. Kama unakubali kushiriki katika utafiti, tafadhali tia sahihi yako katika fomu hii. Utapewa nakala yako ya fomu uliyotia sahihi.

Mawasiliano

Kwa maswali yoyote kuhusu utafiti au kama utapata tatizo loloote baada ya kushiriki katika utafiti huu, wasiliana na mi (Betty Muriithi- 0727 558279-mtafiti mkuu) au wawakilishi wangu kwa msaada. Unaweza pia kuwasiliana na Katibu Mkuu, UoN-KNH ERC.

Nimesoma maelezo ya idhini hii na nimepokea ujumbe kuhusu utafiti huu na kuelewa. Maswali yangu yamejibiwa kikamilifu pia. Mimi nakubali kushiriki katika utafiti huu na kukubalisha ushiriki wa mtoto wangu pia.

Jina la mtoto ....

Jina la mzazi / mlezi: ....

Saini ya mzazi / mlezi .... Tarehe ....

Saini ya shahidi. .... .Date ....

Sahihi ya Mtafiti: .... Tarehe ....

Appendix III: Questionnaire

Questionnaire ID number___________________________ Date of interview: DD/MM/YYYY

Village/location ____________________________

1. Does the child have an ARI?
   1. Yes 2. No

(Indicate diagnosis)____________________________

SOCIAL DEMOGRAPHIC CHARACTHERISTICS

2. Gender	3. Age (Yrs./ months)	4.Height (cm)	5.Weight (Kg)	6. Birth weight (Confirm from MCH card)	7.Was the baby born at term	8. Place of birth
1.Male/ 2. Female					1.Yes 2. No	1.Home 2.Hospital

9. Age of respondent	10. Marital status of respondent	11. Education level of respondent	12. Education level of respondent's spouse	13. Employment status of respondent	14. Spouse employment status	15. Parity	16. BabyBirth order
	1. Married 2. Divorced/ separated 3. Widowed 4. Single 5. Other	1. Informal education 2. Primary school 3. Secondary school 4. Tertiary education 5. No formal education	1. Informal education 2. Primary school 3. Secondary school 4. Tertiary education 5. No formal education	1. unemployed 2. Private sector employee 3. Government employee 4. Self-employed 5. Other	1. Not employed 2.Private sector employee 3.Government employee 4.Self-employed 5.Other		

HOUSING CHARACTERISTICS

What material is your house'							
17. Roof	18. Wall	19. Floor	20. No. of rooms	21. No. of windows	22. Type of kitchen?	23. Main source of fuel for cooking	24. what is your means of lighting
1. Iron sheet 2. Grass 3. Tiles 4. Other	1. Bricks/blocks 2. Mud 3. Timber 4. Iron sheets 5. Other	1. Cement 2. Earth 3. Tiles 4. Other			1.Inside the main house 2.Kitchen detached from main house 3. Cook from open area 4. Other	1. Charcoal 2. Firewood 3. Sawdust stove 4. Paraffin stoves 5.Gas cookers 6.Electric cooker 7.Others	1. Kerosene lamp 2. Electricity 3. Firewood 4. Wick lamp

25. Number of people who live in the household (including this child)

____

26. Does the child sleep in the same house used for cooking?

1. Yes 2. No

27. Immunization status

	Age	**Vaccine**	**Received**	**Not received**
1	At birth	BCG		
		OPV		
		HEP. B		
2	6 weeks	OPV 1		

		DPT/HEP.B/HIB		
		Pneumococcal Vaccine		
		Rotavirus		
3	10 weeks	OPV 2		
		DPT/HEP.B/HIB		
		Pneumococcal Vaccine		
		Rotavirus		
4	14 weeks	OPV 3		
		DPT/HEP.B/HIB		
		Pneumococcal Vaccine		
		Rotavirus		
5	6 Months	Vitamin A		
6	9 Months	Measles		

FEEDING HABITS

28.At which age was this child introduced to other foods other than breast milk?

1. At birth
2. At 1 month
3. After 2 months
4. After 3 months
5. After 4 months
6. After 5 months
7. After 6 months
8. I don't know

29. (If the child is less than 2 years) Is the child still breastfeeding?

1. Yes 2. No 3. I don't know

30. If the child is not breastfeeding, at what age did they stop breastfeeding?

____

31. For children above 6 months; how many times do you feed this child in a day?

1. Once

2. Twice
3. Thrice
4. As many times as the child wants to eat

32. Is the baby usually in the kitchen while you are cooking?

    1. Always   2. Sometime   3. Not at all

33. Does anybody in your house smoke cigarettes?

    1. Yes   2. No

34. If yes, specify whether smoking is in the same room with the child

    1. Yes   2. No

35. Do you have children in your house who go to school?

    1. Yes   2. No

KAP of ARIs; Knowledge (Tick all that apply)

Knowledge

36. The following are symptoms of acute respiratory infections; (cut point cough and difficult breathing)

Cause	**Strongly agree**	**Agree**	**Disagree**	**Strongly disagree**	**Uncertain**
Cough					
Fever					
Sore throat					
Pain while swallowing					
Wheezing					
Runny nose					

37. The following are the causes of ARIs;

Cause	**Strongly agree**	**Agree**	**Disagree**	**Strongly disagree**	**Uncertain**
Bacteria					
Virus					
Kijicho					
Dust					
Exposure to cold weather					
Cold drinks					
Others					

38. ARIs can be passed from one person to another
    1. Strongly agree 2. Agree 3. Disagree 4. Strongly disagree 5. Uncertain
39. Some ARIs can be prevented by immunization
    1. Strongly agree 2. Agree 3. Disagree 4. Strongly disagree 5. Uncertain
40. Breastfeeding the baby exclusively and continuing to breast feed after six months can protect the baby from getting an ARI
    1. Strongly agree 2. Agree 3. Disagree 4. Strongly disagree 5. Uncertain
41. Fast/difficult breathing is a danger sign in a child who has a cough or cold
    1. Strongly agree 2. Agree 3. Disagree 4. Strongly disagree 5. Uncertain
42. Good nutrition can protect a child from getting and ARI
    1. Strongly agree 2. Agree 3. Disagree 4. Strongly disagree 5. Uncertain
43. I have information on /I am aware of ARIs in children
    1. Strongly agree 2. Agree 3. Disagree 4. Strongly disagree 5. Uncertain

Attitudes

44. ARIs are dangerous diseases
    1. Strongly agree 2. Agree 3. Disagree 4. Strongly disagree 5. Uncertain
45. I get worried when my baby presents fast or noisy breathing (difficult breathing)
    1. Strongly agree 2. Agree 3. Disagree 4. Strongly disagree 5. Uncertain
46. Symptoms of respiratory diseases are common and they do not arouse particular concern
    1. Strongly agree 2. Agree 3. Disagree 4. Strongly disagree 5. Uncertain
47. Do you think a child should be taken to a health facility immediately if the child has;(ask 'kwa maoni yako….')

Symptom	Strongly agree	Agree	Disagree	Strongly disagree	Uncertain
Fever					
Cough					
Runny nose					
Fast breathing					
Dry throat					
Ear pain					

Practices (Tick all that apply)

48. What do you do to protect your child from ARIs?

    1. Breastfeeding the baby exclusively and continuing to breastfeed after six months
    2. Dressing the child warmly
    3. Ensuring that the child is fully immunized
    4. Observing proper nutrition for the child
    5. Keeping the child away from pollutants like firewood smoke or cigarette smoke
    6. Observe hygiene

7. Do not know
8. Other (specify)_______________

49. What do you do when your child develops a symptom of a respiratory infection

1. Take them to hospital
2. Consult a neighbor who also has children
3. Observe the child at home to see whether the symptoms will clear
4. Observe the child at home while treating him/her with medicines obtained from a chemist
5. Observe the child at home while treating him/her with medicines that remained the last time he/she had an ARI (probe the drugs)
6. Manage the child at home using homemade remedies
7. Ignore the symptoms

53. If answer is 1, when would you take him/her to the health facility?
    1. Immediately/within 24 hours
    2. When the symptoms become severe
    3. Other (kindly explain your answer)
54. If answer is 6[ignore the symptoms] why so?
    1. It is not a serious condition
    2. These symptoms clear on their own
    3. Other [specify]__________________
55. Do you give drugs or homemade remedies to your child who has a cough or running nose or a fever before going to the hospital?
    1. Yes 2. No
56. If yes, which drugs do you give to the child (list all mentioned)

___
57. How long do you give your child the medicine given at the health facility?
    a. Until the child gets well
    b. For a week
    c. For the number of days instructed by the doctor
58. What do you do in case your child fails to improve after completing prescribed treatment? Buy them another dose of similar medicine

1. Wait for them to recover
2. Take them back to the health facility
3. Take them to a traditional healer
4. Other ____________________

59. If answer is 3; which symptoms will make you take the child back to the health facility?
    1. Difficulty in breathing
    2. Fast breathing
    3. Inability to drink or feed well
    4. The child becomes more sick
    5. Abnormally sleepy or difficult to wake
    6. Other ______________________
60. How do you take care of your child who has a cough or cold?
    1. Breastfeed frequently for children under six months and those still breastfeeding
    2. Give him or her enough food
    3. Increase feeding after illness
    4. Give him or her more fluids like milk porridge and water (older children)
    5. Dess him or her warmly
    6. Clear the nose of younger children
    7. Manage fever
    8. Soothe throat and relieve the cough with a safe remedy
    9. Any other (specify)________________
61. Has anybody had a respiratory illness in the family in the last two weeks?
62. Has this child been hospitalized in the past 3 months?
    1. Yes 2. No
63. If yes, how many times?
64. What was the most recent cause of hospitalization?

Appendix IV: Focus group discussion guide

Introduction (1 minute)

Welcome and thank you for taking time to participate in this discussion today. My name is Betty Muriithi, I am a student at Jomo Kenyatta University of Agriculture and Technology. I am carrying out a study on occurrence of acute respiratory tract infections among children aged below five years in this area.

With me is ______________, your CHV, she will be assisting in this session.

Ground Rules (1 minute)

We are interested in all of your opinions and feelings and therefore do not fear while giving your opinions. We need your ideas, so any criticisms you have will not hurt our feelings. We encourage you to provide frank comments that will improve our study. Some of you may agree or disagree with each other, which is perfectly normal, but please do not comment on others' views as wrong or right. Do not wait for the moderator to ask for your opinion. Feel free to speak at any time, however, please try to avoid interrupting others while they are talking. Everyone will have a chance to speak and all ideas, concerns, and opinions are of value to us. The session will last for about 50 minutes.

Confidentiality (1 minute)

Everything that we will discuss is confidential and we will not tell anyone that you participated in this discussion. A tape recorder will record the discussion because we do not want to miss any of your comments. No one outside this room will have access to these tapes and they will be destroyed after the report is written. My assistant will also take some notes that will also help us in report writing. Does anyone have any questions or clarifications?

Self-introduction- name age parity

Venue:……………. Note-taker:……………………………

Time started:………………………….. No. of participants at start:……………

Time Stopped:…………………………. No of participants at stop: …………….

Script code:…………………………….

General illness information in the community (12 minutes)

1. Give me some examples of ARIs
2. What causes ARIs? (probe belief in supernatural causes or curses)/what type of children get ARI/why do some children get ARI while some others do not get
3. How do you know that a child has an ARI?
4. What can you do to protect your child from getting an ARI
5. What are your concerns (wasiwasi) when your child has an ARI?
6. What do you do when your child starts to develop symptoms of ARIs?
7. What will trigger you to take the child to the hospital
8. What prevents you from taking the child to the hospital? Probe; or delay to take the child to hospital
9. How do you care for your child when he or she gets an ARI? (Probe Feeding practices during ARI episodes)
10. What danger signs do you look out for when your child has an ARI
11. Have you received any information regarding ARIs in children on causes care and management? (Probe; knowledge of pneumonia/ signs/symptoms)
12. What message have you heard/seen on treatment/management of ARIs in children
13. Information needs

Wrap-up (5 minutes)

Before we close, do you have any questions for us? We have discussed a lot of issues about ARIs in young children today and we want to thank you for your participation.

Appendix V: Publication

Austin Journal of Public Health and Epidemiology

Open Access

Austin Publishing Group

Research Article

Occurrence of Acute Respiratory Tract Infections among Children Under Five Years Attending Kinango Sub-County Hospital, Kenya

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Abstract

Objective: To examine occurrence of Acute Respiratory tract Infections (ARIs) and determine factors associated with ARIs among children under five years attending Kinango Sub-County Hospital.

Methods: A cross-sectional survey was conducted among mother-child aged between 0-59 month's pairs attending outpatient care. Participants were recruited using systematic sampling method. Data was collected using an interviewer-administered structured questionnaire. Descriptive statistics were used to summarize child, parental and environmental characteristics. Factors associated with ARIs were established using binary logistic regression analysis. Odds Ratio (OR), at 95% Confidence Interval (CI) and p <0.05 significant level was used to describe an association between covariates and the outcome variable. Independent factors associated with occurrence of ARIS were determined by stepwise logistic regression.

Results: 385 children participated in this study. 228 children (59.2%) presented with ARIs, of which 90.8% were due to acute upper respiratory tract infections. 9.2% of the cases were due to pneumonia. Female gender aOR 3.39 [1.21-9.46], stunting aOR 3.62 [1.04-12.61], high parity aOR 11.45 [2.38-55.09], low maternal education aOR 3.54 [1.10-11.32] and recent hospitalization aOR 8.19 [1.75-38.43] increased the odds of occurrence of an ARI while normal birth weight aOR0.06 [0.01-0.62] was protective of ARIs.

Conclusion: A high prevalence of ARIs among children aged below five years was observed in this study, associated with gender, stunting, parity, maternal education, birth weight and recurring hospitalization. Improvements in literacy levels, child nutrition and maternal and child health at large could help to reduce morbidity due to ARIs in this population.

Keywords: Prevalence; Children under five years; Acute respiratory tract infections

Introduction

Acute Respiratory Tract Infections (ARIs) are infections of the respiratory tract of ranging severity that affect both upper and lower respiratory structures, and related organs [1]. They are among the most common causes of morbidity and mortality among children under the age of five years. They account for up to 50% of all diseases that children under five years encounter [2] and a third of under-fives deaths in developing countries [3,4]. According to GBD 2017, mortalities due to acute lower respiratory tract infections only were 118.9 per 100,000 children under five years globally, representing 15% of all under-fives deaths [5]. Over half of all diagnosis among children presenting with ARI symptoms are usually due to acute upper respiratory tract infections [6,7]. A child can experience up to eight episodes of ARIs of varying severity in a year [8-10].

Although ARIs are common among both children and adults, universal treatment is still lacking due to the nature of their causative agents and diagnostic uncertainty. Symptoms of common infections such as the common cold typically clear in one to two weeks but the symptoms can be quite distressing to both the child and caregiver. Moreover, the infection can spread to other parts of the body resulting to more serious clinical disease and even fatality. Respiratory viruses have been shown to have neuroinvasive capacity [11] that results to various types of encephalopathy, alongside other systemic effects due to extension of microbial toxins, inflammation and reduced lung function [12]. ARIs are also a common reason for administration of antibiotics. Approximately 33% of consultations for a child with an upper respiratory tract infection specifically ends up with an antibiotic prescription [13]. Such irrational administration of antibiotics is steadily yielding resistance to convectional antibiotics, reducing therapeutic options for management of bacterial infections [13,14].

Given the nature of childhood ARIs, prevention and control present more viable options for management of ARIs. Several risk factors for ARIs have been postulated [15,16], that modulate occurrence of ARIs, although these differ widely. Proper understanding of the drivers of occurrence of ARIs in particular settings is therefore necessary for

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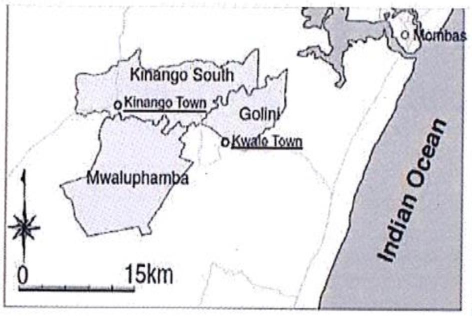

Figure 1: Study site.

development of appropriate prevention and control algorithms. The aim of this study was to examine occurrence of ARIs among children aged below five years attending Kinango Sub-County hospital and determinants of their occurrence.

Methods

Study site

The study was conducted in Kinango Sub-County Hospital, located in Kinango town within Kinango Sub-County in Kwale County, Kenya (Figure 1). The hospital is a level 4 facility with a 94-bed capacity. It has a dedicated maternal and child health clinic, and an outpatient department that serves both adults and children. The hospital's community linkage is well developed, with the community health volunteers actively involved in linking the community to primary care. The hospital's catchment area covers both rural and semi-urban settlements, with varying levels of access by the community.

Kwale County is mostly sparsely populated with a poverty index of 41.8% [17]. It is served by one level four hospital, two level three hospitals and thirty-four level two public health facilities. The average distance to the nearest health facility is about seven kilometers [18].

Study design and sample size calculation

A cross-sectional hospital-based study was conducted. Sample size was calculated using Cochrane formula [19], with a sampling error of 5% at 95% confidence interval assuming a prevalence of 50%, yielding a minimum sample of 385.

Study population

Study subjects were children aged below five years and their mothers. Systematic sampling was used to randomly select study participants. About 800 children aged below five years are usually seen at the outpatient clinic per month. Data was collected from November 2017 to January 2018, during which approximately 2400 children aged below five years were treated. Using a sampling interval of six, every 6th mother-child pair was selected to participate in the study starting from a random point until the sample size was achieved. Children whose mothers consented for their participation were included in the study. Children who were accompanied by caregivers were excluded as well as children whose mothers declined consent.

Study procedure

Recruitment of study participants was conducted during routine outpatient care. Objectives and procedure of the study were explained to the mother-child dyads at the outpatient clinic before consultation. Based on description by WHO [20], an ARI was defined as any acute episode of runny nose, cough, ear discharge, pain or itch, sore throat or hoarseness of voice, difficult or fast breathing with or without fever, or chest in drawing. Upon consultation, cases were classified using the Integrated Management of Childhood Illness (IMCI) criteria [21]. The diagnosis of children who were not suffering from an ARI was also clearly recorded on the health cards. Recruitment of study participants was conducted at the records department after going through the consultation process. Every 6th mother-child pair was requested to participate in the study. In case a selected subject declined consent, the next mother-child pair was requested to participate. The consent form was read and explained to those who agreed to participate in the study after which they were requested to sign the consent document.

Data collection

Following consenting, data collection was conducted using an interviewer-administered structured questionnaire. Presence or absence of an ARI was recorded from the patient's health card. Birth and immunization details of the child were obtained from the maternal and child health booklet where possible or parental recall. The child's weight and height were then taken for computation of Z-scores. The height of infants (0-23 months) was measured in recumbent position using a wooden height board. Heights of children aged above two years were measured in standing position using a vertical height board. The child was placed on board base, to stand in in upright position with head held upright, and back of the head, back and heels against the board. Children aged 0-6 months were weighed using an electronic scale in lying position. Older children who could not stand were weighed in sitting position while those who could stand were weighed in standing position, all lightly dressed.

Statistical analysis

Data was entered into Microsoft access (2016) and exported to STATA Version 14 [22] for analysis. Socioeconomic indicators were summarized using Principal Component Analysis (PCA). Wealth quintiles were then generated and grouped into low, middle and high socioeconomic status. Descriptive and summary statistics were used to summarize child, parental and environmental characteristics in order to describe the study population and calculate the prevalence of ARIs. Factors associated with occurrence of ARIs were established using binary logistic regression. Association was measured using odds ratio at 0.05 significant level and 95% confidence interval. Multivariable regression model was constructed by stepwise estimation, using backward selection. Variables with a P-value greater than or equal to 0.2 were removed sequentially. The model was adjusted for age of the children, gender, birthweight, immunization status, breastfeeding status, underweight, stunting, parental characteristics, exposure to school-going children, contact with an infected person in the past two weeks, previous hospitalization, household density and socio-economic status.

Results

Out of the 385 children who participated in the study, 228

Table 1: Diagnosis observed among study children.

Diagnosis	Number of Children	%
Acute respiratory infection	216	56.1
Acute respiratory tract infection with co-infection	12	3.1
Acute febrile illness	53	13.8
Dermatological conditions	40	10.4
Gastrointestinal infection	19	4.9
Malaria	4	1

(59.2%) presented with ARIs. 5% were co-infected mostly with gastrointestinal and dermatological conditions. Acute febrile illness and dermatological conditions were frequently reported as shown on Table 1. According to IMCI guidelines, 207 (90.8%) children had ARIs and 21 (9.2%) had pneumonia. No cases of severe pneumonia were observed.

Demographic characteristics of study children

Of the study sample, 192 (49.9%) were male. Mean age was 22.14 ± 14.7 months. Majority of the participants; 237 (61.6%) were aged below two years of whom 58 (15.1%) were aged below six months. Only 95 (24.7%) children were born at home. Average breastfeeding duration was 20.1±5.1 months. Children who were fully immunized as per schedule were 277 (72%) as shown in Table 1. Prevalence of underweight, stunting and wasting was 15.8%, 26.3% and 11.4% respectively.

Table 2: Demographic characteristics of study children and association between ARIs and children's demographic characteristics.

Characteristic	No. of Participants (%)	No. of Cases (%)	OR (95% CI)	P-value	Adjusted OR (95% CI)	P-value
Age (Months)						
0-6	58 (15.1)	33 (56.9)	1.06 (0.57-1.96)	0.846		
7-12	67 (17.4)	42 (62.9)	1.35 (0.74-2.44)	0.318		
13-24	112 (29.1)	71 (63.4)	1.39 (0.84-2.30)	0.196		
25-59	148 (38.4)	82 (55.4)	Reference			
Gender						
Male	192 (49.9)	103 (53.6)	Reference		Reference	
Female	193 (50.1)	125 (64.8)	1.59 (1.05-2.39)	0.027	3.39 (1.21-9.46)	0.02
Birth Weight						
Low	25 (8.9)	15 (60.0)	Reference		Reference	
Normal	256 (91.1)	151 (59.0)	0.96 (0.41-2.22)	0.921	0.06 (0.01-0.61)	0.018
Place of Birth						
Home	95 (24.7)	54 (56.8)	Reference			
Hospital	290 (75.3)	174 (60.0)	1.14 (0.71-1.82)	0.59		
Breast Feeding Status						
Supplemented	61 (18.3)	37 (60.7)	Reference			
Exclusive	272 (81.7)	161 (59.2)	0.94 (0.53-1.66)	0.833		
Breast Feeding Duration						
0-12 months	18 (9.6)	11 (61.1)	2.36 (0.31-17.85)	0.407		
13-24 months	165 (87.8)	93 (56.4)	1.94 (0.31-11.90)	0.475		
25-36 months	5 (2.7)	2 (40.0)	Reference			
Immunization Status						
Complete	277 (72.0)	169 (61.0)	Reference			
In progress	87 (22.6)	48 (55.2)	0.79 (0.48-1.27)	0.333		
Incomplete	21 (5.4)	11 (52.4)	0.70 (0.29-1.71)	0.438	0.06 (0.00-1.28)	0.071
Weight for Age						
Normal	324 (84.2)	194 (59.9)	Reference			
Underweight	61 (15.8)	34 (55.7)	0.84 (0.48-1.46)	0.547		
Height for Age						
Normal	284 (73.8)	166 (58.4)	Reference			
Stunted	101 (26.3)	62 (61.4)	1.13 (0.71-1.80)	0.606	3.63 (1.04-12.61)	0.043
Height for Weight						
Normal	341 (88.6)	209 (61.3)	Reference			
Wasted	44 (11.4)	19 (43.2)	0.48 (0.25-0.91)	0.024		

Table 3: Environmental characteristics of study participants and association between ARIs and children's environmental characteristics.

Characteristic	No participants (%)	Prevalence	Univariable analysis OR (95% CI)	P-value	Multivariable analysis aOR (95% CI)	P-value
Household density						
2-4	171 (44.4)	98 (57.3)	Reference			
5-7	156 (40.5)	95 (60.9)	1.16 (0.75-1.80)	0.51		
≥8	58 (15.1)	35 (60.3)	1.14 (0.62-2.08)	0.686		
Number of rooms						
1	23 (6.0)	13 (56.5)	Reference			
2	193 (50.1)	113 (58.5)	1.09 (0.45-2.60)	0.852		
≥3	169 (43.9)	102 (60.4)	1.17 (0.48-2.82)	0.725	2.34 (0.76-7.20)	0.139
History of contact with an infected person						
Had contact	166 (43.1)	99 (59.6)	Reference			
No contact	219 (56.9)	129 (58.9)	0.97 (0.64-1.46)	0.885		
School-going sibling						
Yes	260 (67.5)	164 (63.1)	Reference			
No	125 (32.5)	64 (51.2)	0.61 (0.40-0.95)	0.027		
Hospitalization within the past 3 months						
No	306 (79.5)	180 (58.8)	Reference			
Yes	79 (20.5)	48 (60.8)	1.08 (0.65-1.79)	0.755	8.19 (1.74-38.43)	0.008
Cause of hospitalization						
Respiratory infection related	41 (51.9)	26 (63.4)	1.26 (0.51-3.11)	0.616		
Not respiratory infection related	38 (48.1)	22 (57.9)	Reference			
Exposure to cigarette smoke						
No	238 (61.8)	138 (58.0)	0.87 (0.57-1.33)	0.53		
Yes	147 (38.2)	90 (61.2)	Reference			
Socioeconomic status						
Low	132 (35.9)	79 (59.8)	Reference			
Middle	116 (31.5)	69 (59.5)	0.98 (0.59-1.63)	0.953	4.23 (0.90-19.96)	0.068
High	120 (32.6)	69 (57.5)	0.91 (0.54-1.50)	0.705	3.01 (0.68-13.23)	0.145

Demographic characteristics of parents of study children

Average maternal age was 26±6.1 years. Age ranged from 17 to 47 years. Mothers who had primary level of education were 182 (47.3%). Only 47 (12.2%) of the mothers had attended secondary education and above. Most mothers; 252 (65.5%) were unemployed while 310 (86.4%) fathers were in various forms of employment as shown on Table 2.

Environmental characteristics of study participants

Majority of the children, 288 (74.8%) lived in mud walled houses. Most of the houses; 254 (66.0%) had iron sheet roofing and 298 (77.4%) houses had earthen floor material. Firewood (80%) and charcoal (13%) were the most common sources of cooking energy while kerosene (57.7%) and solar (32.0%) were the most common sources of lighting energy.

Univariable analysis of factors associated with ARIs

As shown in Table 1, female children were significantly more likely (OR 1.59; 95% CI: 1.05-2.39) to be infected with an ARI compared to male children. Odds of infection increased with increase in age, with children aged between 13 to 24 months presenting the highest odds of infection (OR 1.39; 95% CI: 0.84-2.30). Breastfeeding was protective of ARIs by 6% (OR 0.94; 95% CI: 0.53-1.66), as well as normal birth weight (OR 0.95; 95% CI: 0.41-2.22) although not significantly. Odds of infection decreased with increasing breastfeeding duration. Immunization was generally protective of ARIs, with children who were up-to-date on the immunization schedule presenting up to 30% reduced odds of infection (OR 0.70; 95% CI: 0.29-1.71).

The risk of getting an ARI decreased by 43% among children whose fathers were educated up to primary school (OR 0.57; 95% CI: 0.34-0.96). Age, marital status, level of education and employment status of mothers were not statistically significant determinants of occurrence of ARIs. However, odds of infection decreased with increase in mothers' age and with increasing level of education as shown on Table 2.

Not having school going siblings was a significant protective factor too (OR 0.61; 95% CI: 0.40-0.95). Odds of infection increased with increase in household density and number of rooms although not significantly. Absence of contact with an infected person marginally reduced the odds of infection by 3% (OR 0.97; 95% CI:

Table 4: Parental socio-demographic characteristics and association between ARIs and Parental socio-demographic characteristics.

Characteristic	No of participants (%)	ARI Prevalence %	OR (95% CI)	P-value	Adjusted OR (95% CI)	P-value
Maternal age						
<20	52 (13.5)	27 (51.9)	Reference			
21-30	249 (64.7)	152 (61.0)	1.45 (0.79-2.64)	0.225		
>31	84 (21.8)	49 (58.3)	1.30 (0.65-2.60)	0.465		
Marital status of mother						
Married	359 (93.3)	209 (58.2)	0.51 (0.21-1.25)	0.143		
Single	26 (6.7)	19 (73.1)	Reference			
Education level of mother						
No formal education	156 (40.5)	90 (57.7)	Reference			
Primary education	182 (47.3)	110 (60.4)	1.12 (0.73-1.73)	0.609	3.54 (1.10-11.32)	0.033
Secondary education and above	47 (12.2)	28 (59.6)	1.08 (0.56-2.10)	0.819		
Education level of father						
No formal education	90 (25.1)	58 (64.4)	Reference			
Primary education	177 (49.3)	90 (50.8)	0.57 (0.34-0.96)	0.035	0.37 (0.13-1.09)	0.07
Secondary education and above	92 (25.6)	61 (66.3)	1.09 (0.59-2.00)	0.792		
Employment status of mother						
Housewife	52 (13.5)	27 (51.9)	Reference			
Unemployed	252 (65.5)	155 (61.5)	1.48 (0.81-2.70)	0.201	5.14 (0.90-29.36)	0.065
Employed	81 (21.0)	46 (56.8)	1.21 (0.60-2.45)	0.582	7.21 (0.84-61.58)	0.071
Employment status of father						
Unemployed	49 (13.7)	33 (67.3)	Reference			
Employed	310 (86.4)	176 (56.8)	0.64 (0.33-1.21)	0.166		
Parity						
1-2	182 (47.3)	106 (58.2)	Reference			
3-4	106 (27.5)	62 (58.5)	1.01 (0.62-1.64)	0.967	4.69 (1.20-18.28)	0.026
≥5	97 (25.2)	60 (61.9)	1.16 (0.70-1.92)	0.558	11.46 (2.38-55.09)	0.002

0.64-1.46), as well as not having been previously hospitalized in the last three months (OR 0.86; 95% CI: 0.50-1.46). Absence of a smoker in a household lowered the odds of infection by 13% (95% CI: 0.57-1.33) as shown on Table 3.

Housing characteristics, source of cooking and lighting energy and overall exposure of a child to wood smoke were not significantly associated with occurrence of an ARI. These factors were used to calculate socioeconomic status of participants using PCA. Computed scores were categorized onto low, middle and high socioeconomic status, which too were not significantly associated with occurrence of ARIs.

Multivariable analysis

Female children were three times more likely (aOR 3.39; 95% CI: 1.21-9.46) to be infected with an ARI compared to male children. Normal birth weight was significantly protective of ARIs, with up to 94% (aOR 0.06; 95% CI: 0.01-0.62) reduced odds of infection while stunting posed a three-folds increase in odds (aOR 3.62; 95% CI: 1.04-12.61) of getting and ARI as shown on Table 1. Among the parental characteristics, primary level of education among mothers increased a child's odds of getting an ARI by three times (aOR 3.54; 95% CI: 1.10-11.32). High parity also significantly increased odds of infection, with having five and above children increasing odds of infection by 11 times (aOR 11.45; 95% CI: 2.38-55.09) as shown on Table 4. Recent hospitalization significantly increased odds of getting an ARI by 8 times (aOR 8.19; 95% CI: 1.75-38.43).

Discussion

ARIs remain an important public health problem, causing significant morbidity and mortality, and children continue to bear the highest burden of these infections. This study reported a prevalence of 59.2%. In agreement with this finding, Muthoni & Ngesa [9], reported an estimated ARI prevalence of 55-60 % for Kwale County from models based on national health and demographic survey data. Additionally, a high individual risk of infection by various respiratory viruses, up to 93.4% was reported in a large household survey in rural North Coast with similar settings [23], suggesting a high likelihood of occurrence of ARIs along the larger coastal region. The high prevalence observed could also be as a result of timing of the study, since the study was conducted during a peak season for transmission of respiratory diseases. Equally high prevalence rates were observed in related studies [16,24,25], highlighting a substantial burden of ARIs among children under five years in various settings.

ARI infections peaked at two years. This age group has been shown to be highly vulnerable to ARIs mostly due to underdevelopment of their immune system [26], coupled with incomplete development of their lungs and relatively short bronchial tree that causes an infection to spread faster [27]. Additionally, increasing contact between the child and other household members as the child grows older and decreasing protective effects of passive maternal immunity, coupled with increased contact with fomites makes them more exposed to ARIs.

This study identified female gender as a significant determinant for occurrence of ARIs. Although previous studies [1,28,29] have consistently reported a higher risk among males. Involvement of gender in development of ARIs remains relatively non-conclusive. For instance, no consistent sex differences in the burden of ARIs was observed over a period of twenty-four years, even after controlling for possible confounding factors while examining sex-specific trend of childhood ARIs in Nigeria [30]. Since perception of gender as a potential modulator of response to infection persists, it is necessary to elucidate its mechanisms and establish whether it is applicable to childhood ARIs in order to understand ARIs development in each gender.

Normal birth weight was significantly protective against ARIs in this study. Birthweight is an important modulator of child survival, growth and development [31]. Children born with low birth weight are more susceptible to respiratory infections [6] especially of the lower respiratory tract [32]. Protective effect of normal birth weight observed in this study was tentatively due to immune system sufficiency and optimal lung function conferred by normal birthweight, despite potential confounding by factors such as malnutrition and continued exposure to environmental triggers.

Childhood stunting increased the odds of getting an ARI in this study. The high prevalence of malnutrition that has been extensively reported in this population [33-35] tentatively explains this observation. Although the relationship between infections and malnutrition is mostly bidirectional [36,37], a child with underlying malnutrition lacks nutrients needed for immune activation, increasing their susceptibility to acute infections [38]. Further, the process of linear growth catch-up that could reverse stunting and its effects on immunity may be slow or impossible in this setting due to food insecurity and high burden of infectious diseases resulting in sustained stunting with sustained susceptibility to ARIs [39]. In concurrence, an association between stunting and occurrence of ARIs among children was similarly observed in a study conducted in Bangladesh [40].

Maternal education status was significantly associated with occurrence of ARIs too. Children whose mothers were educated up to primary level had significantly increased odds of getting an ARI. Moreover, odds of infection decreased with increasing level of maternal education in the unadjusted model although not significantly. Generally, a higher level of education among mothers promotes adoption of good childcare practices that reduce exposure of children to ARIs and other infections. It is also likely to improve social and environmental conditions of a household resulting in improvements in child health by modifying factors such as employment and household income. In agreement with the findings of this study, a meta-analysis of observational studies from low and middle-income countries identified low maternal education as a risk factor for mortality due to acute infections of the lower respiratory tract [41], confirming the impact of maternal education.

Hospitalization in the preceding three months significantly increased the odds of getting an ARI. Recurrent hospitalization in early childhood increases the risk of morbidity with acute respiratory infections and even asthma in a dose response manner [42]. Recurrent ARIs particularly increase the risk of subsequent respiratory infections [43]. Of the children who had been previously hospitalized in this study, 51.9% had been hospitalized for respiratory related infections especially pneumonia and asthma, suggesting that recurrent ARIs potentially increase the risk of getting an ARI in future.

Parity was shown to affect occurrence of ARIS, with odds of getting an ARI increasing with increasing parity. High parity could have increased household density and person-to-person contact, facilitating transmission of respiratory pathogens. Moreover, this study observed an association between school-going siblings and occurrence of ARIs, who have been shown to be important introducers of respiratory pathogens in households [44], suggesting a potential risk posed by multiple siblings. High parity compromises quality of care accorded to each child too, due to increased financial and social requirements. This affects not only living conditions but also nutritional care of children especially since this population has been shown to be relatively food insecure [33], generally increasing susceptibility to infectious diseases.

An important limitation of this study is that prevalence of ARIs was captured at the hospital level hence it may not be a true reflection of the activity of ARIs in the community. A longitudinal study will illustrate the epidemiology of ARIs among under-fives better. Additionally, diagnosis was made based on clinical symptoms using IMCI guidelines. Over diagnosis or under diagnosis is possible given the limitations surrounding its application.

Conclusion

This study highlights a high burden of ARIs among children under five years. Female gender, stunting, low maternal education and high parity were significantly associated with occurrence of ARIs. Normal birth weight and absence of hospitalization in the previous three months were protective factors. This study suggests that improvements in maternal education, with increased awareness on maternal and child health could minimize morbidity due to ARIs in this population. Prevention and management of other infectious diseases is also likely to reduce the burden of ARIs and improve overall health of children. Since no intervention can singly reduce morbidity and mortality due to ARISs, modulation of core risk factors could substantially help to reduce preventable deaths.

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Appendix VI: Science and ethics approval

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5th May 2017

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05 MAY 2017
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Betty Kathomi Muriithi
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College of Health Sciences
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J.K.U.A.T

Dear Betty

REVISED RESEARCH PROPOSAL – FACTORS INFLUENCING OCCURRENCE OF ACUTE RESPIRATORY TRACT INFECTIONS AMONG CHILDREN UNDER THE AGE OF FIVE IN MATUGA SUB-COUNTY (P780/11/2016)

This is to inform you that the KNH- UoN Ethics & Research Committee (KNH- UoN ERC) has reviewed and **approved** your above revised proposal. The approval period is from 5th May 2017 – 4th May 2018.

This approval is subject to compliance with the following requirements:

a) Only approved documents (informed consents, study instruments, advertising materials etc) will be used.
b) All changes (amendments, deviations, violations etc) are submitted for review and approval by KNH-UoN ERC before implementation.
c) Death and life threatening problems and serious adverse events (SAEs) or unexpected adverse events whether related or unrelated to the study must be reported to the KNH-UoN ERC within 72 hours of notification.
d) Any changes, anticipated or otherwise that may increase the risks or affect safety or welfare of study participants and others or affect the integrity of the research must be reported to KNH- UoN ERC within 72 hours.
e) Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. (*Attach a comprehensive progress report to support the renewal*).
f) Clearance for export of biological specimens must be obtained from KNH- UoN ERC for each batch of shipment.`
g) Submission of an *executive summary* report within 90 days upon completion of the study. This information will form part of the data base that will be consulted in future when processing related research studies so as to minimize chances of study duplication and/ or plagiarism.

For more details consult the KNH- UoN ERC website **http://www.erc.uonbi.ac.ke**

Protect to discover

Yours sincerely,

PROF M. L. CHINDIA
SECRETARY, KNH-UoN ERC

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