



Risk Factors of Acute Respiratory Infection Among Under Five Children Attending Public Hospitals in Sana'a City- Yemen

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Researchers

Abdalmjeed Abdalzeez Mansor Ahkam

Yaser muqbil mohammed Anber

Ahmed Ali Saleh Ali Rashed

Mohammed Khalid Yahya Qussas

Ali Muhammad Ali Murshid

Hesham Abdalkrim Saleh Thamee

Majed Hammdan Abdullah Tonin

Ishag Ahmed Ali Sara'a

Arafat Mohssen Hussein Saboul

Supervisor

Dr. Houria Abdulraqip Taher Al-Sabri

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الاستهلال



Dedication

*We dedicate this research paper to Allah almighty my
creator my strong Pillar my source of inspiration wisdom
knowledge and understanding. He has been the source of my
strength throughout this program*

*This research dedicates to our parents, whose affection, love,
encouragement, and pray of day and night make us able to
get such success and honor. For being our guardians and for
their continues care. Our sincerest, thanks for all teachers
one by one, who taught us from the first year in the school
till the end of our journey in this collage, thanks for given us
part of your precious time.*

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We would also like to thank all the parents who helped us to fill out questionnaires

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LIST OF ABBREVIATIONS

Abbreviation	Term
AIDS	Acquired Immunodeficiency Syndrome
ARDS	Acute respiratory distress syndrome
ARIs	Acute respiratory infections
BALT	Bronchial associated lymphoid tissue
CAP	Acquired pneumonia
COPD	Chronic obstructive pulmonary disease
CT	Computed tomography
DALYs	Disability-adjusted life-years
FEF	Forced expiratory flow
FEV1	Forced expired volume in the first second
FIRS	Forum of International Respiratory Societies
GAS	Group A streptococci
HIV	Human Immunity Virus
HRV	Human rhinovirus
IMCI	International Management of Childhood Illnesses
LRTI	Lower respiratory tract infection
MRI	Magnetic resonance imaging
PA	Poster- anterior
RSVs	Respiratory syncytial viruses
SARI	Sever acute respiratory infection
SIRS	Systemic inflammatory response syndrome
URTI	Upper respiratory tract infections
USA	United States American
WHO	World Health Organization

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ABSTRACT

Background: Acute respiratory infections (ARIs) are one of the leading causes of childhood morbidity and mortality worldwide, as well as the contributing to a third of the under-five deaths in lower income countries.

The aim of the study: to assess the risk factors of acute respiratory infection among child aged less than five years at public hospitals in Sana'a City -Yemen.

Method: A cross-sectional survey. Interviewer administered structured questionnaire was used to collect data from a sample of (412) Childs.

Results: More than half (61.4%) of participants were age group between 1 to 12 months. more than half (62.9%) of participants were male. Most (76.2%) of study participants have acute respiratory infection and while (23.8%) of study participants not have acute respiratory infection. Most (87.1%) of participants not have chronic lung diseases and (78.1%) of them not have family history of diseases. More than half (55.3%) of participants not received vitamin A last 6 months.

Conclusion: There was statistically significant between acute respiratory infection with Hospital name and room number because (p-value=0.010, 0.032) respectively. There was statistically significant between acute respiratory infection with nutritional status and family history of diseases because (p-value=0.025, 0.034) respectively. There was statistically significant between acute respiratory infection with exposure to wood smoke, smoking pollution, wood and cow dung because (p-value=0.006, 0.016 ,0.003, 0.017) respectively.

Keyword: *Risk factors , Acute respiratory infection, child, public hospitals, Yemen.*

CHAPTER ONE:

INTRODUCTION

INTRODUCTION

CHAPTER ONE: INTRODUCTION

1.1. Background of the Study

Acute respiratory infections (ARIs) are one of the leading causes of childhood morbidity and mortality worldwide, as well as the contributing to a third of the under-five deaths in lower income countries (*Mir et al., 2022*).

Acute respiratory infection (ARI) is the occurrence of a cough accompanied by short, rapid breathing which may be linked to death, although a significant reduction has been achieved over the previous two decades (*Gebrerufael and Hagos, 2023*).

Respiratory tract infections (RTIs) are among the most commonly encountered major public health problems, with a higher incidence of lower RTIs among children and more generally the poor (*El-Koofy et al., 2022*).

According (WHO), reported that in 2019, 740,180 children were died from pneumonia, which account for 14% of deaths in this age group. According to UNICEF data; a child dies from pneumonia every 39 s (*El-Koofy et al., 2022*).

Globally, ARI among children remains one of the leading causes of morbidity and mortality in children under-five years. It is the largest public health burden worldwide, developing countries (*Gebrerufael and Hagos, 2023*).

Most common organisms knownto cause ARI among children include bacteria such as *Staphylococcus aureus*, *Streptococcus pyogenes*, *Pneumococci*, *Hemophilus influenzae* and *Klebsiella pneumoniae*. Viruses such as Adeno, Rhino, Corona and Influenzae are also the common etiological agents (*Cihambanya, 2017*).

Acute respiratory infections are classifiedas Respiratory diseases are diseases of the airways and other structures of the lung. They are among the leading causes of morbidity and mortality worldwide. Some of the most common conditions are asthma, chronic obstructive pulmonary disease (COPD), and occupational lung diseases. The Forum of

International Respiratory Societies (FIRS) considers pneumonia, asthma, COPD, lung cancer and tuberculosis to be the five most important lung diseases worldwide from a prevalence standpoint (*Soriano et al., 2020*).

Low-income countries commonly experience a tenfold increase in mortality and a fiftyfold rise in the associated burden compared to developed countries. Around 70% of childhood pneumonia hospitalization rates are among under-fives in the USA (*El-Koofy et al., 2022*).

Acute respiratory infections include both upper and lower respiratory tract infections, with the common cold and influenza being the most common ARIs. Symptoms of ARI consist of short, rapid breathing, or difficulty breathing that is chest related. Pneumonia is a presentation of ARI and is solely responsible for 15% of global childhood deaths across the world. Symptoms presented with pneumonia include fast (*Mir et al., 2022*).

Research has shown that many factors are associated with ARI. These factors differ from one country to another. Evidence from developing countries reveals that low birth weight, exposure to indoor air pollution, non-exclusive breast feeding, incomplete immunizations, crowding (more than seven members per household), poor nutrition, formula feeding, weaning, young maternal age, low educational status of mothers and fathers, and premature birth are consistently associated with severe ARI (*Geberetsadik et al., 2015*).

While antibiotics are effective against some bacterial infections, many respiratory infections are caused by range of other pathogens, such as viruses. The diversity of micro-organisms causing ARI, and a diagnostic deficit of around 30%, make the formulation of an effective universal treatment for this disease impossible. Therefore, the identification of

risk factors for ARI in the community is important for developing effective policies and strategies to interrupt transmission and improve health outcomes (*Chen et al., 2014*).

Lack of awareness, defects in immune system, overuse and misuse of antibiotics, co morbid illnesses (especially HIV), malnutrition, prematurity or measles, environmental determinants (particularly absence of ventilation, passive smoke exposure, overcrowding or poor living conditions) and social factors (principally poverty and poor access to both preventative, including immunization, and curative health services) are important contributory factors (*Choube et al., 2014*).

Knowledge of the potential risk factors would aid in supporting preventive public health interventions to reduce the incidence of ARI, therefore, current data is required to aid in making informed decisions on the appropriate interventions. Studies on economic burden of ARI have been conducted in other continents but scanty information is available regarding cost of ARI, this information would be used in public health education and health promotion to educate the public on preventive measures for ARI.

1.2. Problem Statement

Acute Respiratory infection accounts for 94,037,000 disability adjusted life years and 1.9 million deaths worldwide. Acute respiratory infections are the most common causes of under-five illness and mortality. The under five children gets three to six episodes of acute respiratory infections annually regardless of where they live. Disease burden due to acute respiratory infection is 10–50 times higher in developing countries when compared to developed countries (*Alemayehu et al., 2019*).

1.3. Research Question

1.3.1. Major research question

What is the risk factors of acute respiratory infection among under five children attending public hospitals in Sana'a –City ?

1.3.2. Minor research question

1. What is the demographic characteristics of under five years' children ?
2. What is the risk factors of acute respiratory infection in under five years' children ?
3. What is the relationship between some of demographic data and acute respiratory infection ?
4. What is the relationship between risk factors and acute respiratory infection ?

1.4. Significant of Study

This study it will identify common risk factors of ARI among under five children.

Maternal and provide health for child must be skillful with enough risk factors of ARI to prevent ARI among children.

Study aimed to assess the risk factors of acute respiratory infection among under five children attending public hospitals in Sana'a -City.

1.5. Definitions of terms

Risk factors

Is a variable associated with an increased risk of disease or infection. The main difference lies in the realm of practice: medicine (clinical practice) versus public health. As an example from clinical practice, low ingestion of dietary sources of vitamin C is a known risk factor for developing scurvy. Specific to public health policy, a determinant is a health risk that is general, abstract, related to inequalities, and difficult for an individual to

control. For example, poverty is known to be a determinant of an individual's standard of health.

Acute respiratory

Is a life-threatening lung injury that allows fluid to leak into the lungs. Breathing becomes difficult and oxygen cannot get into the body. Most people who get ARDS are already at the hospital for trauma or illness.

Infection

The invasion and multiplication of microorganisms such as bacteria, viruses, and parasites that are not normally present within the body. An infection may cause no symptoms and be subclinical, or it may cause symptoms and be clinically apparent.

Under five children

A shorthand term for children under 5 years of age; a period of rapid growth and relatively high nutritional requirements.

Public hospitals

Are a hospitals which is government owned and is fully funded by the government and operates solely off the money that is collected from taxpayers to fund healthcare initiatives. In some countries, this type of hospital provides medical care free of charge to patients, covering expenses and wages by government reimbursement.

Place limit

Study done in Republican Teaching Hospital Authority, Al-Thawra Modern General Hospital, Palestine Maternity and Child Hospital, Al-Sabeen Maternity and Child Hospital and 22 may Teaching Hospital- Dhela Hamdan.

Time limit

The study was conduct during 2023-2024.

CHAPTER TWO

LITERATURE REVIEW

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CHAPTER TWO: LITERATURE REVIEW

2.1 Definition of Acute respiratory tract infections:

Acute respiratory tract infections are heterogeneous and complex group of diseases caused by a wide range of pathogens in which the possible anatomic site (s) extend from the pharynx to the alveoli (**Ujunwa and Ezeonu, 2014**).

Acute respiratory infections (ARIs) are a group of diseases that are caused by different microorganisms where viral etiologies are responsible for 80% of cases. Influenza and noninfluenza viruses are responsible for significant annual morbidity and mortality across all age groups (**Alemayehu et al., 2019**).

Acute respiratory infection (ARI) refers to infection at different sites along the respiratory tract, resulting in interference of normal breathing activity in an individual. The sites include the nasal cavity, sinuses, pharynx, larynx, epiglottis, trachea, bronchi, and lungs, with symptoms lasting for 30 days or less (**Ben Hassen et al., 2020**).

2.2 Epidemiology of ARI

Acute respiratory infection (ARI) is a universal problem found in all age groups and in all countries. According to the WHO, lower respiratory tract infection (LRTI) are the second major cause of illness (429.2 million episodes) worldwide annually. In developing countries, a quarter of all pediatric hospital admissions are due to ARI. Twenty percent to 40% of all hospitalizations of children under five years of age worldwide are due to ARI. Each year, approximately 3% of all children less than twelve months of age need to be admitted to the hospital for moderate or severe viral lower respiratory tract infections. An estimated 156 million new cases of pneumonia, the leading complication of ARI, are registered annually, with 97% of them residing in the developing world. An estimated 7% to 13% of all pneumonia cases are severe enough to require emergency hospitalization (**Vardanyan, 2015**).

ARI is a universal problem found in all age groups and in all countries. According to the WHO, LRTI are the second major cause of illness (429.2 million episodes) worldwide annually. In developing countries, a quarter of all pediatric hospital admissions are due to ARI. Twenty-percent to 40% of all hospitalizations of children under five years of age worldwide are due to ARI. Each year, approximately 3% of all children less than twelve months of age need to be admitted to the hospital for moderate or severe viral lower respiratory tract infections **(Vardanyan, 2015)**.

Respiratory syncytial virus (RSV), a cause of LRTI, is the major cause of ARI in children worldwide. According to the American Lung Association, from 75,000 to 125,000 children are hospitalized due to RSV each year and about 0.2%-7% of them die, of which 20-25% of the deaths are attributable to pneumonia cases and 70% to bronchiolitis. Influenza viruses also lead to severe respiratory disease in the youngest population group. Annual hospitalization rates from influenza viruses are 3 per 1,000 for 6 to 23 months old children worldwide. Mortality rate from LRTI is 10 to 50 times higher in developing countries than in developed countries. In middle income countries, LRTI ranks at 4th place among causes of death with 5.4% of all deaths. In lower-income countries, LRTI is ranked as the first leading cause of death, consisting 11.3% of all deaths among children and adults **(Vardanyan, 2015)**.

The mortality rate from pneumonia is 215 times higher in low-income countries than higher income ones. It is estimated that one-out-of-every-five pediatric deaths worldwide are due to pneumonia, estimated at 1.6 million deaths annually. This is more than malaria, AIDS and tuberculosis deaths combined. Acute respiratory infections are also the main causes of disability-adjusted life-years (DALYs) lost in developing countries. Global burden of RSV disease is assessed at 64 million cases and 160,000 deaths annually **(Vardanyan, 2015)**.

Some concepts in infectious disease epidemiology are unique for the field and for that reason, worth some extra attention. When studying diseases with human-human transmission one has to be aware that a case can also be an exposure i.e. cases can give rise to secondary cases. The basic

reproductive number, R_0 , is a measure of the average number of persons infected by a case in a totally susceptible population. This is dependent on how contagious the pathogen is, but also on the route of transmission, the number of contacts and duration of the infectious period. The R_0 is in general enhanced if the incubation period is shorter than the latency period, i.e. the infected individuals are infectious before they develop symptoms (**Rhedin, 2017**).

If $R_0 > 1$ there is a risk that the pathogen will cause an epidemic. The fact that some individuals are usually immune to a certain disease will also affect the spreading patterns. The immunity on a population level is referred to as herd immunity and is of great importance for preventing disease outbreaks. The level of required vaccination coverage for preventing outbreaks is related to the R_0 of the disease. B. pertussis has a high R_0 whereas influenza is less contagious, for that reason, a vaccination coverage of 50-76% is needed to prevent influenza outbreaks whereas B. pertussis requires a higher coverage, approximately 92-93% (**Yang et al., 2013**).

2.3 Respiratory Tract Infections

2.3.1. Upper Respiratory Tract Infections

Lack of immunity and high exposure at daycare centers and schools make upper respiratory tract infections (URTI) common in children. A longitudinal community surveillance study in Utah reported that children <5 years experienced respiratory symptoms in 38% of all weeks during the twelve months study period (**Byington et al., 2015**). Most URTIs have viral etiology and are self-limiting, yet some may progress to severe infections in need of treatment (**Rhedin, 2017**).

- ***Common Cold (Nasopharyngitis)***

The common cold is a heterogeneous group of mild URTIs of predominantly viral etiology. Symptoms include coryza, sore throat, and cough. The disease is estimated to cause 22 million days of absence from school annually in US children. The infections are in general self-limiting within two weeks and prolonged symptoms ≥ 2 weeks are usually due to serial infections (**Rhedin,**

2017). No curative treatment is available, nevertheless, nasal cleaning and intranasal anticongestives have a role in the treatment of infants to facilitate feeding. A placebo-controlled randomized trial reported a role of honey in alleviating nocturnal coughing and sleep difficulties **(Cohen et al., 2012)**. There is poor evidence for cough medicines and mucolytics **(Rhedin, 2017)**.

- ***Pharyngotonsillitis***

Streptococcus pyogenes, or Group A streptococci (GAS) accounts for approximately 37% of all pharyngotonsillitis episodes in children, however, less common in children below two years **(Thornton et al., 2017)**. Viral and bacterial aetiology cannot be accurately distinguished by clinical examination. Testing for GAS in children should be performed according to the Centor criteria. A rare but fearsome immunological complication to GAS pharyngotonsillitis is rheumatic fever, where destruction of the heart valves can lead to permanent heart failure. Antibiotic treatment seems to reduce the risk of the complication but the number needed to treat for one to benefit is very high in high-income countries **(Spinks et al., 2013)**.

Both chronic and acute pharyngotonsillitis is associated with a high grade of virus detection yet anaerobic bacteria such as *Fusobacterium necrophorum* are increasingly being recognized as underreported causes in children **(Proença-Módena et al., 2014)**.

Anaerobic infection should be a differential diagnosis in adolescents due to the risk of thrombophlebitis and septic embolization (Lemierre syndrome). Mononucleosis or kissing disease is mainly caused by Epstein-Barr virus but is also associated with some other herpesvirus infections **(Arthur Rhedin, 2017)**.

The disease is characterized by tonsillar enlargement, moderate-to-high fever, petechiae of the palate, bilateral lymphadenopathy and splenomegaly. The disease has a long incubation period and is primarily seen in teenagers. Restriction of physical activity should be recommended for 3-4 weeks after the infection due to an increased risk of splenic rupture **(Arthur Rhedin, 2017)**.

4.3.1.1. *Acute Otitis Media*

Acute otitis media is a usually self-limiting infection of the middle ear. Complication such as mastoiditis and labyrinthitis are very rare **(Wald, 2022)**. The disease has traditionally been considered a bacterial infection but the role of respiratory viruses is increasingly being recognized **(Chonmaitree et al., 2015)**.

Current guidelines from the American Academy of Pediatrics recommend observation with close follow-up for non-severe (mild otalgia ≤ 48 h, fever $< 39^{\circ}\text{C}$) unilateral otitis in children > 6 months whereas antibiotic treatment with amoxicillin is recommended in complicated cases **(Wald, 2022)**. In Sweden, antibiotic treatment with phenoxymethylpenicillin is recommended to children < 1 year, adolescents and in complicated cases whereas observation with follow-up is recommended children 1-12 years with uncomplicated disease **(Diagnostik, 2010)**.

- ***Viral group (Laryngotracheitis)***

Viral group is a mild self-limiting infection in the larynx, sometimes involving areas of the lower respiratory tract. The disease mainly affects children between six months and three years of age . Classical symptoms are difficulties breathing, barky cough and stridor due to inflammation of the mucous membrane of the larynx. Worsening is commonly seen during the night-time hours, which has been suggested to be due to low levels of anti-inflammatory endogenous serum cortisol **(Rhedin, 2017)**.

The duration of the disease is short, usually < 48 hours and hospitalization is seldom needed. Parainfluenza virus is the most common cause of viral croup, but several respiratory viruses have been associated with the disease. Treatment with steroids is recommended in moderately severe cases whereas inhalation of epinephrine and oxygen treatment is indicated only in severe cases **(Rhedin, 2017)**.

- ***Other Upper Respiratory Tract Infections***

Owing to successful immunization programs, the lethal upper respiratory tract infections epiglottitis (primarily caused by *Haemophilus influenzae* type B) and diphtheria i.e. “true croup” (caused by *Corynebacterium diphtheriae*) are rarely seen in vaccinated children. A decline in the incidence of sinusitis has been seen following the pneumococcal conjugate vaccine (**Lindstrand et al., 2014**).

2.3.2. Lower Respiratory Tract Infections

An estimated 703.000 deaths can be attributed to lower respiratory tract infections (LRTI) in children under five years annually (**Rhedin, 2017**).

- ***Asthma and Wheezing***

Asthma is a heterogenic chronic disease of the respiratory tract that is characterized by hyperreactivity of the immune system. The disease can be IgE-mediated (allergic asthma) or not (non-allergic asthma) (**Rhedin, 2017**). Wheezing or sibilant rhonchi refers to a characteristic high-pitched whistling sound heard upon lung auscultation in children with asthma as well as in some viral infections. Although asthma is not an infectious disease, the acute disease is commonly triggered by viral infections and can mimic respiratory infections such as wheezy bronchitis. Moreover, treatment with the antibiotic azithromycin have shown to shorten the length of asthma-like episodes in children, which suggests a role of bacteria in the acute disease (**Stokholm et al., 2016**).

However, it could also be the result of an anti-inflammatory effect of macrolides that has previously been observed. Exposure to a large diversity of bacteria during childhood has been shown to be protective against asthma, which is commonly referred to as the hygiene hypothesis. In contrast, respiratory virus infections early in life have been associated with later development

of asthma (**Blanken et al., 2013**). It is not fully understood whether virus-induced wheezing is causing asthma or merely a first symptom of an underlying susceptibility (**Rhedin, 2017**).

- **Bronchiolitis**

Bronchiolitis is a viral infection of the small airways in the lower respiratory tract. Acute inflammation with increased mucus production results in symptoms of coryza, cough, and lowgrade fever frequently progressing into severe breathing difficulties (tachypnea, nasal flaring, use of accessory muscles). Diagnosis is based on a characteristic wheezing upon pulmonary auscultation and x-ray is not needed in uncomplicated cases (**Ralston et al., 2014**).

Bronchiolitis is usually restricted to children below one year of age whereas the diagnoses of wheezy bronchitis, reactive airway disease or non-allergic asthma are used for wheezing non-asthmatic episodes in older children. The most common causative agents are respiratory syncytial virus, metapneumovirus and rhinovirus (**Ralston et al., 2014**).

Supportive care including nutrition and supplemental oxygen (in children with oxyhaemoglobin saturation $\leq 90\%$) are sometimes necessary. Inhalation therapy with hypertonic saline might alleviate symptoms whereas inhalation of epinephrine and salbutamol are no longer recommended due to lack of evidence. Neither do corticosteroids or chest physiotherapy have a role in the treatment (**Linder et al., 2014**).

- **Pneumonia**

Pneumonia is an infection in the lung parenchyma characterized by high fever, tachypnea, indrawings, productive cough and lethargy. Complications include empyema or parapneumonic effusion. The disease is commonly divided into nosocomial i.e. hospital-acquired and community-acquired pneumonia (CAP). The incidence of childhood CAP is currently decreasing owing to a globally improved nutritional status as well as to vaccination against the two major causing pathogens (**Rhedin, 2017**).

A simplistic algorithm for diagnosing pneumonia was released by the World Health Organization (WHO) that was later included in the International Management of Childhood Illnesses (IMCI) strategy. The IMCI algorithm is based on respiratory rate, chest-wall indrawings, and cough and has been criticized for low specificity as episodes of bronchiolitis, asthma and dehydration frequently are misclassified as CAP (**Gowraiah et al., 2014**).

A clinical diagnosis is sufficient for non-severe cases that are treated as outpatients whereas radiographic confirmation is recommended in hospitalized patients (**Rhedin, 2017**).

2.4 Pathophysiology :

The onset of infection and proliferation of microorganisms within the alveolar space elicits an acute inflammatory response. Local effects of the cellular influx, cytokine production, and increased alveolar capillary permeability results in impaired ventilation and decreased lung compliance. Major ventilation-perfusion mismatch occurs with increased right-to-left shunting as consolidation progresses. Hypoxia, seen in severe pneumonia, produces pulmonary vasoconstriction which often attenuates the right-to-left shunt. The reduced pulmonary compliance increases the work of breathing and with associated inflammation produces dyspnea (**Ali et al., 2009**).

The local inflammatory response results in the production of a number of cytokines that migrate out of the lung and produce fever, leukocytosis, and a number of metabolic and vascular changes. Severe pneumonia may result in bacteremia, systemic inflammatory response syndrome (SIRS), septic shock, and multiorgan dysfunction syndrome. The most common cause of acute respiratory distress syndrome (ARDS) is sepsis secondary to pneumonia (**Ali et al., 2009**).

The respiratory tract is permanently exposed to infections that may remain localized (bronchitis, pneumonias) or become potentially invasive (bacteremia and meningitis). It can be considered as an immunologic organ the upper part of which, the tracheobronchial tree, has the same secretory epithelium as the naso-oropharynx and shares bronchial associated lymphoid tissue (BALT). In

this tissue, secretory IgA are more abundant than IgG. It is colonized by a commensal bacterial flora, including some potentially pathogenic species (*Streptococcus pneumoniae*, *Haemophilic influenza*, *Neisseria meningitis*). The pulmonary compartment includes the bronchioles and the alveoli, the wall of which is made of pneumocystis, resident macrophages, plasmacytoid dendritic cells and T cells. This wall is protected by a film that contains microbicidal agents, such as surfactant and phospholipase A2 (**Alonso, 2008**).

Immune defenses of the respiratory tract involve mechanical factors, mucociliary escalator, receptor and effector molecules of the innate immune system and, by the proximity of lymph and blood vessels, humoral and cellular effectors of adaptive immunity. However, this sophisticated respiratory tract immune system can be bypassed in the non-immunized host by infections due to primary pathogens (tuberculosis, plague, whooping cough, influenza) and may be impaired by endogenous factors (genetic defects, iatrogenic disorders) or exogenous factors (chemical pollutants, respiratory viruses) making the host susceptible to occasional pathogens, including commensal organisms (**Alonso, 2008**).

2.5 DIAGNOSTIC MEASURES

2.5.1. Imaging Techniques

Chest radiographs are useful in assessing respiratory disease in children. In addition to determining lung abnormalities, they provide information about the bony thorax (rib or vertebral abnormalities), the heart (cardiomegaly, pericardial effusion), and the great vessels (right aortic arch/vascular rings, rib notching) (**pediatrics, 2010**).

Chest radiographs should be obtained in both the posteroanterior (PA) and lateral projections. Estimation of lung hyperinflation based on a single PA view is unreliable, whereas flattened diaphragms and an increased AP diameter on a lateral projection indicates hyperinflation. Expiratory views and fluoroscopy may detect partial bronchial obstruction due to an aspirated

foreign body resulting in regional hyperinflation because the lung or lobe does not deflate on exhalation. Routine chest radiographs should be obtained after a full inspiration. Crowding of the blood vessels with poor inspiration can be misinterpreted as increased markings or infiltrates. External skin folds, rotation, and motion may produce distorted or unclear images **(pediatrics, 2010)**.

A barium esophagogram is valuable in diagnosing disorders of swallowing (dysphagia) and esophageal motility, vascular rings (esophageal compression), tracheoesophageal fistulas, and, to a lesser extent, gastroesophageal reflux. When evaluating for a tracheoesophageal fistula, contrast material must be instilled under pressure via a catheter with the distal tip situated in the esophagus **(pediatrics, 2010)**.

A computed tomography (CT) scan of the chest is the imaging test of choice for evaluating pleural masses, bronchiectasis, and mediastinal lesions as well as delineating pleural from parenchymal lesions. CT scans with intravenous contrast material provide excellent information about the pulmonary and great vessel vasculature and pulmonary embolism. High-resolution CT scans are used to assess lung parenchyma (pulmonary fibrosis, interstitial fluid) and the airways (bronchiectasis). The speed of current CT scanners makes it possible to scan most children without sedating them. However, sedation may be required to decrease motion artifact. Magnetic resonance imaging (MRI), useful in visualizing cardiac anatomy, is less useful for evaluation of pulmonary lesions. Ultrasonography can be used to delineate some intrathoracic masses and is the imaging procedure of choice for assessing parapneumonic effusion/empyema. It is useful when assessing diaphragmatic motion **(pediatrics, 2010)**.

2.5.2. Measures of Respiratory Gas Exchange

Measurements of oxygenation (PO₂ and O₂ saturation) and ventilation (PCO₂) are important in the management of pulmonary diseases. A properly performed **arterial blood gas** analysis provides information about the effectiveness of both oxygenation and ventilation. However,

arterial samples are more difficult to obtain, so capillary and venous blood samples are more commonly used. The PCO₂ from a capillary sample is similar to that from arterial blood. The PCO₂ in venous samples is approximately 6 mm Hg higher than arterial PCO₂. The ratio of the serum bicarbonate concentration to PCO₂ determines the pH. Capillary or venous samples should not be used to assess oxygenation (**pediatrics, 2010**).

There are both respiratory and metabolic causes of acidosis. In the presence of an alkalosis or acidosis, respiratory compensation (decreasing PCO₂ to maintain a normal pH) can occur within minutes, but renal compensation (increasing the serum bicarbonate level) may not be complete for several days (**pediatrics, 2010**).

Pulse oximetry measures the O₂ saturation of hemoglobin by measuring the blood absorption of two or more wavelengths of light. It is noninvasive, easy to use, and reliable. Because of the shape of the oxyhemoglobin dissociation curve, O₂ saturation does not decrease much until the PO₂ reaches approximately 60 mm Hg. Pulse oximetry may not accurately reflect true O₂ saturation when abnormal hemoglobin is present (carboxyhemoglobin, methemoglobin), when perfusion is poor, or if no light passes through to the photodetector (nail polish) (**pediatrics, 2010**).

The measurement of PCO₂ is accomplished most reliably by blood gas analysis. However, there are noninvasive monitors that record end-expiratory PCO₂ (end-tidal CO₂), which is representative of alveolar PCO₂. End-tidal PCO₂ measurements are most commonly used in intubated and mechanically ventilated patients, but some devices can measure PCO₂ at the nares. Transcutaneous electrodes can be used to monitor PCO₂ and PO₂ at the skin surface, but are not particularly accurate. Noninvasive techniques of CO₂ measurement are best suited for detecting trends rather than for providing absolute values (**pediatrics, 2010**).

2.5.3. Pulmonary Function Testing

Measurement of lung volumes and airflow rates using spirometry are important in assessing pulmonary disease. The patient inhales to TLC and then forcibly exhales until no more air can be

expelled. This test is often referred to as spirometry. During the forced expiratory maneuver the VC, the forced expired volume in the first second (FEV1), and forced expiratory flow (FEF) rates are measured. The predicted values for lung functions are based on patient age, gender, and race, but rely mostly on height. Most children above 6 years of age can perform spirometry. It is possible to perform these tests in infants using sedation and sophisticated equipment (**pediatrics, 2010**).

Airway resistance, FRC, and RV cannot be measured with spirometry and require other techniques. Body plethysmography can be used to measure airway resistance and lung volumes. Helium dilution can measure TLC and RV by determining the magnitude of dilution of inhaled helium in the air within the lung (**pediatrics, 2010**).

Abnormal results on pulmonary function testing can be categorized as indicating obstructive airway disease (low flow rates and increased RV or FRC) or a restrictive defect (low VC and TLC, with relative preservation of flow rates and FRC). When the FEV1 and flow rates are decreased to a greater extent than the VC, then airway obstruction is likely, but a proportional decrease in VC, FEV1, and flow rates suggests a restrictive lung defect. The mean midexpiratory flow rate (FEF25–75%) is a more sensitive measure of small airways disease than the FEV1, but is also more variable. The VC, FEV1, and FEF25–75% can be obtained with a simple spirometer. Pulmonary function testing can detect reversible airway obstruction characteristic of asthma with a significant improvement in FEV1 (>12%) or in FEF25–75% (>25%) following inhalation of a bronchodilator. Spirometry is also useful for longitudinal patient management. The peak expiratory flow rate (PEFR) can be obtained with a simple handheld device and may be useful for home monitoring of older children with asthma. However, it is highly dependent on patient effort and values must be interpreted with caution. Inhalation challenge tests using methacholine, histamine, or cold, dry air are used to assess airway hyperreactivity, but require sophisticated equipment and special expertise and should be performed only in a pulmonary function laboratory with experienced technicians (**pediatrics, 2010**).

2.5.4. Endoscopic Evaluation of the Airways

Endoscopic evaluation of the upper airways (nasopharyngoscopy) is performed with a flexible fiberoptic nasopharyngoscope to assess adenoid size, patency of the nasal passages, and abnormalities of the larynx. It is especially useful in evaluating stridor and assessing vocal motion function. Endoscopic evaluation of the intrathoracic airways can be done with either a flexible or rigid bronchoscope. Bronchoscopy is useful in identifying airway abnormalities (stenosis, malacia, endobronchial lesions, excessive secretions) and in obtaining airway samples for culture (bronchoalveolar lavage), especially in immunocompromised patients. Rigid bronchoscopy is the method of choice for removing foreign bodies from the airways and performing other interventions, and flexible bronchoscopy is most useful as a diagnostic tool and for obtaining lower airway cultures. Bronchoscopy requires deep sedation, but flexible nasopharyngoscopy can be performed without anesthesia. There are few absolute contraindications to bronchoscopy. Relative contraindications include bleeding diatheses, thrombocytopenia ($<50,000/\text{cm}^3$), and clinical conditions too unstable to tolerate the procedure (**pediatrics, 2010**).

2.5.5. Examination of Sputum

Sputum specimens may be useful in evaluating lower respiratory tract infections, but they are difficult to obtain in young children. In addition, an expectorated specimen may not provide a representative sample of lower airway secretions. Specimens containing large numbers of squamous epithelial cells are either not from the lower airways or are heavily contaminated with upper airway secretions and may yield misleading results. Sputum in patients with lower respiratory tract bacterial infections often contains polymorphonucleated leukocytes and one predominant organism on culture. If sputum cannot be obtained, then bronchoalveolar lavage specimens (obtained by bronchoscopy) may be used for microbiologic diagnosis in selected

situations. In patients with CF who cannot produce sputum, specially processed throat cultures are often used as surrogates for lower airway cultures **(pediatrics, 2010)**.

2.5.6. Lung Biopsy

When less invasive methods fail to provide diagnoses in patients with pulmonary disease, a lung biopsy may be required. Although transbronchial lung biopsy through a bronchoscope is useful in adults, it is seldom done in children. Either a thoracoscopic procedure or a thoracotomy is preferred in children. Thoracotomy allows the surgeon to inspect and palpate the lung, which aids in choosing the best site for biopsy, but it is more invasive than thoracoscopy. In most cases, infants and children tolerate lung biopsy well **(pediatrics, 2010)**.

2.6 Signs and Symptoms of ARI

Respiratory infection is divided into two groups: upper respiratory infection and lower respiratory infection. Acute respiratory infections are usually caused by the common cold, which commonly affects the sinuses, airways, or lungs. Symptoms of respiratory problems differ in the kinds of infection a child is suffering from. Some infections have minor symptoms, and some have severe symptoms. Usually, the respiratory infection starts with the runny nose, headache or sometimes fever. But those symptoms can be easily unseen in small children who are below two, as they can neither show nor explain the discomfort. This might lead to pneumonia for many children **(UK, 2018)**.

2.6.1 Upper respiratory infections

Upper respiratory infection includes common cold, ear infection, laryngitis, pharyngitis, and epiglottitis. An ear infection is counted as an upper respiratory infection because the middle ear is connected to the upper respiratory tract by a tiny tube which is also called the Eustachian tube. Ear

infection is a very common complication of other infections like common cold, influenza, pneumonia **(Smith et al., 2022)**.

An upper respiratory infection can be caused by many different viruses and most of these viruses are caught by touching the things that contain viruses. Upper respiratory tract infections are diagnosed by looking at the symptoms and treated according to the severity and cause of the infection. The symptoms of upper respiratory tract infections (URTIs) can be managed by providing enough liquids, having the child rest, clearing the mucus from the child's nose and by other methods too. The symptoms of common cold and influenza are similar due to which it is easier to get confused, but the symptoms of influenza are severe than common cold. Some of the upper respiratory infections are treated using anti-biotic **(Kharel and Bhandari, 2020)**.

Majority of upper respiratory infections are caused by viruses where Rhinoviruses cause 25-30% of infection; respiratory syncytial viruses (RSVs), influenza virus, human metapneumovirus and adenovirus causes 25-35% of infections and others are unidentified viruses **(Kharel and Bhandari, 2020)**.

2.6.2 Lower respiratory tract infections

Lower respiratory infection usually occurs in the lungs and in the airways. Lower respiratory infection includes Bronchitis, Bronchiolitis, and Pneumonia. Viruses are the most common cause of lower respiratory tract infections. The main viruses that cause lower respiratory infection in children are rhinovirus, RS virus (respiratory syncytial virus). Children who are under 1 year the main cause of the infection is RS virus and children over one-year is rhinovirus. The common symptoms of lower respiratory infections are wheeze, cough, fever, sore throat, breathlessness. It is treated according to the cause of infection by antibiotics or antiviral drugs. The lower respiratory infection lasts longer and can be more serious than upper respiratory infection **(UK, 2018)**.

2.7 Risk Factors of ARI

2.7.1 Age Group

Since the initiation of the program in 2010, there has been limited understanding in what risk factors affect severe acute respiratory infection (SARI) patients in relation to the respiratory diseases acquired. However, there have been numerous studies that have tried to determine the contribution of different respiratory diseases to different populations who have been affected by SARI. For example, Iwane et al. (2011) had compared the severity of human rhinovirus (HRV) associated with hospitalization among young children residing in three geographic areas of the U.S. They saw that there was four-fold increased rates detected among children two years or older that were hospitalized compared to the control (asymptomatic) group. Similar trend was seen for children who tested positive for other viruses such as RSV, parainfluenza virus, and influenza virus, which were hospitalized after presenting severe acute respiratory illness **(Ortiguerra, 2016)**.

In short, they developed a model that had shown no significant difference in clinical indicators of severity across different species of HRV, as well as between HRV and other respiratory pathogens that cause severe respiratory illness **(Nascimento et al., 2010)**. Nevertheless, the analyses only occurred among children's age, which makes other risk factors unidentified by this study. There was no significant data on other demographic categories such as availability of medical services and vaccination data from children (both hospitalized and control groups) that were analyzed **(Ortiguerra 2016)**.

Disparity in the proportion of people that have access and availability to the yearly influenza vaccine can also affect the rate of acute respiratory distress in many different populations. Since its development during the 1950s, it has been shown to have about 70–90% effectiveness in preventing influenza illness among healthy adults. In addition, children seem to be the most susceptible to acquiring influenza illness because of their under-developed immune system. It has

been shown that roughly 42% of all preschool and school-aged children are prone to getting sick from influenza yearly because it is easily transmitted from one child to another (**Hassan et al., 2009**).

2.7.2 Geographic Location

The geographical location of each population, their behavioral patterns regarding infectious diseases are also dictated by where the populations are situated. People who live in rural areas are often not in direct contact with many people daily; hence their likelihood of exposure is much lower compared to heavily populated areas. These people are more prone to quarantine practices themselves during illness from everyone else in order to reduce the spread of the disease because of ease and space availability. Inversely, people living in populated cities and urban communities are less likely to practice similar measures of prevention due to its fast-paced lifestyles and inadequate spaces for quarantine measures. Lifestyles of those living in urban cities often carry out daily tasks, such as work, school, and chores, even when they are presented with respiratory symptoms indicative of illness. In addition, the close proximity of people living in urban cities makes it much easier for communicable diseases to spread. This offers a much better scenario for the possible spread of communicable diseases, which is often seen during influenza seasons. This scenario is also true for migrant workers, much like the ones living along the border region, who often travel far in order to earn a living. This poses a less than ideal setting for disease prevention because of their ability to either carry out or bring diseases into local communities (**Ortiguerra 2016**).

2.7.3 Immunization

Immunizations are another factor that affects how the population reacts to infectious diseases. Since this area of the country consists of high-risk groups associated with elevated rates of acute respiratory distress, which includes people of racial and/or ethnic minorities, undocumented

immigrants, and homebound elderly, whom all might not have routine access to health care nor have proper health care providers. For example, during the 2004-2005 influenza season, the vaccination rate in the United States among the general population was only about 42%, which falls short of the 80% objective set forth by CDC. In fact, researchers had recently demonstrated that African Americans and Hispanic Americans were shown to be the lowest percentage in the population being vaccinated in 2011, with a coverage rate of 40.5% and 43.5%, respectively. Much of these people belonging in the unvaccinated group were those from the high risk groups, specifically people who are over the age of 50 years and immune-compromised people with chronic medical conditions **(Ortiguerra 2016)**.

However, not only do socioeconomic disparities contribute to this growing problem. In fact, there have been numerous studies that demonstrated various reasons for the low immunization rates, not only for influenza virus, but overall recommended immunizations for children and adults. These fears stem from the myth that the vaccine virus might revert back to the virus' wild type form, thereby causing the recipients to become sick, even though various clinical trials have not seen such reversions from occurring. In addition, many of the people surveyed also reported concerns with adverse effects such as fever, muscle aches, nausea, and chills due to the components of the vaccine even if very few reported cases of adverse effects were reported after receiving them **(Ortiguerra 2016)**.

2.7.4 Gender

Other potential risk factors that must be addressed are gender, pregnancy among females, and existing comorbidities that might increase the severity of respiratory diseases. Females are also at higher risk of acquiring acute respiratory illness because of their traditional roles in families and society. Interactions between females and their children usually occur more due to their responsibilities as mothers such as feeding and bathing, when compared with males who are often gone throughout the day with their job. Females are also traditionally left alone to give care for

extended families such as grandparents who live with them. Occupational risks are also present in women, making them highly susceptible to various diseases. Healthcare workers, grade school teachers, and day-care workers are often held by predominantly females, which potentially lead to a gender-specific risk for communicable disease acquisition **(Ortiguerra 2016)**.

2.7.5 Comorbidities

Comorbidities can greatly affect how some people react to infectious diseases, which can exacerbate or worsen the symptoms of respiratory diseases. Medical conditions such as asthma, bronchitis, chronic respiratory disorders, and other pre-existing illnesses have profound effects on the rate and severity of respiratory illnesses. They had found that children who experienced RSV associated lower respiratory infections in their first year of life were more likely to report chronic wheezing and asthma at the age of 5. In addition, RSV infections among school age children with asthma also demonstrated viral illnesses lasting longer, more severe, and were more likely to have an episode of loss of asthma control. Furthermore, most viral upper respiratory infections in children and young adults are frequently associated with conjunctival and tympanic infections. These symptoms include earache from tenderness and bulging of tympanic membrane, tachypnea (rapid breathing), wheezing, severe cough, breathlessness, and other respiratory distress **(Ortiguerra 2016)**.

2.8 Nursing Management of ARI

Nurses have an important role in managing children with RTIs, both in the community and in the hospital environment. Managing children both in primary and secondary care, so are well placed for managing RTIs, one of the most common illnesses in childhood. In primary care, practice nurses, community nurses, health visitors, school nurses, and pediatric nurse practitioners can often decide on further management and referral. **(Fabrellas et al., 2011)**

In most cases, children with RTIs can be managed in the community with reassurance, advice on fluids, and antipyretics, and occasional prescription of antibiotics depending on clinical need. Nurses also play an extended role in supporting parents who may be worried and anxious about their child's symptoms, by ensuring appropriate follow-up arrangements are provided, and that written and verbal safety net explanations are given and understood with regard to what should be done if the child deteriorates at home. Nurses also play an important role in encouraging uptake of immunization, which has been found to play a preventive role in development of further RTIs **(Paul, et al., 2011)**.

In the hospital set up, nurses in the emergency department should identify sick children during triaging because they are often the first health care professional to come into contact with such patients. The triage nurse should identify the child with pre-terminal severe breathing difficulty and arrange immediate or urgent medical attention. Pre-terminal signs in a child with breathing difficulty are exhaustion, bradycardia, a silent chest, and significant apnea. Severe or life-threatening breathing difficulty is manifested by inappropriate drowsiness (difficult to rouse), agitation, and cyanosis in air **(Fabrellas et al., 2011)**.

In the resuscitation situation, nurses in the emergency department will perform regular observations, administer respiratory support (eg, oxygen, continuous positive airway pressure) and medicines, ensure requested investigations are done, e.g., a chest X-ray has been performed and acted upon. Nurses also need to ensure that parents are well supported in this vital period and are kept well informed about their child's progress. Some children who need to be transferred to the pediatric intensive care unit will need to be transported to specialist centers, and it is important that the transfer process happens smoothly and in a time-critical manner **(Paul et al., 2014)**.

Once children have been stabilized in the emergency department, they will be transferred to the pediatric ward where their ongoing care will continue, including regular observations, i.e., administration of fluids and medicines, supporting nutrition, and personal hygiene. Communication with parents and ensuring that they feel involved in the care of their child is essential during this

transition period. When the child is ready for discharge, nurses need to ensure that adequate supply of medicines are made available for continuing care. Signs of deterioration should be explained, and the family should be informed of any hospital follow-up that has been arranged **(Paul, et al., 2011)** .

There is an increasing spectrum of nurse practitioner roles identified in pediatric care that have been evolving for many years. While some areas of respiratory care, such as asthma and cystic fibrosis, have well established nurse practitioner roles, these roles may not be that easily identified in the management of children with acute RTI in the hospital environment. **(Brown et al., 2013; Vandenbranden 2013)**

Community neonatal nurses supporting infants and families after discharge from neonatal intensive care units is another established area of practice where specialist nurses deliver respiratory care. Individual practice areas, such as the specialist nurse dealing with respiratory care in ex-premature babies, e.g., CLD of prematurity, arranging home oxygen, providing nasogastric feeding support and palivizumab injections are a few areas where specialist nursing roles have been well established. **(Whelan 2012; Kuethe et al., 2011)**

Emergency departments and pediatric assessment units are seeing changes in medical practice with the emerging role of the advanced pediatric nurse practitioner. Advanced pediatric nurse practitioners are trained to a level where they can autonomously assess and manage children to the level of a medical professional, including ordering investigations, planning medical and nursing care, and prescribing medications, while also undertaking nursing care. **(Paul et al., 2014)**

Another important aspect of managing RTIs in children is prescription of antibiotics (for bacterial RTIs). While it is important that antibiotics are prescribed with caution, as discussed previously, all prescribers, including non-medical prescribers, must have an understanding of where such prescriptions are likely to be beneficial. This knowledge will enable the practitioner to counsel families about the appropriateness of antibiotic therapy and reassure them when such therapies are not going to be of benefit to the child **(Paul et al., 2014)**.

2.9 Prevention

The prevention of respiratory illnesses in Aboriginal and Torres Strait Islander children, or at the very least a closure of the gap in disease burden between them and their non-Indigenous contemporaries, will be largely dependent on ongoing changes in socioeconomic disparities and a reduction in modifiable risk factors. Preventing recurrent ARIs and addressing risk factors early in life is likely to translate to long-term health benefits, particularly the prevention of chronic lung disease. In this section, we do not differentiate between prevention of acute and chronic illnesses as the important determinants of disease are largely the same. Further, whilst socioeconomic change is critical, it will take time and a focus on more readily modifiable risk factors is necessary (**Chang et al., 2015**).

The critical factors to address are maternal health and wellbeing (before, during and after pregnancy) to improve neonatal and infant outcomes from birth, infant and child nutrition, reductions in exposure to environmental tobacco smoke and other pollutants, prevention of the uptake of smoking in youth, timely provision of recommended vaccines during pregnancy, infancy and early childhood (particularly influenza, pertussis and pneumococcal vaccines) and the education and empowerment of parents/careers to recognize abnormal respiratory signs and symptoms and to seek timely care. Enabling parents/careers to feel confident in seeking care and discussing their concerns with health care providers is important given data suggesting some families feel they are not taken seriously by their provider (**Bell, 2015**).

The prevention of chronic respiratory infections can be facilitated by adequate follow-up following illness, particularly following lower respiratory infections such as pneumonia and bronchiolitis and when illness progresses to chronic cough (> four weeks duration) (**Chang et al., 2014**). Further, educating parents on the importance of seeking care for persistent symptoms and completing courses of prescribed medications, including antibiotics, is important. There are scarce data on parent/career knowledge of cough and medication use for ARI. In an urban study of Aboriginal and

Torres Strait Islander children (**HealthBulletin, 2017**), 95% of parents (n = 180) were aware that persistent and wet cough was abnormal, however 13% incorrectly reported antibiotics should only be taken until there were no more symptoms present suggesting more education is required (**O'Grady et al., 2018**).

2.10 Management

In managing illnesses among Aboriginal and Torres Strait Islander people, the commonly encountered paradigm of a defeatist approach of 'minimal treatment' needs to be changed to a 'best possible care of intensive and appropriate treatment'. The major improvement in longevity of people with cystic fibrosis over the last three decades is not related to major technological or genetic breakthroughs, but related to improved clinical care through better attention to nutrition, airway clearance and intensive treatment of infections. If Aboriginal and Torres Strait Islander children receive optimal treatment (including a system-wide approach that includes multi-disciplinary, evidence based, culturally appropriate, management pathways), the clinical outcomes should be similar to their non-Indigenous counterparts. Readers are referred to specific management guidelines for individual conditions (**O'Grady et al., 2018**).

2.10.1. Early detection

There are no specific respiratory risk assessment tools for Aboriginal and Torres Strait Islander children that have been developed and evaluated. However, there are many symptoms suggestive of chronic lung disease. In children, the most common is cough. Indeed, chronic cough is one of the earliest symptoms of airway disease and may reflect an underlying serious disorder (**O'Grady et al., 2018**).

It is also one of the most common symptoms presenting to respiratory (lung) specialists. Delayed diagnosis of an underlying disorder may cause further chronic morbidity (**O'Grady et al., 2018**), while early diagnosis leads to appropriate management and subsequent resolution of cough and

improved quality of life (QoL) (Chang et al., 2014).

In a national multicenter study, 18% of the 346 children newly referred for chronic cough had a serious underlying diagnosis (bronchiectasis, aspiration, cystic fibrosis) and 41% (n = 142) of children had PBB, a likely pre-bronchiectasis condition in children at high risk of CSLD. The 31 (9%) children who had bronchiectasis were significantly more likely to be Indigenous than nonindigenous (OR = 4.4, 95% CI, 1.9, 10) (O'Grady et al., 2018).

Importantly, 70% of the cohort were misdiagnosed as asthma. In another study where children who presented to the ED were recruited, a new and serious chronic lung disease was diagnosed in 36 of the 117 (31%) followed-up for their persistent cough on day 28 (Chang et al., 2014). Therefore, management of chronic cough is paramount to early diagnosis of an underlying lung disorder. Obtaining the correct diagnosis also reduces the morbidity from incorrect medications used (O'Grady et al., 2018).

2.10.2. Primary health care setting

Use of appropriate cough pathways or algorithms is one strategy that leads to earlier diagnosis of underlying chronic illness and reduce the morbidity of chronic cough and unnecessary costs. In a multi-center randomized controlled trial based in referral centers (Chang et al., 2014), it was found that use of a cough management pathway embedded within a guideline improved clinical outcomes (improved QoL and reduced the duration of cough i.e. earlier diagnosis and management of the etiology of the cough). A systematic review (Chang et al., 2017) and an expert panel report found high quality evidence that the use of cough management protocols improves clinical outcomes in children with chronic cough (> four week duration) (O'Grady et al., 2018).

The presence of chronic wet cough in children implies lower airway infection and intense inflammation, as seen in PBB (Douros et al., 2011). In an NT-based follow-up study, Indigenous children with persistent wet cough (n = 30) after an acute hospitalization for an ALRI were significantly more likely to have bronchiectasis compared with those without a cough (n = 126),

(OR = 3, 95% CI, 1.1, 7, p = 0.03) (**McCallum et al., 2016**). Treatment of the end bronchial infection present in these children with chronic wet cough would likely halt the ongoing infection and inflammation and prevent CSLD (**Goyal et al., 2016**). In children from a population at risk of chronic lung disease, a model of care that follows up (and treats when required) children post-hospitalization to lung illness could prevent development of CSLD (**O'Grady et al., 2018**).

CHAPTER THREE

METHODOLOGY

CHAPTER THREE: METHODOLOGY

3.1. Study design:

Descriptive cross -sectional study was conducted to assess the risk factors of acute respiratory infection among child aged less than five years at public hospitals in Sana'a City -Yemen.

3.2. Study setting:

The study was conducted at public hospitals include (Al-Thawra Modern General Hospital Authority, Republican Teaching Hospital Authority and Al-Sabeen Maternity and Child Hospital) in Sana'a city- Yemen.

3.3. Study population

The study population consisted of all child aged under five years that were admitted to the above-mentioned hospitals during study period in Sana'a City.

3.4. Sampling method:

The sample was taken from the target hospitals through convenient sampling technique. All child aged under five years that were admitted during six weeks of the study tell the sample size was completed.

3.5. Sampling Technique:

The sample size was determined through the use Steven K. Thompson taking into consideration the following: The sample size was calculated as a follow: the population of the study was all that admitted to the pediatric department during three months at three

public hospitals which 9522 children, precision (5%), and 95% confidence level. The final sample size was 370 + (42 pilot study) children.

Table 1: Distribution of the total sample according to name hospitals

Name of hospital	Total of population	Sample size
Al- Thawra Modern General Hospital Authority	1828	79
Republican Teaching Hospital Authority	3257	141
Al-Sabeen Maternity and Child Hospital	4437	192
Total	9522	412

Calculation of the sample size from each level in the University was prepared by the following formula:

$$\frac{n}{N} * K = \text{sample size to each hospital}$$

- n = (sample size)
- N= (study population)
- K= (population of each hospital).

3.6. Inclusion and Exclusion Criteria

3.6.1. The inclusion criteria were included:

1. All children admitted to hospitals with acute respiratory tract infection.
2. All children who their parents agree to participate in the study.

3.6.2. The exclusion criteria were included:

1. All children who their parents disagree to participate in the study.

3.7. Data collection:

3.7.1. Data collection methods:

Data was collected through the six weeks where good rapport was maintained in the whole period of data collection, mothers were told to sign the verbal consent form. The specific time for interviewed was between 8 a.m. to 2 p.m. The questionnaire prepared in English language. The data for the research was collected using face-to-face interviews with mother. The face-to-face interviews were conducted in Arabic language in a quiet environment in the public area of the selected department, away from noise and other distractions. All the collected data has been checked by the researchers daily for completeness and finalization.

3.7.2. Study instrument:

The questionnaire was modified from previous studies (*Ghimire et al., 2022*). The instrument of this research consist of the following :

Part I: Demographic and Personal Data : this part include the demographic and personal data shush as: age, sex, socio-economic status, room no, where do you live and residence. six question which as multiple choice question.

Part II: Neonate Period Data: This part include the neonate period data such as: place of births delivered, type of births delivered, birth weight, gestational age and ect. question which as multiple choice question.

Part III: Parental Data: This part consist two sections including:

- **Section I: mother data:** This section include the mother data such as: mother age, age at marriage, mother education, occupation of mother, smoking. Five question which as multiple choice question

- **Section II: Father Data**

This section include the father data such as: father age, father education, occupation of father, smoking. Four question which as multiple choice question

Part IV: Family Data: This part include the family data such as: siblings, number of under five children, household family size. Three question which as multiple choice question.

Part V: Risk Factors Data: This part include risk factors data such as: nutritional status, has the baby getting of Vitamin A last 6 months, co – morbidities, indoor air pollution, environmental pollution. Five question which as multiple choice question Yes and no.

Part VI: Data on disease: This part include data disease such as: child suffer from respiratory infection, fever, dyspnea, cough, runny nose, headache, symptom's duration. Seven question which as multiple choice question Yes and no.

3.8. Pilot study:

The pilot study was performed before data collection present to point out weakness of the questionnaire and performed before data collection. A pilot study was on (42) participants from sample size of the Childs on items in a questionnaire to assess the clearing, feasibility of the study and modification of the questionnaire was made.

3.9. Validity and reliability:

The questionnaire was adopted from previously validated and reliable studies was reviewed by (5 experts) to determine if all questions were clearly worded and were not be misinterpreted. As a result, some questions were omitted, some added, and others rephrased. Other questions added were formulated by the researcher with the help of literature supervisor and experts were modified to add or omitted to clearly and corrected

misinterpreted and doubtlessness from credence and completeness of study tools.
Reliability by chrobch $\alpha = 0.812$.

3.10. Data analysis :

The data was entered in SPSS program version 24. The data was double-checked. The data was analyzed according to the study objectives. Frequencies and percentage were used. The association between a dependent variable (ARI) and each independent variable (risk factors) was measured as Odds Ratio (OR) with 95% Confidence Intervals (CI). Finally, multiple logistic regressions using enter method was carried out to get the final model of risk factors for ARI.

3.11. Ethical consideration

A letter was issued from the faculty of medical science 21 September to target hospitals. Parents were assured that their responses would not influence their child life. Purpose and benefits of the study were explained to the parents. The parents were assured of confidentiality. Verbal consent were obtained from parents which describe the study and indicate that the subjects could withdraw from the study at any time.

CHAPTER FOUR: RESULTS

CHAPTER FOUR: RESULTS

Demographic characteristics of under five years' children

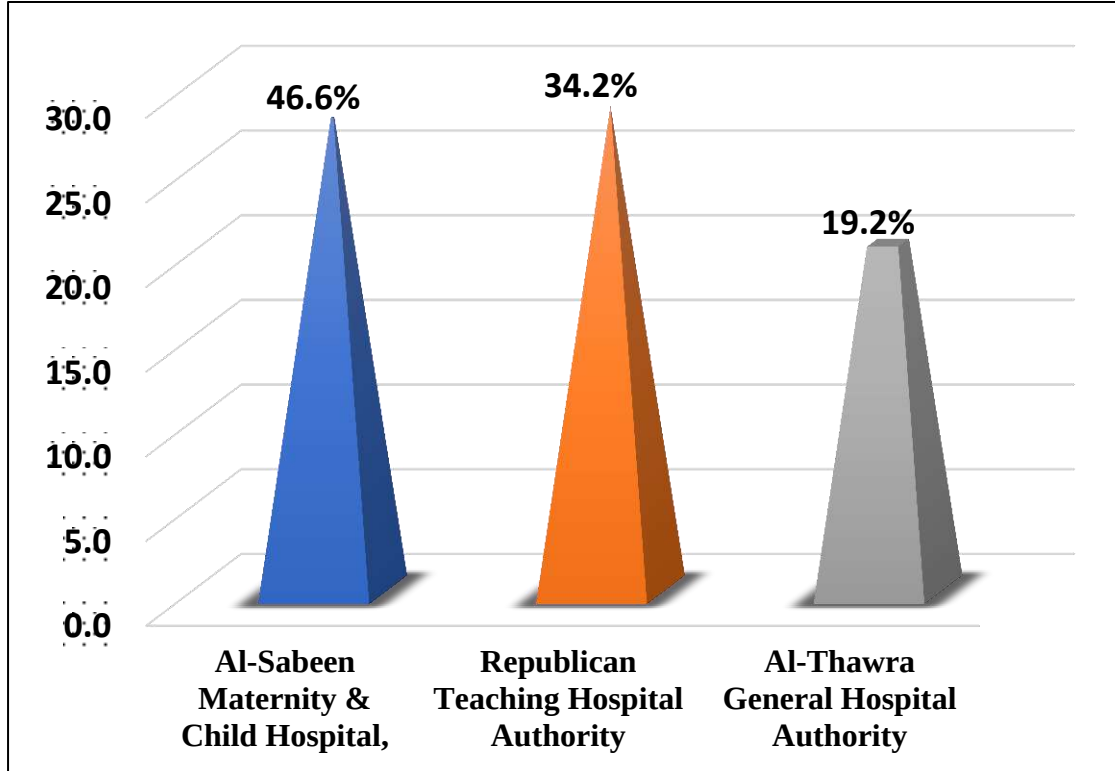


Figure 1: Distribution of participants according to hospital name (n=412).

Figure (1): show distribution of participants according to hospital name, the highest percentage of the research sample was from the Al-Sabeen Maternity & Child Hospital 46.6%, follow by 34.2% Republican Teaching Hospital Authority, then Al-Thawra Modern General Hospital Authority 19.2%.

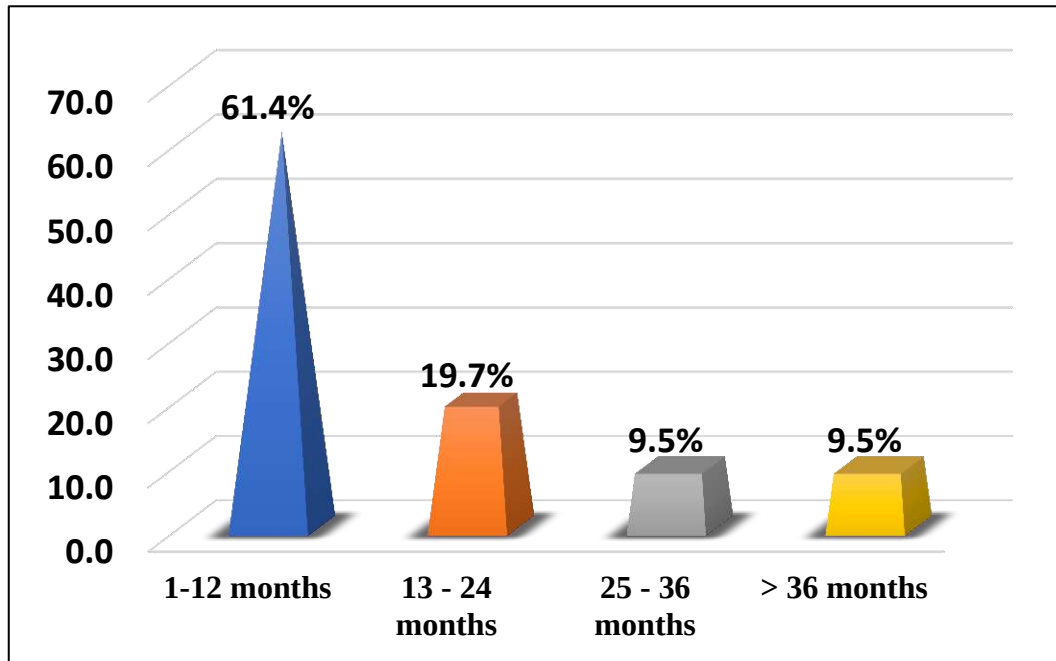


Figure 2: Distribution of participants according to age in months group (n=412).

Figure (2): show distribution of participants according to age in months group, more than half (61.4%) of participants were age group between 1 to 12 months, follow by (19.7%) of participants were age group between 13 to 24 months, while. (9.5%) of participants were age group between 25 to 36 months and > 36 months.

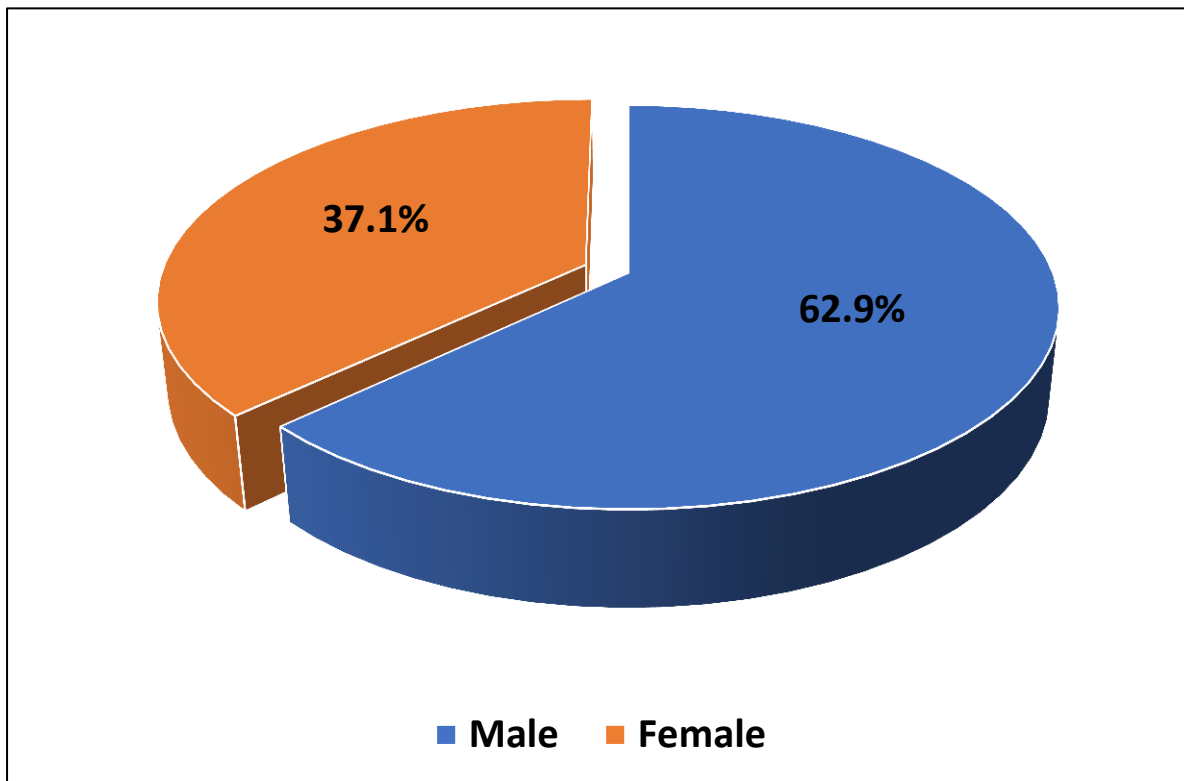


Figure 3: Distribution of participants according to sex (n=412).

Figure (3): show distribution of participants according to sex, more than half (62.9%) of participants were male, while. (37.1%) of participants were female.

Table 1: Distribution demographical characteristics of participants (n=412).

Characteristics	F	%
Economic status		
• ≤ 50 thousand YR	310	75.2
• 51-99 thousand YR	81	19.7
• 100-150 thousand YR	19	4.6
• > 150 thousand YR	2	0.5
Where do you live		
• In an apartment building	104	25.2
• In the private house	291	70.6
• In the dormitory	16	3.9
• Other (specify)	1	.2
Residence		
• Urban	184	44.7
• Rural	228	55.3
Room Number:		
• 1-3	286	69.4
• 4-6	113	27.4
• > 6	13	3.2

Table 1 note that, distribution demographical characteristics of participants. Most (75.2%) of participants had ≤ 50 thousand YR economic status. Most (70.6%) of study participants live in the private house. More than half (55.3%) of participants from rural. More than two third (69.4%) of them have 1-3 room.

Table 2: Distribution demographical characteristics of participants towards neonatal period data (n=412).

Characteristics	F	%
Place of births delivered:		
• Hospital	214	51.9
• Health center	25	6.1
• Home	173	42.0
Type of births delivered		
• Normal	324	78.6
• S.C	88	21.4
Gestational age		
• Full term	363	88.1
• Premature	49	11.9
Nursery stays		
• Yes	107	26.0
• No	305	74.0
Number of pregnant		
• < 3	242	58.7
• 4-7	155	37.6
• > 7	15	3.6
Number of still birth		
• < 4	255	61.9
• 4-7	145	35.2
• > 7	12	2.9
Breastfeeding		
• Yes	342	83.0
• No	70	17.0
Still Breastfeed your child		
• Yes	253	61.4
• No	159	38.6
How many months breastfeed		
• None	234	56.8
• After six-month	146	35.4
• Before six months	32	7.8
Immunization up to date		
• Yes, immunized	177	43.0
• Partial	107	26.0
• Not immunized	128	31.1
Oxygen treatment in neonate		
• Yes	145	35.2
• No	267	64.8
Weight in kg		
• Mean & SD	2.67± 0.65	

Table 2 note that, distribution demographical characteristics of participants. About half (51.9%) of participants birth delivered in hospital. Most (78.6%) of study participants were normal birth delivered. Regarding gestational age majority (88.1%) of participants full term and (74.0%) did not stay in Nursery. More than half (58.7%) of mother have less than 3 pregnant and (61.9%) of them have less than 4 still birth. Most (83.0%) of study participants were breastfeeding and (61.4%) of study participants were still breastfeed your child. More than one third (43.0%) of study participants were immunized and more than two third (64.8%) of them were oxygen treatment in neonate.

Table 3: Distribution demographical characteristics of participants towards parental data (n=412).

Characteristics	F	%
Mother age		
• < 20 years	20	4.9
• 20 – < 25 years	104	25.2
• 25 – < 30 years	136	33.0
• 30 – < 35years	71	17.2
• > 35 years	81	19.7
• Mean & SD	(27.82± 6.10)	
Age at Marriage of mother		
• < 15 years	59	14.3
• 16 – 20 years	287	69.7
• 21 – 25 years	53	12.9
• > 25 years	13	3.2
• Mean & SD	(18.59± 3.10)	
Mother education		
• Illiterate	150	36.4
• Primary	147	35.7
• Secondary	96	23.3
• University	19	4.6
Occupation of mother		
• Housewife	397	96.4
• Worker	15	3.6
Smoking		
• Yes	34	8.3
• No	378	91.7
Father age		
• < 25 years	46	11.2
• 26 – < 30 years	100	24.3
• 30 – < 35 years	110	26.7
• 35-< 40 years	81	19.7
• > 40 years	75	18.2
• Mean & SD	(32.24± 7.17)	
Father education		
• Illiterate	54	13.1
• Primary	122	29.6
• Secondary	152	36.9
• University	84	20.4
Occupation of father		
• Employment	55	13.3
• Non-employment	357	86.7
Smoking		
• Yes	166	40.3
• No	246	59.7

Table 3 shows that, distribution characteristics of participants towards parental data. Most (33.0%) of mother were age group between 25– <30 years, while (69.7%) age at marriage of mother between 16-20 years. Most (36.4%) of mother were illiterate educational level and (94.4%) of them were housewife occupation. Majority (91.7%) of mother did not smoke. Most(26.7%) of father were age group between 30– <35 years. Most (36.9%) of father were secondary educational level and (86.7%) of father were non-employment. More than half (59.7%) of father did not smoke.

Table 4: Distribution demographical characteristics of participants towards family data (n=412).

Characteristics	Frequency	%
Siblings		
• < 3	247	60.0
• 3 – 5	133	32.3
• > 5	32	7.8
Number of children under five		
• None	172	41.7
• 1-3	238	57.8
• > 3	2	.5
Household family size		
• 1-5	126	30.6
• 6 – 10	219	53.2
• > 10	67	16.3

Table 4 notes that, distribution demographical characteristics of participants towards family data. Most (60.0%) of participants were had siblings <3 children. More than half (57.8%) of participants were had from 1-3 children under five years. Most (53.2%) of participants were between 6-10 family size.

Risk factors of acute respiratory infection in under five years' children

Table 5: Distribution nutritional status and Co – morbidities of participants (n=412).

Characteristics	Frequency	%
Nutritional status:		
MUAC		
Mean & SD	(12.084± 1.768)	
Chronic lung diseases		
• Yes	53	12.9
• No	359	87.1
Family history of diseases:		
• Asthma	41	10.0
• COVID-19	6	1.5
• T.B	6	1.5
• None	359	87.1
Vitamin A last 6 months		
• Yes	184	44.7
• No	228	55.3

Table 5 notes that, distribution nutritional status and Co – morbidities of participants. Most (87.1%) of participants not have chronic lung diseases and (78.1%) of them not have family history of diseases. More than half (55.3%) of participants not received vitamin A last 6 months.

Table 6: Distribution environmental factors and indoor air pollution of participants (n=412).

Characteristics	Frequency	%
Exposure to wood smoke		
• Yes	171	41.5
• No	241	58.5
Bedroom pollution		
• Yes	159	38.6
• No	253	61.4
Kitchen place		
• Inside house	315	76.5
• Outside house	97	23.5
Cooking fuel		
• Yes	406	98.5
• No	6	1.5
Type of fuel		
• Gas		
○ Yes	354	85.9
○ No	58	14.1
• Wood		
○ Yes	222	53.9
○ No	190	46.1
• Cow dung		
○ Yes	25	6.1
○ No	387	93.9
Child in the kitchen while cooking		
• Yes	203	49.3
• No	209	50.7
Smoking pollution:		
• Yes	216	52.4
• No	196	47.6
Have pets in your home		
• Yes	236	57.3
• No	176	42.7
Type of pet		
• Cats		
○ Yes	110	26.7
○ No	302	73.3
• Rabbits		
○ Yes	133	32.3
○ No	279	67.7
• Sheep		
○ Yes	80	19.4
○ No	332	80.6
• Dogs		
○ Yes	5	1.2
○ No	407	98.8
• Cows		
○ Yes	51	12.4
○ No	361	87.6

Table 6 shows that, distribution environmental factors and indoor air pollution of participants. Most (58.5%) of participants did not exposure to wood smoke, and (61.4%) of participants did not bedroom pollution. Most (76.5%) of participants have Kitchen inside house, and majority (98.5%) of them used cooking fuel and (85.9%) of them used gas. about (50.7%) of participants were child in the kitchen while cooking and (52.4%) of them were smoking pollution. Finally (57.3%) of participants have pets in your home.

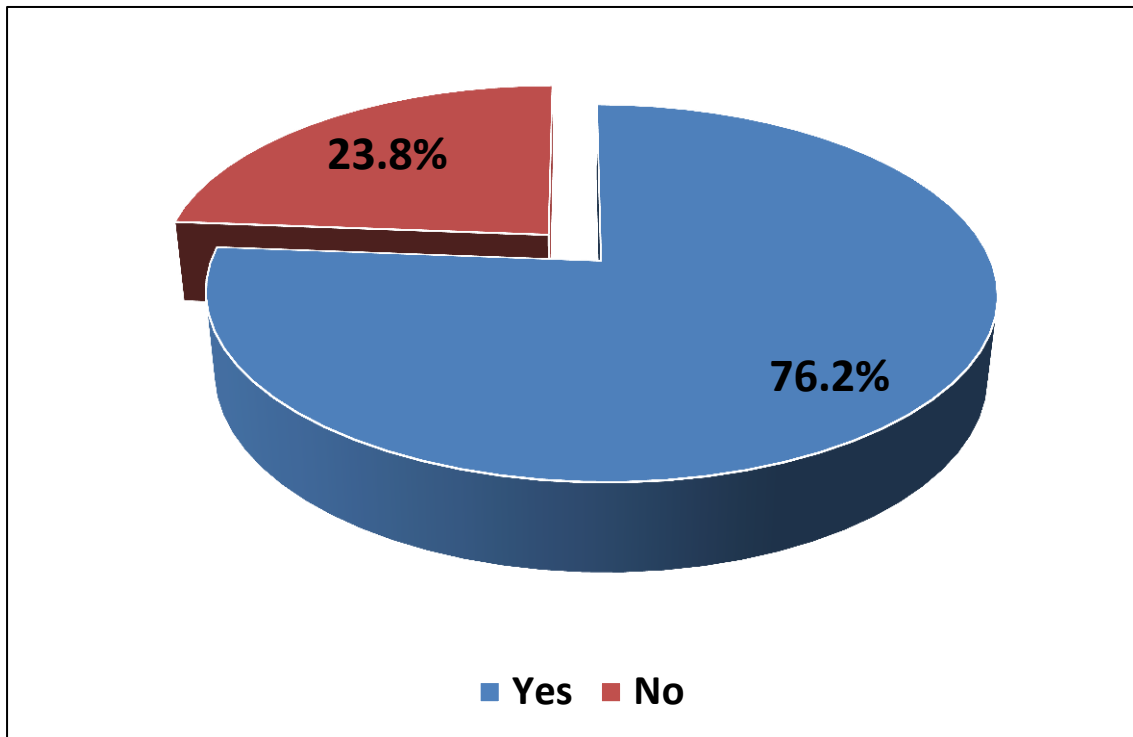


Figure 4: Prevalence of participants toward acute respiratory infection (n=412)

Figure 4 show that, prevalence of participants toward acute respiratory infection. Most (76.2%) of study participants have acute respiratory infection and while (23.8%) of study participants not have acute respiratory infection.

The relationship between some of demographic data and acute respiratory infection

Table 7: Association between acute respiratory infection and risk factor toward demographical characteristics.

Demographical characteristics	Acute respiratory infection					
	Yes		No		Chi-square	p-value
	F	%	F	%		
Hospital name						
• Al-Sabeen Maternity & Child Hospital	156	37.9	36	8.7	9.305	0.010
• Republican Teaching Hospital Authority	95	23.1	46	11.2		
• Al-Thawra General Hospital Authority	63	15.3	16	3.9		
Sex						
• Male	194	47.1	65	15.8	0.660	0.416
• Female	120	29.1	33	8.0		
Age in months						
• 1-12 months	200	48.5	53	12.9	3.196	0.362
• 13 - 24 months	58	14.1	23	5.6		
• 25 - 36 months	29	7.0	10	2.4		
• > 36 months	27	6.6	12	2.9		
Economic status						
• ≤ 50 thousand YR	241	58.5	69	16.7	2.616	0.455
• 51-99 thousand YR	57	13.8	24	5.8		
• 100-150 thousand YR	14	3.4	5	1.2		
• > 150 thousand YR	2	.5	0	.0		
Where do you live						
• In an apartment building	73	17.7	31	7.5	3.138	0.371
• In the private house	228	55.3	63	15.3		
• In the dormitory	12	2.9	4	1.0		
• Other (specify)	1	.2	0	.0		
Room Number:						
• 1-3	225	54.6	61	14.8	6.872	0.032
• 4-6	77	18.7	36	8.7		
• > 6	12	2.9	1	.2		
Residence						
• Urban	143	34.7	41	10.0	0.415	0.520
• Rural	171	41.5	57	13.8		

Table 7 show that, association between acute respiratory infection and risk factor toward demographical characteristics. There was statistically significant between acute respiratory infection with Hospital name and room number because (p-value=0.010, 0.032) respectively. while there was not statistical difference significantly between acute respiratory infection with other variables because (P – value > 0.005).

Table 8: Association between acute respiratory infection and risk factor toward neonate period data.

Characteristics	Acute respiratory infection					
	Yes		No		Chi-square	p-value
	F	%	F	%		
Place of births delivered:						
• Hospital	160	38.8	54	13.1	1.126	0.570
• Health center	21	5.1	4	1.0		
• Home	133	32.3	40	9.7		
Type of births delivered						
• Normal	244	59.2	80	19.4	0.685	0.408
• S.C	70	17.0	18	4.4		
Gestational age						
• Full term	276	67.0	87	21.1	0.055	0.815
• Premature	38	9.2	11	2.7		
Nursery stays						
• Yes	82	19.9	25	6.1	0.14	0.905
• No	232	56.3	73	17.7		
Number of pregnant						
• < 3	184	44.7	58	14.1	0.124	0.940
• 4-7	118	28.6	37	9.0		
• > 7	12	2.9	3	0.7		
Number of still birth						
• < 4	192	46.6	63	15.3	0.365	0.833
• 4-7	113	27.4	32	7.8		
• > 7	9	2.2	3	0.7		
Breastfeeding						
• Yes	257	62.4	85	20.6	1.265	0.261
• No	57	13.8	13	3.2		
Still Breastfeed your child						
• Yes	198	48.1	55	13.3	1.516	0.218
• No	116	28.2	43	10.4		
How many months breastfeed						
• None	185	44.9	49	11.9	5.469	0.065
• After six-month	102	24.8	44	10.7		
• Before six months	27	6.6	5	1.2		
Immunization up to date						
• Yes, immunized	133	32.3	44	10.7	0.213	0.899
• Partial	82	19.9	25	6.1		
• Not immunized	99	24.0	29	7.0		
Oxygen treatment in neonate						
• Yes	117	28.4	28	6.8	2.473	0.116
• No	197	47.8	70	17.0		
Weight in kg						
Mean & SD	2.703± 0.676		2.587± 0.573		0.689	0.408

Table 8 show that, association between acute respiratory infection and risk factor toward neonate period data. There was not statistically significant between acute respiratory infection with variables because ($P - \text{value} > 0.005$).

Table 9: Association between acute respiratory infection and risk factor toward parental data.

Characteristics	Acute respiratory infection					
	Yes		No		Chi-square	p-value
	F	%	F	%		
Mother age						
• < 20 years	16	3.9	4	1.0	2.825	0.588
• 20 – < 25 years	81	19.7	23	5.6		
• 25 – < 30 years	98	23.8	38	9.2		
• 30 – < 35years	58	14.1	13	3.2		
• > 35 years	61	14.8	20	4.9		
Age at Marriage of mother						
• < 15 years	47	11.4	12	2.9	1.149	0.765
• 16 – 20 years	216	52.4	71	17.2		
• 21 – 25 years	42	10.2	11	2.7		
• > 25 years	9	2.2	4	1.0		
Mother education						
• Illiterate	122	29.6	28	6.8	3.726	0.293
• Primary	109	26.5	38	9.2		
• Secondary	70	17.0	26	6.3		
• University	13	3.2	6	1.5		
Occupation of mother						
• Housewife	305	74.0	92	22.3	2.257	0.133
• Worker	9	2.2	6	1.5		
Smoking						
• Yes	27	6.6	7	1.7	0.209	0.647
• No	287	69.7	91	22.1		
Father age						
• < 25 years	40	9.7	6	1.5	4.115	0.391
• 26 – < 30 years	78	18.9	22	5.3		
• 30 – < 35 years	81	19.7	29	7.0		
• 35-< 40 years	59	14.3	22	5.3		
• > 40 years	56	13.6	19	4.6		
Father education						
• Illiterate	41	10.0	13	3.2	3.585	0.310
• Primary	100	24.3	22	5.3		
• Secondary	113	27.4	39	9.5		
• University	60	14.6	24	5.8		
Occupation of father						
• Employment	37	9.0	18	4.4	2.799	0.094
• Non-employment	277	67.2	80	19.4		
Smoking						
• Yes	122	29.6	44	10.7	1.134	0.287
• No	192	46.6	54	13.1		

Table 9 show that, association between acute respiratory infection and risk factor toward parental data. There was not statistically significant between acute respiratory infection with variables because ($P - \text{value} > 0.005$).

Table 10: Association between acute respiratory infection and risk factor toward family data.

Characteristics	Acute respiratory infection					
	Yes		No		Chi-square	p-value
	F	%	F	%		
Siblings:						
• < 3	186	45.1	61	14.8	0.427	0.808
• 3 – 5	104	25.2	29	7.0		
• > 5	24	5.8	8	1.9		
Number of children under five:						
• None	125	30.3	47	11.4	2.542	0.280
• 1-3	187	45.4	51	12.4		
• > 3	2	.5	0	.0		
Household family size:						
• 1-5	94	22.8	32	7.8	4.8856	0.088
• 6 – 10	175	42.5	44	10.7		
• > 10	45	10.9	22	5.3		

Table 10 show that, association between acute respiratory infection and risk factor toward family data. There was not statistically significant between acute respiratory infection with variables because ($P - \text{value} > 0.005$).

The relationship between risk factors and acute respiratory infection

Table 11: Association between acute respiratory infection and risk factor toward nutritional status and Co – morbidities

Characteristics	Acute respiratory infection				Chi-square	p-value
	Yes		No			
	F	%	F	%		
Nutritional status:						
MUAC						
Mean & SD	11.98± 1.76		12.434± 1.75		5.089	0.025
Chronic lung diseases						
• Yes	46	11.2	7	1.7	0.032	0.858
• No	268	65.0	91	22.1		
Family history of diseases:						
• Asthma	36	8.7	5	1.2	3.755	0.034
• COVID-19	5	1.2	1	.2		
• T.B.	5	1.2	1	.2		
• None	268	65.0	91	22.1		
Vitamin A last 6 months						
• Yes	141	34.2	43	10.4	3.857	0.277
• No	173	42.0	55	13.3		

Table 11 show that, association between acute respiratory infection and risk factor toward nutritional status and Co – morbidities. There was statistically significant between acute respiratory infection with nutritional status and family history of diseases because (p-value=0.025, 0.034) respectively. while there was not statistical difference significantly between acute respiratory infection with other variables because (P – value > 0.005).

Table 12: Association between acute respiratory infection and risk factor toward environmental factors and indoor air pollution

Characteristics	Acute respiratory infection					
	Yes		No		Chi-square	p-value
	F	%	F	%		
Exposure to wood smoke						
• Yes	142	34.5	29	7.0	7.517	0.006
• No	172	41.7	69	16.7		
Kitchen place						
• Inside house	235	57.0	80	19.4	1.914	0.167
• Outside house	79	19.2	18	4.4		
Child in the kitchen while cooking						
• Yes	159	38.6	44	10.7	0.984	0.321
• No	155	37.6	54	13.1		
Smoking pollution:						
• Yes	175	42.5	41	10.0	5.782	0.016
• No	139	33.7	57	13.8		
Bedroom pollution						
• Yes	128	31.1	31	7.5	2.628	0.105
• No	186	45.1	67	16.3		
Cooking fuel						
• Yes	311	75.5	95	23.1	2.308	0.129
• No	3	.7	3	.7		
Type of fuel						
• Gas						
○ Yes	269	65.3	85	20.6	0.070	0.791
○ No	45	10.9	13	3.2		
Wood						
○ Yes	182	44.2	40	9.7	8.836	0.003
○ No	132	32.0	58	14.1		
Cow dung						
○ Yes	24	5.8	1	.2	5.748	0.017
○ No	290	70.4	97	23.5		
Have pets in your home						
• Yes	137	33.3	41	10.0	0.098	0.754
• No	177	43.0	57	13.8		
Type of pet						
• Cats						
○ Yes	85	20.6	25	6.1	0.093	0.761
○ No	229	55.6	73	17.7		
• Rabbits						
○ Yes	104	25.2	29	7.0	0.426	0.514
○ No	210	51.0	69	16.7		
• Sheep						
○ Yes	62	15.0	18	4.4	0.091	0.763
○ No	252	61.2	80	19.4		
• Dogs						
○ Yes	5	1.2	0	.0	1.580	0.209
○ No	309	75.0	98	23.8		
• Cows						
○ Yes	43	10.4	8	1.9	2.107	0.147
○ No	271	65.8	90	21.8		

Table 12 show that, association between acute respiratory infection and risk factor toward nutritional status and Co – morbidities. There was statistically significant between acute respiratory infection with exposure to wood smoke, smoking pollution, wood and cow dung because (p-value=0.006, 0.016 ,0.003, 0.017) respectively. while there was not statistical difference significantly between acute respiratory infection with other variables because (P – value > 0.005).

CHAPTER FIVE

DISSCUSSION

CHAPTER FIVE: DISSCUSION

Introduction

Acute respiratory infection (ARI) is the occurrence of a cough accompanied by short, rapid breathing which may be linked to death, although a significant reduction has been achieved over the previous two decades. Globally, ARI among children remains one of the leading causes of morbidity and mortality in children under-five years. It is the largest public health burden worldwide, developing countries, especially in Sub-Saharan Africa (SSA) including Ethiopia have continued to share an overburden of this infection (*Gebrerufael and Hagos, 2023*).

This study was conducted to assess the prevalence and risk factors of acuterespiratory infection among under five children.

In this study, more than half (61.4%) of participants were age group between 1 to 12 months, this result in line with study done in Uganda (*Nshimiyimana and Zhou, 2022*), which was about 44.5% of children with ARI symptoms were under 24 months of age. This result disagree with study done by (*Ghimire et al., 2022*), who reported that the more than half of the children (64%) were aged 24 months

More than half (62.9%) of participants were male, while. (37.1%) of participants were female. This finding agreement with study done in Pakistan (*Mir et al., 2022*), show that the more than half of participants were male (54.7%) and disagree with (*Ghimire et al., 2022*), which was 49.5% were male and the rest 50.50% female.

Most (75.2%) of participants had $\leq$ 50 thousand YR economic status. Most (70.6%) of study participants live in the private house. More than half (55.3%) of participants from rural. Agree with (*Abebaw and Damtie, 2022*), The majority of the study participants (60.8%) were rural dwellers and (42.4%) of the respondents came from families with monthly income

ranging from 1000–2500 birr.

The current study reveals that were the about half (51.9%) of participants birth delivered in hospital. Most (78.6%) of study participants were normal birth delivered. Regarding gestational age majority (88.1%) of participants full term and (74.0%) did not stay in Nursery. More than half (58.7%) of mother have less than 3 pregnant and (61.9%) of them have less than 4 still birth. Most (83.0%) of study participants were breastfeeding and (61.4%) of study participants were still breastfeed your child this result similar with (*Gritly et al., 2018*), most of the children (72.50%) whose mothers were interviewed breastfed their children.. More than one third (43.0%) of study participants were immunized this result in current study in line with (*Biswal et al., 2019*), who mentioned that 72.3% of the children were fully immunized. and more than two third (64.8%) of them were oxygen treatment in neonate.

Most (33.0%) of mother were age group between 25– 30 years, while (69.7%) age at marriage of mother between 16-20 years. Most (36.4%) of mother were illiterate educational level, this result in line with (*Adane et al., 2020*), study reported that the most (49.0%) of mothers aged between 26–35Years and (79.1%) of them do not have formal education.

In present study, Majority (94.4%) of mother were housewife occupation, this finding agree with (*Keter, 2015*), who revealed most mothers (61.1%) were unemployed/housewives, 13.7% farmers,10.0% were in formal employment, 7.8% self-employed, 6.4% casual Laboure's and a few0.9% were students. Majority (91.7%) of mother did not smoke.

Most(26.7%) of father were age group between 30– <35 years. This finding agree with study done in Cameroon (*Tazinya et al., 2018*), which was children with younger fathers (≤ 30 years. Most (36.9%) of father were secondary educational level and (86.7%) of father were non-employment. This result is not in line with (*Ali et al., 2022*), which was most 54 (40.91%) of father not able to read and write.

In this study, Most (60.0%) of participants were had siblings <3 children. More than half (57.8%) of participants were had from 1-3 children under five years. Most (53.2%) of participants were between 6-10 family size. Other study (*Alemayehu et al., 2019*), who reported the highest proportion of children had 3 and above siblings.

Most (58.5%) of participants did not exposure to wood smoke, and (61.4%) of participants did not bedroom pollution. Most (76.5%) of participants have Kitchen inside house, disagree with (*Alemayehu et al., 2019*), who reported that the most 62 (67.4) of participation have kitchen outside house and majority (98.5%) of them used cooking fuel and (85.9%) of them used gas. Agree with (*Abdisadiq, 2018*), who reported that majority of the study participants, 156 (72.2%) were using wood for cooking. about (50.7%) of participants were child in the kitchen while cooking and (52.4%) of them were smoking pollution. Finally (57.3%) of participants have pets in your home.

There was statistically significant between acute respiratory infection with Hospital name and room number because (p-value=0.010, 0.032) respectively. This result is not in line with (*Abdisadiq, 2018*), which was no statistically significant between acute respiratory infection with Hospital name and room number because (p-value more than 0.05).

There was statistically significant between acute respiratory infection with nutritional status and family history of diseases because (p-value=0.025, 0.034) respectively. This finding is in line with (*Tazinya et al., 2018*), who reported that the statistically significant between acute respiratory infection with nutritional status (Malnourished) with p-value= 0.001.

There was statistically significant between acute respiratory infection with exposure to wood smoke, smoking pollution, wood and cow dung because (p-value=0.006, 0.016 ,0.003, 0.017) respectively. This finding similar with (*Tazinya et*

al., 2018), which was found statistically significant between acute respiratory infection with exposure to wood smoke with p-value= 0,001.

CHAPTER SIX: CONCLUSION & RECOMMENDATIONS

CHAPTER SIX CONCLUSION & RECOMMENDATIONS

6.1. Conclusion

According to the results obtained, the researchers concluded that:

More than half (61.4%) of participants were age group between 1 to 12 months.
more than half (62.9%) of participants were male

Most (75.2%) of participants had ≤ 50 thousand YR economic status. Most (70.6%) of study participants live in the private house. More than half (55.3%) of participants from rural. More than two third (69.4%) of them have 1-3 room.

Most (87.1%) of participants not have chronic lung diseases and (78.1%) of them not have family history of diseases. More than half (55.3%) of participants not received vitamin A last 6 months.

Most (76.2%) of study participants have acute respiratory infection and while (23.8%) of study participants not have acute respiratory infection.

There was statistically significant between acute respiratory infection with Hospital name and room number because (p-value=0.010, 0.032) respectively.

There was statistically significant between acute respiratory infection with nutritional status and family history of diseases because (p-value=0.025, 0.034) respectively.

There was statistically significant between acute respiratory infection with exposure to wood smoke, smoking pollution, wood and cow dung because (p-value=0.006, 0.016, 0.003, 0.017) respectively.

6.2. RECOMMENDATIONS

We recommended that:

6.2.1. Recommendations for parents and community:

1. There is need for community-based interventions directed towards improved diet, supplementation (vitamin supplements or fortified milk) and parental education (promoting breastfeeding).
2. All types of Smoking in the household should be strongly discouraged to reduce the incidence of ARI and other smoking related risks.
3. Continue to promote indoor air pollution reduction in the community to reduce the health effects especially smoking and other environmental risk factors associated with ARI.
4. Health education activities be enhanced to promote improved environmental sanitation and to reduce crowding.
5. Paediatricians and general practitioners should take their role in the process of education of families and particularly the mothers about the following:
 - a. Risk factors of ARI.
 - b. Dangerous signs of ARI illness and the importance of simple supportive therapy as well as the early referral of child with severe illness.
 - c. The value of timely and complete immunization and the importance of breast-feeding.
 - d. Avoidance of taking medications without medical prescription.

6.2.2. Recommendations for Ministry of health:

- Government efforts to reduce cost of management of ARI and improve on the care seeking behaviour should mainly target these two prime cost drivers i.e. clinician's consultation and cost of medicine.
- Strengthening of ARI program in order to make its message reaches the majority of mothers through the following:

- a. Mass media.
- b. Training of doctors and medical workers.
- c. The ARI program must share the health educational department in Ministry of Health during planning.
- d. Implementation and evaluation for continuous medical education program which enable the medical staff to operate their scientific and medical information.
- e. To have an ARI unit PHC center, especially in low standard of living areas high density population and low level of education.

6.2.3. Recommendations for Researcher:

- Further researches should be done for another risk factors to explore their effect on the development of ARI.

REFERENCES

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APPENDIX



QUESTIONNAIRE about:

Risk Factors of Acute Respiratory Infection Among Under Five Children Attending Public Hospitals in Sana'a City

رقم الاستبيان:

رقم المستشفى:

Consent informed:-

We are the students of the Nursing Department Medical Collage – 21 September University are pleased with us to put in your hands a questionnaire looking for the Risk Factors of Acute Respiratory Infection Among Under Five Children Attending Public Hospitals in Sana'a City and to meet the bachelor's degree in Nursing and the importance of your decent opinion on this matter. We hope you are honored To answer the paragraphs of question and accuracy in giving information and we will only use for the purpose of conducting this scientific research.

Consent

Unconsent

Supervisor

Dr. Houria Al-Sabri

2023

PART 1 : Demographic and Personal Data

1. Age: year months
2. sex: a- Male b- Female
3. Socio-economic status:
 - a. ≤ to 50 thousand YR
 - b. 51-99 thousand YR
 - c. 100-150 thousand YR
 - d. 150 YR
4. Where do you live?
 - a. In an apartment building ☐
 - b. In the private house ☐
 - c. In the dormitory ☐
 - d. Other (specify) ☐
5. Room No:
6. Residence: a - Urban ☐ b- Rural ☐

PART 2 : Neonate Period Data

1. Place of births delivered: a- Hospital ☐ b- Health center ☐ c- Home ☐
2. Type of births delivered: a - Normal ☐ b- C.S ☐
3. Birth weight: Kg unknown ☐
4. Gestational age: a- full term ☐ b- premature ☐
5. Nursery stay: a- Yes ☐ b- No ☐
 - If yes, reasons :-
 - How long of the child survival in the Nursery:-days
6. Number of pregnant:-
7. Number of still birth :-
8. Oxygen treatment in neonate.: a- Yes ☐ b- No ☐
9. Immunization up to date: a- Yes, immunized ☐ b- Partial ☐ c- Not immunized ☐

10. **Breastfeeding:** Yes ☐ No ☐
- (If yes) **How many month:**
11. Do you breastfeed your child? a-Yes ☐ b-No ☐
- (If No) **How many month:** a- after six month ☐ b- before six month ☐

PART 3 : Parental Data

• Mother Data

1. **Mother age:**
2. **Age at Marriage:**
3. **Mother education:** a- Illiterate ☐ b- primary ☐ c- Secondary ☐ d- University ☐
4. **Occupation of mother:** a- housewife ☐ b- worker ☐ c- specify ☐
5. **Smoking:** a- Yes ☐ b- NO ☐

• Father Data

1. **Father age:**
2. **Father education:** a- Illiterate ☐ b- Primary ☐ c- Secondary ☐ d- University ☐
3. **Occupation of father:**
4. **Smoking:** a- Yes ☐ b- NO ☐

PART 4 : Family Data

1. **Siblings:**
2. **Number of under five children:**
3. **Household family size:**

PART 5 : Risk Factors Data

1. **Nutritional status:**

- MUAC:

2. **Has the baby getting of Vitamin A last 6 months:** a- Yes ☐ c- No ☐

• **Co – morbidities**

3. **Chronic lung diseases:** a- Yes ☐ c- No ☐

4. **Family history of diseases:** a- Asthma ☐ b- COVID-19 ☐ c- T.B ☐

Others:

• **Indoor air pollution:**

5. **Exposure to wood smoke:** a- Yes ☐ b- No ☐

6. **Kitchen place:** a- Inside house ☐ b- Outside house ☐

7. **Child in the kitchen while cooking:** a- Yes ☐ b- No ☐

If yes How long duration stay in kitchen:

8. **Smoking pollution:** a- Yes ☐ b- No ☐

• **Environmental pollution:**

9. **Bedroom pollution:** a- Yes ☐ b- No ☐

10. **Cooking fuel:** a- Yes ☐ b- No ☐

(If yes) what fuel type: a- gas ☐ b- Wood ☐ c- Cow dung ☐ d- Charcoal ☐

11. **Do you have pets in your home:** a- Yes ☐ b- No ☐

(If yes) What type of pet:

a- Cats ☐ b- Rabbits ☐

c- Sheep ☐ d- Dogs ☐

e- Cows ☐ f- So

PART 6: Data on disease

1. Do the child suffer from respiratory infection a- Yes ☐ b- No ☐
If yes, what type of infection: a- chronic ☐ b- acute ☐
2. Fever: a- Yes ☐ b- No ☐
3. Dyspnea: a- Yes ☐ b- No ☐
4. Cough : a- Yes ☐ b- No ☐
- If yes , with a- Sputum ☐ b- Blood ☐ c- Dry ☐
5. Runny nose: a- Yes ☐ b- No ☐
6. Headache: a- Yes ☐ b- No ☐
7. Symptom's duration: a- Hours b- Day.....



رقم الاستبيان:

رقم المستشفى:

الاستبيان

نحن طلاب قسم التمريض- الكلية الطبية – جامعة 21 سبتمبر للعلوم الطبية والتطبيقية يطيب لنا أن نضع بين يديك استبانة بحث عن " عوامل خطر عدوى الجهاز التنفسي الحادة بين الأطفال دون سن الخامسة الذين يترددون على المستشفيات العامة – مدينة - صنعاء " وذلك لاستيفاء الحصول على درجة البكالوريوس في التمريض ولأهمية رأيك الكريم في هذا الموضوع فإننا نرجوا منك التكرم بالإجابة على فقرات الاستبانة والدقة في إعطاء المعلومات وسوف نستخدمها فقط لغرض اجراء هذا البحث العلمي. شاكرين ومقدرين لمدى تعاونكم معنا، وتقبلوا فائق التقدير والاحترام.

لذلك نامل منكم المشاركة في هذا البحث.

إشراف الدكتورة/

د/ حورية عبدالرقيب الصبري

الجزء الاول : البيانات العامة والشخصية

1. العمر ☐ أ- السنه ☐ ب- الشهر ☐
2. الجنس ☐ أ- ذكر ☐ ب- انثى ☐
3. الحالة الاقتصادية
☐ أ- اقل من 50 ألف شهريا
☐ ب- من 51 - 99 ألف شهريا
☐ ت- من 100 - 150 ألف شهريا
☐ ث- أكثر من 150 ألف شهريا
4. اين تعيشوا
☐ أ- في مبنى سكني
☐ ب- في منزل خاص
☐ ت- في مخيمات
☐ ث- في مكان اخر
5. عدد الغرف :
6. مكان الإقامة ☐ أ- الريف ☐ ب- المدينة ☐

الجزء الثاني : بيانات فترة الوليد

1. مكان الولادة ☐ أ- المشفى ☐ ب- المركز ☐ ج- البيت ☐
2. نوع الولادة ☐ أ- طبيعي ☐ ب- عمليه قيصرية ☐
3. وزن الطفل أثناء الولادة كجم، غير معروف ☐
4. عمر الحمل ☐ أ- كامل ☐ ب- قبل موعده ☐
5. هل دخل الحضانه ☐ أ- نعم ☐ ب- لا ☐
- (اذا نعم)، ما سبب دخوله الحضانه

- كم الفترة التي ظل في الحضانه.....

6. الحمل رقم

7. الطفل رقم

8. هل تعالج بـ الاكسجين في وقت الولادة ☐ أ- نعم ☐ ب- لا ☐

9. بيانات اخذ اللقاحات : أ- نعم تلقح ☐ ب- جزء من اللقاحات ☐ ج- لم يلحق ☐

10. هل كانت الرضاعة طبيعية ☐ أ- نعم ☐ ب- لا ☐

(اذا نعم) كم شهر

11. هل طفلك لازال يرضع ☐ أ- نعم ☐ ب- لا ☐

- اذا لا متى تم فطامه ☐ أ- بعد ستة أشهر ☐ ب- قبل ستة أشهر ☐

الجزء الثالث : بيانات الآباء

• بيانات الأم

1. عمر الام

2. عمرها وقت الزواج

3. المستوى التعليمي للام : أ- امي ☐ ب- اساسي ☐ ج- ثانوي ☐ د- جامعي ☐

4. وظيفه الأم : أ- ربت بيت ☐ ب- تعمل ☐

5. هل الأم تدخن : ☐ أ- نعم ☐ ب- لا ☐

• بيانات الأب

1. عمر الأب

2. المستوى التعليمي للأب : أ- امي ☐ ب- اساسي ☐ ج- ثانوي ☐ د- جامعي ☐

3. وظيفه الاب

4. هل يدخن ☐ أ- نعم ☐ ب- لا ☐

الجزء الرابع : بيانات العائلة

1. الاخوة
2. عدد الاخوة الذين اعمارهم اقل من خمس سنوات
3. حجم الاسرة

الجزء الخامس : عوامل الخطر

1. الحالة التغذوية للطفل
أ- المواء
2. هل الطفل تناول فيتامين اي في الستة الأشهر الأخيرة : أ- نعم ☐ ب- لا ☐

• المرضية

3. هل لديه مرض الرئة المزمن :
4. هل لدى العائلة :

- أ- ربو ☐
- ب- كورونا ☐
- ت- سل رئوي ☐
- ث- أمراض أخرى ☐

• تلوث الهواء الداخلي :

5. التعرض لدخان الخشب : أ- نعم ☐ ب- لا ☐
6. مكان المطبخ : أ- داخل البيت ☐ ب- خارج البيت ☐
7. هل يبقى الطفل في المطبخ وقت الطبخ : أ- نعم ☐ ب- لا ☐
- (إذا نعم) كم فترة بقاء الطفل في المطبخ
8. التلوث بالدخان : أ- نعم ☐ ب- لا ☐

• التلوث البيئي

9. تلوث غرفة النوم ☐ أ- نعم ☐ ب- لا ☐
10. وقود الطبخ ☐ أ- نعم ☐ ب- لا ☐
- (إذا نعم) ما نوع الوقود ☐ أ- غاز ☐ ب- خشب ☐ ج- روث البقر ☐ د- الفحم ☐
11. هل لديكم حيوانات اليفة في المنزل: ☐ أ- نعم ☐ ب- لا ☐

(إذا نعم) ما نوع الحيوانات:-

- ☐ أ- قطط
- ☐ ب- اغنام
- ☐ ت- ابقر
- ☐ ث- أرانب
- ☐ ج- كلاب
- ح- غير ذلك

الجزء السادس: بيانات عن المرض

1. هل يعاني الطفل من التهاب الجهاز التنفسي ☐ أ- نعم ☐ ب- لا ☐
- (إذا نعم)، ما نوع الالتهاب
2. هل لديه حمى ☐ أ- نعم ☐ ب- لا ☐
3. صعوبة التنفس ☐ أ- نعم ☐ ب- لا ☐
4. كحه ☐ أ- نعم ☐ ب- لا ☐
- (إذا نعم)، مع ☐ أ- بلغم ☐ ب- دم ☐ ج- جافة ☐
5. سيلان أنف : ☐ أ- نعم ☐ ب- لا ☐
6. صداع : ☐ أ- نعم ☐ ب- لا ☐
7. مدة الاعراض ☐ أ- أيام ☐ ب- ساعات

الملخص

الخلفية: تعد التهابات الجهاز التنفسي الحادة أحد الأسباب الرئيسية لمرضاة ووفيات الأطفال في جميع أنحاء

العالم، فضلاً عن أنها تساهم في ثلث وفيات الأطفال دون سن الخامسة في البلدان ذات الدخل المنخفض.

الهدف من الدراسة: تقييم عوامل خطر الإصابة بالتهاب الجهاز التنفسي الحاد بين الأطفال الذين تقل أعمارهم

عن خمس سنوات في المستشفيات الحكومية في مدينة صنعاء - اليمن.

الطريقة: مسح مقطعي. تم استخدام استبيان منظم يديره الباحث لجمع البيانات من عينة مكونة من (٤١٢) طفلاً.

النتائج: أكثر من نصف المشاركين (٦١,٤٪) كانوا من الفئة العمرية ما بين ١ إلى ١٢ شهراً. وكان أكثر من نصف

المشاركين (٦٢,٩٪) ذكور. يعاني معظم (٧٦,٢٪) المشاركين في الدراسة من التهاب تنفسي حاد، بينما (٢٣,٨٪) من

المشاركين في الدراسة لا يعانون من التهاب تنفسي حاد. أغلب المشاركين (٨٧,١٪) ليس لديهم أمراض رئوية مزمنة

و(٧٨,١٪) منهم ليس لديهم تاريخ عائلي للإصابة بالأمراض. أكثر من نصف المشاركين (٥٥,٣٪) لم يتلقوا فيتامين أ

خلال الستة أشهر الماضية.

الاستنتاج: هناك دلالة إحصائية بين الإصابة التنفسية الحادة واسم المستشفى ورقم الغرفة (بقيمة = ٠,٠١٠،

٠,٠٣٢) على التوالي. كانت هناك دلالة إحصائية بين الإصابة التنفسية الحادة مع الحالة التغذوية والتاريخ العائلي

للأمراض (بقيمة = ٠,٠٢٥، ٠,٠٣٤) على التوالي. كانت هناك دلالة إحصائية بين الإصابة الحادة بالجهاز التنفسي

مع التعرض لدخان الخشب والتلوث بالتدخين والخشب وروث البقر (بقيمة = ٠,٠٠٦، ٠,٠١٦، ٠,٠٠٣، ٠,٠١٧)

على التوالي.

الكلمات المفتاحية: عوامل الخطر، التهابات الجهاز التنفسي الحادة، الطفل، المستشفيات الحكومية، اليمن.

Republic of Yemen

Ministry of Higher Education And

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الجمهورية اليمنية

وزارة التعليم العالي والبحث العلمي

جامعة ٢١ سبتمبر للعلوم الطبية
والتطبيقية

كلية التمريض

عوامل خطر الإصابة بالتهاب الجهاز التنفسي الحاد بين الأطفال الذين تقل أعمارهم عن خمس سنوات في المستشفيات الحكومية في مدينة صنعاء - اليمن.

بحث مقدم إلى كلية التمريض ، جامعة ٢١ سبتمبر لاستكمال متطلبات نيل درجة

البكالوريوس في علوم التمريض

إعداد الباحثين

عبدالمجيد عبدالعزيز منصور احكم

احمد علي صالح علي راشد

ياسر مقبل محمد عنبر

علي محمد علي مرشد الحدم

محمد خالد يحيى قساس

ماجد همدان عبدالله طنين

هشام عبدالكريم صالح ثامر

عرفات محسن حسين سبول

إسحاق احمد علي السراء

إشراف

الدكتورة: حورية عبد الرقيب طاهر

١٤٤٥ هـ