Deanship of Graduate Studies
Al-Quds University

Risk factors of Pneumonia among Under-five Children in the Gaza Strip: Case-control Study

Amro Mohammad Ahmad Rabah

M.Sc. Thesis

Jerusalem - Palestine

1445 – 2023

Risk factors of Pneumonia among Under-five Children in the Gaza Strip: Case-control Study

Submitted by:
Amro Mohammad Ahmad Rabah

BSc. Of General Nursing – Palestine Collage of Nursing
Gaza, Palestine

Supervised by: Dr. Hatem El-Dabbakeh

Thesis Submitted in Partial Fulfillment of the Requirement for the Degree of Master's in public health- Epidemiology, Faculty of public health - Al Quds University

1445 – 2023

Al-Quds University

Deanship of Graduate Studies

School of Public Health

Thesis Approval

Risk factors of Pneumonia among Under-five Children in the Gaza Strip: Case-control Study.

Prepared by: Amro Mohammad Ahmad Rabah
Registration No.: 22012090

Supervisor: Dr. Hatem El-Dabbakeh

Master thesis submitted and accepted. Date: 23/08/2023
The names of signatures of the examining committee members are as follows:

1. Head of committee: Dr. Hatem El-Dabbakeh Signature……..…
2. Internal examiner: Dr. Khitam Abu Hamad Signature. ……..…
3. External examiner: Dr. Nabil El-Baraquni Signature……..…

Jerusalem- Palestine

1445 / 2023

Dedication

My dear mother, in your absence your love continues to shine brightly in my heart. This master's thesis is dedicated to you, though I can no longer hear your voice or feel your embrace, your spirit remains a guiding force inspiring me to push beyond limits, my source of steady support and encouragement forever and always, you are with me.

Forever in my heart.

Declaration

I certify that this thesis submitted for the degree of the master is the result of my research, except where otherwise acknowledged, and that this thesis or any of its parts has not been submitted for a higher degree to any other university or institution.

Signature:

Amro Mohammad Ahmad Rabah

Date: 23/08/2023

Acknowledgment

First and foremost, I begin by expressing my profound gratitude to Allah, the Almighty, for his countless blessings, guidance, and steady support throughout the journey of completing this master's thesis.

I would like to express my deepest gratitude to all those who have supported and contributed to the completion of this master's thesis.

I am deeply grateful to my supervisor, Dr. Hatem El-Dabbakeh whose expertise, patience, and mentorship have been invaluable. His guidance and constructive feedback have played a pivotal role in shaping the direction and quality of this research. I am truly blessed to have had their support.

I would also thank the mothers who participated in this study.

I highly appreciated the effort of the faculty members at Al-Quds University, the faculty of public health in the academic journey, I'm deeply thankful.

I would also like to express my deepest gratefulness to my family and friends for their support and encouragement. Their love and motivation have been a constant source of inspiration and strength throughout this academic journey.

Amro Mohammad Ahmad Rabah

Abstract

Background: pneumonia is still one of the top leading causes of death among children worldwide especially in low and middle-income countries, children under-five years most age group affected by pneumonia, there are several risk factors for pneumonia among under-five children, by identification of these risk factor may mitigate the occurrence and spread of pneumonia.

Aim: to assess the main risk factors associated with pneumonia among under-five children in Gaza Strip, in order to develop effective prevention strategies and a better understanding of the underlying risk factors.

Methodology: Hospital-based matched case-control study, the study population are children aged 1-59 months in Gaza Strip coming to governmental hospitals (El- Nasser Hospital, Mubarak hospital for Children, and Al- Aqsa Martyr Hospital) during the data collection period, with a sample size 338 children (169 case and 169 control), nonrandomized convenient sample method, the data was being collected by used interviewed questionnaire, the data analyzed by using SPSS version 25, t-test, Pearson's chi-squared test, and Logistic regression analyses were used to identify factors that affected pneumonia cases compared to controls among the study children, the P-value was considered significant at $P \leq 0.05$ and not significant at $P > 0.05$.

Result: The mean age of the children was 18.82±17.53 months (cases) and 18.72±17.09 months (control) with a range of 1–59 months. There were several factors were found to be associated with pneumonia: maternal occupation status (employed mother) (OR = 10.77; 95% CI, 3.74- 31.08; *P*-value 0.000), Birth order 2^{nd} -3^{rd} (OR = 2.12; 95% CI, 1.09-4.13; *P-value* 0.026), birth order ≥ 4 (OR = 2.32; 95% CI, 1.31-4.1; *P-value* 0.004), type of delivery cesarean section (OR = 1.91; 95% CI, 1.22-2.99 ; *P-value* 0.005), prematurity (OR = 2.18; 95% CI, 1.08-4.41; *P* = 0.030), Admission to Neonatal Intensive Care Unit (OR = 2.54; 95% CI, 1.42-4.55; *P*-value 0.002) History of mechanical ventilation (OR = 2.18 ; 95% CI, 1.08-4.41 ; *P*-value 0.030), History of recurrent Lower respiratory tract infection (OR = 1.9; 95% CI, 1.1-3.3; *P-value* = 0.022), History of hospital admission due to Lower respiratory tract infection (OR = 4.94; 95% CI, 2.95-8.28; *P*-value 0.000), History of bronchial asthma or wheezing episodes (OR = 2.04; 95% CI, 1.14-3.66; *P-value* 0.016), History of neurological disease (OR = 2.88; 95% CI, 1.54-5.4; *P-value* 0.001), mild wasting (OR = 4.28; 95% CI, 1.7-10.8; *P-value* 0.002), (OR = 4.28; 95% CI, 1.7-10.8; *P-value* 0.002), moderate wasting (OR = 3.2; 95% CI, 1.57-6.5; *P-value* 0.001), sever wasting (OR = 7.42; 95% CI, 2.09-26.35; *P-value* 0.002), mild stunting (OR = 2.76; 95% CI, 1.49-5.13; *P-value* 0.001), moderate stunting (OR = 3.54; 95% CI, 1.79-6.98; *P-value* 0.000), sever stunting (OR = 16.5; 95% CI, 2.09- 130.03; *P-value* 0.008), Underweight (OR = 2.87; 95% CI, 1.74-4.71; *P-value* 0.000),and exposure outdoor air pollution (Electrical generator near residency (OR = 4.61; 95% CI, 1.29- 16.49; *P*-value 0.019), and Factory/ petrol station near residence (OR = 2.55; 95% CI, 1.08-6; *P-value* 0.032)).

Conclusion: Identification of pneumonia's risk factors could help in decrease the occurrence of the disease, This study investigated the main risk factors of pneumonia among under-five children in the Gaza Strip, which include (parental sociodemographic factors, maternal and child-related factors, and environmental factors), the results showed several factors had a significant association with the occurrence of pneumonia among under-five children, most of these factors were modifiable, by correction of these factors could decrease the burden of pneumonia.

Table of Contents

List of Tables

List of Figures

List of abbreviation

ARI	Acute respiratory infection
CAP	Community-acquired pneumonia
CI	Confidence interval
CP	Cerebral palsy
CS	Cesarean section
HAP	Hospital-acquired pneumonia
HCAP	Health care-associated pneumonia
Hib	Haemophilus Influenza Type B
MOE	Ministry of Education
MOH	Ministry of Health
MV	Mechanical ventilator
NGOs	Non-Governmental Organizations
NICU	Neonatal intensive care unit
OCHA	United nations office for the coordination of humanitarian affairs
OR	Odds ratio
PCBS	Palestinian Central Bureau of Statistics
PCV	Pneumococcal vaccine
PHC	Primary health care
RTI	Respiratory tract infection
SDGs	Sustainable developmental goals
SpO2	Oxygen saturation
SPSS	Statistical Product and Service Solutions
UFM	Under-five mortality
UNCTAD	United Nation Conference on Trade and Development
UNICEF	United Nations International Children's Emergency Fund
UNRWA	United Nations Relief and Works Agency for Palestine Refugees in the Near East
VAP	Ventilator-associated pneumonia
WFP	World food program
WHO	World Health Organization

Chapter One

Introduction

1.1 Background

Pneumonia remains one of the most common leading cause of death around the world, globally lower respiratory tract infection and pneumonia are the fourth leading cause of death for all age groups, while in the low income country considered the second leading cause of death for all age groups (World Health Organization [WHO], 2020), despite there is a decline in morbidity and mortality rate of pneumonia among under-five children but it still high and it considered one of the top leading cause of death among under-five years' children in low and middle income countries unlike high income country (Dadonaite and Roser, 2019), Under-five mortality (UFM) an important indicator of child health, respiratory infection and congenital anomalies are the most common causes of death among under-five children (Waterston and Nasser, 2017), yearly pneumonia kills more than 800,000 children under five years' age (United Nations International Children's Emergency Fund [UNICEF], 2021), according to Ministry of Health (MOH) annual report in 2022 mortality rate among children from 1 to under 5 years is 0.6/1000 live birth, pneumonia is the 8th cause of death in this age group, infant mortality rate 10.8/1000 live birth, respiratory disorders is the 4th leading cause of death among this age group, the UFM was 13.6/ 1000 live birth.

Pneumonia is one of the most common prevalent infectious disease among under five-children worldwide there are 1400 pneumonia cases per 100,000 children every year (UNICEF, 2021), unfortunately, more than the half of pneumonia cases (around 57%) considered sever cases and need hospitalization, the most common factors for hospitalization are low oxygen saturation (SpO2) lower than 92% and wasting (Bhat et al., 2021).

There are several risk factors for pneumonia, children with immune compromised have a higher chance to have pneumonia more than children whose immune system functioning well. (WHO, 2021), in a prospective study conducted in Brazil results shown that poverty is a risk factor for pneumonia especially among children, poor children suffer from malnutrition and other diseases accompanied with poverty, children in poor area have more risk to develop pneumonia than children in higher income areas (Thorn et al., 2011).

1.2 Problem statement

Despite the advancement in medical, laboratory and radiological tests pneumonia has a high morbidity and high mortality rate in low and middle income countries (developing countries) so that it considers as a public health problem (Izadneghader, et al 2013), by reviewing the literature pneumonia among under five-children considered as a public health problem in low and middle income countries whereas Palestine one of these countries, which make pneumonia public health problem also in Palestine especially in the Gaza Strip, by reviewing the admission daily report in pediatric department at Al-Aqsa Martyrs hospital the percentage of admitted cases due to pneumonia during the period from 1st Oct. 2021 to 31st March 2022 was 14.4% from all admitted cases.

In Palestine especially in Gaza Strip there is a scarcity of studies about risk factors of pneumonia among under-five children, also no clear information or statistics about pneumonia's incidence, also the problem lies because the population census in Palestine especially in the Gaza Strip contain a high percentage of children (under 18 years), particularly under-five children who are expected to have pneumonia more than other individual in the other age groups.

1.3 Study justification

This study is important for several factors. Firstly, helps to fill the gap in information that existed, increases the level of awareness about pneumonia among under-five children, and this study will be a base study for further studies on this topic.

Secondly, the identification of disease risk factors helps minimize the occurrence of disease, and also decreases the number of admitted cases to the hospital, in order to improve the children's health and prevent disease.

Finally, the identification of pneumonia risk factors is important to decrease the burden on healthcare facilities (by decrease inpatients number), healthcare personnel (by decrease efforts), children's families (by decreasing out-of-pocket expenditure on medication), and the community (by prevent transmission of communicable disease).

1.4 Study objective

1.4.1 Aim

To assess the main risk factors associated with pneumonia among under five children in Gaza Strip, in order develop effective prevention strategies and better understanding of the underlying risk factors.

1.4.2 Specific objectives

- To identify pneumonia's risk factors among under five children in Gaza Strip.
- To identify common sociodemographic risk factors for pneumonia among under five children.
- To assess the relationship between socio-demographic characteristics and the occurrence of pneumonia among under five children.
- To assess the relationship between environmental factors and the occurrence of pneumonia among under five children.
- To assess the relationship between child physiological and nutritional factors and the occurrence of pneumonia among under five children.
- To explore the difference of risk factors among cases and control of the study
- To set recommendations that will help minimize the incidence of pneumonia among under five children.

1.4.3 Research questions

- What are the main risk factors of pneumonia among under five years' children?
- What are the most common socio-demographic risk factors for pneumonia among under five children?
- Is there a relationship between some parental characteristics (education, occupation, age) and the occurrence of pneumonia among under five children?
- Is there a relationship between some child's characteristics (age, type of delivery, feeding pattern, nutritional status) and the occurrence of pneumonia among under five children?
- What are the most common environmental risk factors for pneumonia among under five children?

- Is there a relationship between environmental risk factors like indoor smoking, crowding, type of housing) and the occurrence of pneumonia among under five children?

1.5 Context of the study

1.5.1 Geographical and demographical context

Palestine geographically around 27,000 Km² bounded by Mediterranean Sea from the west, Jordan river from the east, Lebanon from the north and El Aqaba gulf from the south as shown in the map (annex 1)

For extended period, the Israel occupation territory occupied Palestine in 1948, Palestinian where displaced from their land to refugee camps inside and outside Palestine, in refugee camps distributed in Gaza Strip (Annex 2), West bank, Lebanon, Syria and Jordan, then in 1967 the Israel occupation territory return and occupied Gaza Strip, West Bank and East Jerusalem as they called.

The total Palestinian population is about 5,227,193 in the Gaza Strip and West Bank, distributed as the following in the Gaza strip (365 Km²) the total population 2,106,745 and west bank (5,661 Km²) the total population 3,120,448. Gaza strip is considered one of the highest population density in the world, and it consists of five governorates Rafah, Khan-Younis, Der-El-Balah (middle governorate), Gaza and North Gaza governorate (PCBS, 2021), according to MOH annual report in 2020 the fertility rate in Gaza Strip 3.3 birth for women in reproductive age, crude birth ratio 26.5/ 1000, children under-five years are 15.2% from total population (MOH, 2022).

Children group is the largest portion of Palestinian population its nearly the half of the community there are about 2,311,396 children in Palestine, children population comprise 44% from total population, under five age group are nearly 718,923 children in Palestine, they are comprising 31.1% from total children population in Palestine (PCBS, 2021).

1.5.2 Socioeconomic context

Palestine is considered one of the low-income countries, it has many crises the most important cause of the socioeconomic crisis is the occupation, political deviation and decrease in donation from outside, this is worsening the condition, Palestine suffer

from poverty a rate around 52% and unemployment around 50% (United Nation Conference on Trade and Development [UNCTAD], 2019).

People in the Gaza Strip have suffered from blocked for more than 15 years, which has tragedian consequences on their life, It create a state of isolation from the rest of Palestine and even the rest of the world also, by constricting the movement of people across the borders and constrict the movement of goods and essential drugs, number of problems arise in this period of time, like cut off the electricity power, obstructs patients' movement abroad to receive necessary treatment, deterioration of economic status as manifested by increase the unemployment rate, and the obstacles face the fishing and agriculture (OCHA, 2022).

Furthermore, besides the blockade and restriction of the movement, the Gaza Strip was exposed to three destructive wars in 2008, 2012 and 2014, the cost of these wars was many of murders, casualties and destruction of the houses and buildings, the war in 2008 led to the loss of over 60% of Gaza's total capital stock , and in a similar vein, the war in 2014 resulted in damage equivalent to 85% of the capital remaining after the previous war, indeed Israeli occupation, closures, and wars worsen the economic status in Palestine especially in the Gaza Strip and increase the poverty rate (UNCTAD, 2020)

1.5.3 Palestinian Health Care System

Palestinian health care system consists from four main providers: ministry of health (MOH), UNRWA, non-governmental organizations (NGOs) and private sector, MOH is the main health care provider in Palestine. According to the MOH annual report in 2022, in Gaza Strip MOH provides primary health care (PHC) in 52 health centers, secondary health care in 13 hospitals, UNRWA provides health care for refugees, mainly provide PHC at 22 UN clinic, non-governmental organizations (NGOs) provide PHC at 19 health care centers, secondary and tertiary health care in 17 hospitals. Private sector provides secondary and tertiary health care in 3 hospitals.

Palestinian health care system provides various child care programs like vaccination and school health programs, provided by MOH and UNRWA in PHC centers and outreach clinics.

The main provider of secondary health care for children in Gaza Strip is MOH, there are 377 bed for inpatients children distributed over hospitals, pediatric hospitals in Gaza Strip (Al-nassr Pediatric hospital which is a general hospital and Al-Rantesy Special Pediatric hospital), beside Mohammad EL-Dora hospital which provide general pediatric services, cardiac care services and intensive care, while other governmental hospitals (Al-Aqsa Martyrs, Gaza European Hospitals, Naser Medical Complex Hospital and Bet-Hanoon hospital) include either medical or surgical pediatric departments or both. Children with medical or surgical disorders admitted to governmental hospitals.

Chapter Two

Conceptual Framework and Literature Review

2.1 Conceptual framework

The conceptual framework of this study illustrate the main risk factors for pneumonia among under-five years' children, as shown below, the conceptual framework was developed after reviewing the literature, risk factors categorize into three categories, sociodemographic factors for parents, environmental factor, and personal and nutritional factors.

- **Parental socio-demographic factors**

In this study the researcher will try to investigate the relationship between parental socio-demographic factors and pneumonia, these factors include father/mother age, educational level (preparatory, secondary or university) occupational status (worker, unemployed or employee), family type, and income.

- **Maternal and child related factors**

Because multiple and complex maternal and child's related risk factors are associated with respiratory diseases and pneumonia; the study concentrate on these factors and grouped it in three groups, first group of variables is natal history and postnatal risk factors included: birth order, birth weight, type of delivery, prematurity, exposure to delivery complications, history of admission to NICU, history of mechanical ventilator nutritional status, pattern of feeding, and vaccination status, the second group is history of lower respiratory tract infection (RTI) included: history of pneumonia in the first month of life, history of recurrent lower RTI, history of admission due to lower RTI, history of bronchial asthma or wheezing episodes, history of upper respiratory tract infection (URTI), presence of chronic disease, and history of neurological disease, and the third group is feeding history and nutritional status included: type of feeding, supplementation, wasting, stunting, under weigh and anemia.

- **Environmental factor**

Many environmental factors help/play a role in the occurrence and transmission of respiratory and other infectious diseases, the environmental factors under investigation in

this study were indoor air pollution (smoking by parents, type of fuel for cocking), outdoor air pollution (electrical generator near residency and factory/petrol station near residence) type of housing, type of house roof, availability of basic sanitation, presence of cattle near house, presence of birds kept inside house, pits kept inside house, molding spots in the house, child hygiene (washing bed covers and lining and exposed it to sun light), house ventilation, and crowding.

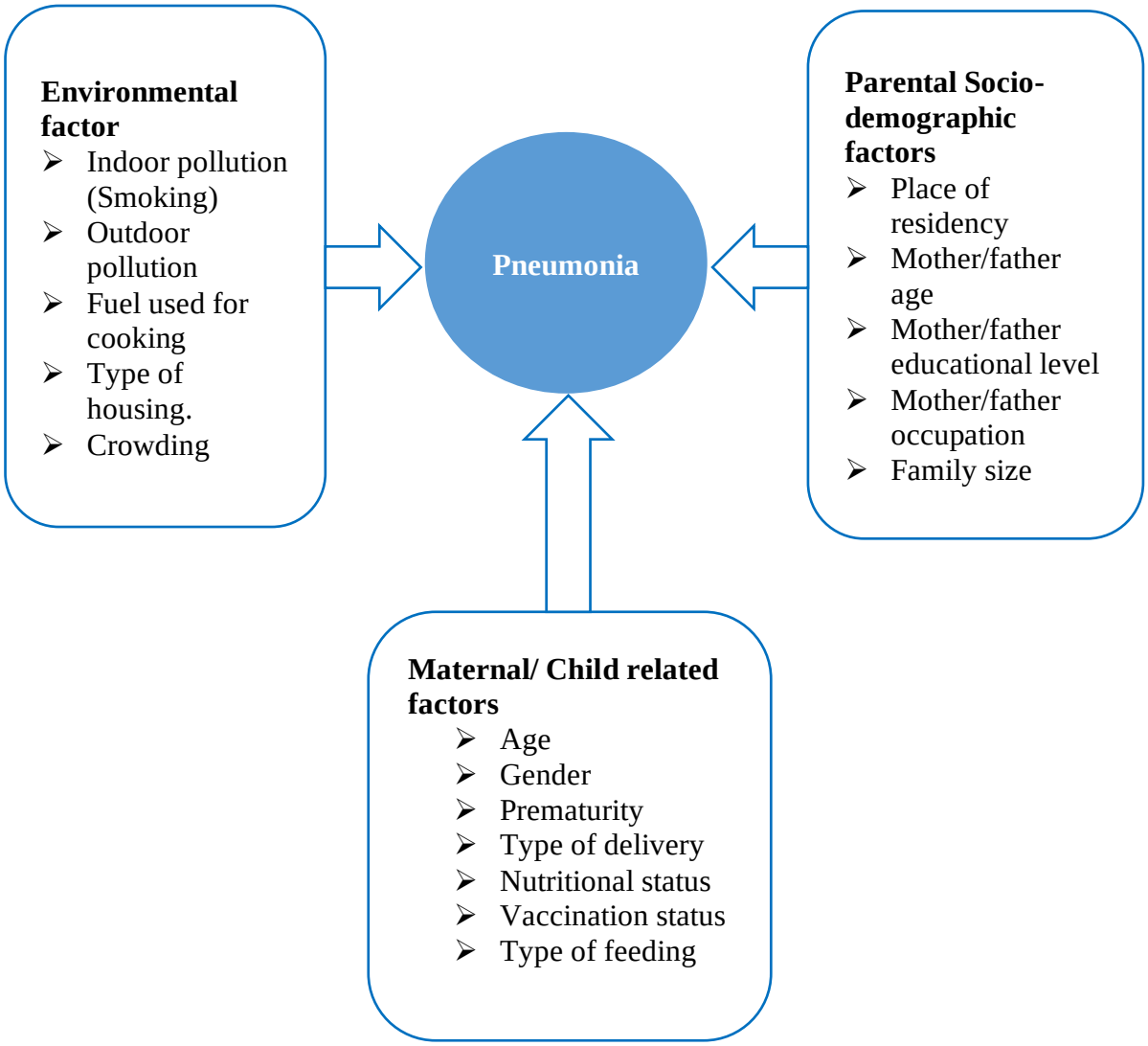


Figure 2.1 Conceptual framework of the study

2.2 Literature review

2.2.1 Definition of pneumonia

Pneumonia is an inflammation of lung tissue, its considered infectious disease caused by bacteria such as streptococcus pneumonia which considers the most common cause of bacterial pneumonia among children, virus infection or fungi infection, it may cause by noninfectious causes such as foreign body aspiration (Kliegman, 2020).

WHO classified pneumonia as severe pneumonia and not severe pneumonia, severe pneumonia is diagnosed when SPO2 is less than 90%, severe RDS, or pneumonia accompanied by poor feeding or convulsions, needs hospitalization, but not severe pneumonia characterized by tachypnea and chest in-drawing, no need for hospitalization home care enough (WHO, 2013).

Pneumonia also classified according to the site of acquisition into four categories according to Up-to-date website:

- Community-acquired pneumonia (CAP): defined as pneumonia occurred outside of health care facilities, viral infection is the most common etiology of CAP among the children and adolescents (Rueda, et al 2022)
- Nosocomial pneumonia: infection which occurred in the hospital, which includes:
    - Hospital-acquired pneumonia (HAP): pneumonia occurs after 48 hours of admission to the hospital, it increases the burden on the hospital which increase the length of stay and charges, it even causes patients death (Giuliano, Baker and Quinn 2018)
    - Ventilator-associated pneumonia (VAP): pneumonia occurs after 48 hours of endotracheal intubation.
- Healthcare-associated pneumonia (HCAP): pneumonia occurred in health care settings or after a recent discharge from the hospital.

2.2.2 Signs and symptoms of pneumonia

Signs and symptoms are varying according to the severity of the infection, the most common symptoms are cough, fever and tachypnea, in some cases poor feeding and lethargy are

presenting, doing physical examination and check vital signs to assess if their fever or difficulty of breathing by assessment of the respiratory rate if their tachypnea or not, nasal flaring and chest in-drawing, auscultation if there decreased air entry or not, radiological test, blood test, if the child has tachypnea, low saturation level and fever considered a sever case (Lissauer, 2017).

2.2.3 Etiology of pneumonia

Pneumonia occur due to bacterial, viral or fungal infection, among neonates the bacterial infection (E. coli, streptococcus type B, Klebsiella and Listeria monocytogenes) is the most common etiology of pneumonia among this age group, the infection occurs immediately after delivery, while another types of bacteria are responsible for occurrence of pneumonia among late neonate these bacteria are S. pneumonia, S. pyogenes, and Staph. aureus, among children from one month to five years, viral infection is the most common etiology of pneumonia (Ebeledike and Ahmad, 2023).

In a case-control study conducted in Zambia to identify the etiology of pneumonia among under-five children, the results showed that viral infection is the most common etiology of pneumonia among this age group, the respiratory syncytial virus is the most common virus cause pneumonia (Mwananyanda et al, 2021).

In a systemic review analysis performed in China, the results showed that the most common bacteria responsible for pneumonia among under-five children are Klebsiella pneumonia, S. pneumonia, E. coli and other types of bacteria, while the most common viruses are human rhinovirus, respiratory syncytial virus, human bocavirus and other types of viruses (Ning et al, 2017).

In the USA the most common pathological casus of CAP among children (under 18 yrs.) was viruses, while bacteria are less common, the most common viruses were rhinovirus and respiratory syncytial virus, and the most common bacteria were Mycoplasma pneumonia and Streptococcus pneumonia (Yun et al, 2022).

Previously the most common etiology of pneumonia was the bacteria, but now a day the most common etiology of pneumonia is the virus infection, there were a change in etiology of pneumonia through the time (le Roux and Zar 2017).

2.2.4 Vaccination

Administration of Hemophilus influenza type b vaccination (Hib) before one year which protects children from pneumonia (Brooks et al., 2010), as well as pneumococcal conjugated vaccine (PCV) which decreases severity and hospitalization of pneumonia cases and decreases mortality rate among children under-five years (Afonso et al., 2013; Eicher et al., 2022; Shahid et al., 2023).

2.2.5 Treatment

The WHO provide an evidence based recommendation for pneumonia treatment among children these recommendations are as the follow:

First recommendation: child with mild pneumonia (tachypnea without chest in-drawing or severe warning signs), take oral antibiotic for three days in area with low prevalence of HIV, the preferred antibiotic is amoxicillin which is considered first-line treatment, if there were no response to the first line treatment the child should refer to health institution for second line treatment.

Second recommendation: under-five children with chest in-drawing also treat with oral amoxicillin for five days.

Third recommendation: under-five children who have severe symptoms will treat with administering of ampicillin along with gentamycin by intravenous or intramuscular rout for five days as a first line of treatment, while Ceftriaxone considered the second line treatment in case of failed of the first line of treatment.

Fourth recommendation: The recommended initial antibiotic regimen for HIV-infected and HIV-exposed infants, as well as for children under 5 years old diagnosed with pneumonia marked by chest in-drawing or severe pneumonia, consists of Ampicillin (or penicillin in cases where ampicillin is unavailable) in combination with gentamicin or ceftriaxone as a first-line treatment, if there is no response the second line treatment is preferred which consist of ceftriaxone alone.

Fifth recommendation: It is advised to consider co-trimoxazole (Trimethoprim/ sulfamethoxazole) therapy as a supplemental treatment for HIV-infected and HIV-exposed infants aged 2 months to 1 year who are suspected of having Pneumocystis jirovecii pneumonia (fungal pneumonia) and present with chest in-drawing or severe pneumonia

2.2.6 Epidemiology

- **High-income countries**

A study conducted in Germany in 2015, compares the incidence of pneumonia between two groups, the healthy-children group, and the at-risk children group, and showed the incidence rate of pneumonia among under-five healthy children is 3,779 per 100,000 children, while the incidence of pneumonia among under-five children who are at risk is 6,555 per 100,000 children (Pelton et al 2015).

A detailed analysis done in Poland in 2014 the results showed that hospitalization due to pneumonia increase with the decrease in the child's age, the infant has the heights incidence of hospitalization and the incidence of hospitalization in the age group between two years to five years was 1573 per 100,000 from all cases of pneumonia, the mortality rate among the hospitalized children is different among age groups, infants have the lowest mortality rate among all age groups (Lang, 2021).

According to population-based surveillance performed in the USA in 2015, the incidence of community-acquired pneumonia among children in this study was 15.7 per 10,000 children, the majority of hospitalized pneumonia patients were under-five children, the younger children have a higher incidence of pneumonia and have a higher incidence of hospitalization due to pneumonia than older children (Jain et al, 2015).

- **Low and middle-income countries**

A systemic review study done in 2022 to identify the incidence of pneumonia among children and to identify the mortality from pneumonia, this study reviewed articles had done in humanitarian emergencies countries, the incidence of pneumonia among under-five children are high especially in the refugee camps, the poorer camps with poor access to clean water have a higher incidence of pneumonia, despite the decrease in case fatality of pneumonia but it considered one of the top leading cause of death in these countries, pneumonia considered a humanitarian burden (Chen et al, 2022).

In Ethiopia, the incidence of pneumonia among under-five children was 33 per 100 children (Abuka, 2017), in a systematic review conducted in East Africa in 2020 the pooled prevalence was 34 per 100 children, which is considered high (Beletew et al., 2020).

According to cohort study conducted in South Africa in 2015 the incidence of pneumonia among infants was 27 per 100 children (Roux et al., 2015).

In a systemic review study conducted in 2020 in India, the results showed that there is decrease on pneumonia incidence among children, the incidence of pneumonia is higher among children who live in rural area than children in the same age live in the urban area, despite the decrease of incidence of pneumonia but India still have a high incidence rate of pneumonia which considered a burden (Wahl et al, 2020).

2.2.7 Burden of pneumonia

Treating pneumonia imposes a significant financial burden on households, in a study conducted in Uganda to assess the coast of pneumonia among under-five the results showed, on average, the total societal cost for each instance of pneumonia, across all healthcare settings and types of visits, was $42. Hospitalized cases incurred an average cost of $62 per episode, while cases treated on an outpatient basis cost an average of $16 per episode. A concerning finding was that approximately 39% of households experienced catastrophic health expenditures as a result of the out-of-pocket payments associated with pneumonia treatment (Kiracho, et al. 2021).

In a study conducted in Bangladesh a total of 1472 children diagnosed with severe pneumonia were included in the study, the average cost incurred by households per pneumonia episode was US$147, with a 95% confidence interval ranging from US$141.1 to US$152.7. Several factors significantly influenced household cost of illness, including the child's age, household income, the type of healthcare facility, and the length of hospital stay. Notably, costs were most sensitive to the length of hospital stay and the loss of productivity (Sultana et al, 2021).

While in a study conducted in the USA, out of the 256,916 patients who received outpatient treatment for CAP, approximately 10.6% of them had at least one hospitalization, among these hospitalized patients, 18.7% experienced at least one hospitalization directly related to CAP, on average, the total cost per patient was US$14,372, with 10.9% of this cost attributed to CAP-related expenses and 26.1% associated with inpatient care (Divino et al, 2020).

In a study conducted in China, with sample size 7811 under-five children, the overall expense incurred by the participants due to pneumonia amounted to 1,138,733 Chinese Yuan (CNY) nearly equal US$156,123, the mean costs were 5,722 CNY nearly equal US$784, multivariate analysis demonstrated that the sole factor associated with increased costs was hospitalization (Li et al, 2017).

In a study conducting in Taiwan in order to estimate the economic burden of pneumonia, the results showed that yearly societal expenses for pneumonia reached 150 million US$, with hospital costs around 17 million US$, on average, families incurred expenses of 218 US$ when their child was diagnosed pneumonia (Yi-Chien et al, 2015).

2.2.8 Risk factors of pneumonia

2.2.8.1 Global studies

In a retrospective study conducted in Cameroon in 2014 with sample size 333 children under five years old, to identify the effectiveness of Pneumococcal vaccine (PCV) program, there is no changes of number of cases, severity or mortality rates, this research indicate that there is seasonal variation in number of cases, in winter there is increasing in number of cases, the peak of cases is in January (Wallen, 2014).

In a cross-sectional study using demographic and health survey datasets from (1996-2014), conducted in Zambia, with sample size 30,391 children under five years' old, the results show that there was decline in ARI trend in this time period, children who live in rural area have a higher prevalence ARI than children who live in urban area, in this study vaccination doesn't have a statistically significant effect in prevention of ARI, increase in maternal age considered as protective factors form ARI, as well as the advancement in educational level protect the child form ARI, child younger than one year has a higher chance to develop ARI than child who older than one year, underweight is also risk factor for ARI, children who live in crowded houses -the researcher defined crowded as more than six family member- have a higher chance to develop ARI more than children who live in not crowded house, families using wood fire or charcoal as a source of cooking fuel their children have a higher risk to develop ARI than families using electricity as a cooking fuel, child with other comorbidities has a higher chance to develop ARI than child without other comorbidities, this study indicated that vitamin A supplementation protect the under five children from ARI (Mulambya et al., 2019).

In India the situation is look alike other developing countries but there are some differences, in the hospital based prospective study conducted in India in 2020, with sample size 270 children age between 2 month and 5 years, the incidence of sever pneumonia cases is 64% with CI (57.9- 69.4), the risk factors of severe pneumonia are: practicing open defecation (OR 16.9), poor ventilation of house (OR 16.4), acyanotic congenital cardiac disease (OR 9.2) prematurity (born before 37 weeks of gestation) (OR 7.5), history of measles (OR 6.3), over-crowding (OR 4.5), living in kuccha (OR 3.9), incomplete vaccination (OR 3.7) and home treatment tried OR 3.8 all these risk factors are statistically significant with sever pneumonia P value < 0.05 (Kasundriya et al, 2020).

Case-control study conducted in Indonesia in 2019 and published in 2021, with sample size 176 child their age between 10 months – 59 months, the results showed that the risk factors of pneumonia among this age group are: nonexclusive breastfeeding (OR= 7.9), indoor air pollution (OR= 6.1) and incomplete immunization (OR= 3.2) (Sutriana et al, 2021)

Climate changes have different effect on spread of pneumonia, this result shown in a study conducted in Bangladesh, in this study the researcher review monthly report on pneumonia among under five children from 2012 to 2016, the results shown that the temperature have negative relationship with incidence on pneumonia, the variation on temperature has positive relationship with length of stay on hospital, there are variation in pneumonia incidence according to change in seasons and this variation are statistically significant, the highest incidence is in October and November, the highest admission rate of pneumonia among under five children is in winter (Dec., Jan. and Feb.), maximum temperature has a negative relationship with incidence of pneumonia OR= 0.98 CI (0.97-0.99), PCV protect the children from pneumonia OR=0.49 CI (0.43- 0.55) as many studies indicated (Hossain, 2020).

Study conducted in Ethiopia 2016/2017 to assess the risk factors of acute respiratory infection (ARI) which include pneumonia among under five children, study design is case control study with sample size 288 (192 cases and 96 controls) case to control ratio is 2:1, this study indicate that the maternal literacy has a statistically significant positive relationship with ARI, children with malnutrition have high risk to have pneumonia more than children with good nutrition, child order has relation with pneumonia among under five children, by increase of number of siblings increase the risk for the child who under five to have pneumonia, all of this relation are statistically significant relationship between risk factors and ARI (Alemayehu et al, 2019).

Hospital based case control study conducted between 2010 to 2013 in Brazil to assess the risk factors of community acquired pneumonia among children under five years of age after application of pneumococcal vaccination program, the study sample consist of 814 children (407 cases and 407 controls) with case to control ratio 1:1, this study indicates that there a positive statistically significant relationship between household crowding with risk of having pneumonia, children who haven't been vaccinated against influenza virus have higher risk to have pneumonia more than children who have the vaccine (Lima et al., 2016).

In Uganda a cross sectional study conducted in 2019 and published in 2021, has 336 participants who are under five years old (2 months to 59 month) who have respiratory symptoms, conducted to assess the prevalence of pneumonia and associated risk factors among under five children who have respiratory symptoms, this study indicates that quarter of the sample have pneumonia, the most common risk factors which have statistically significant relationship with pneumonia are child age below six month have a higher risk of pneumonia more than the older, children who live in rural residency have higher risk to have pneumonia more than children who live in urban residency, children who have up to date vaccination as program have a lower risk to have a pneumonia than children who don't compliant to vaccination program, by increasing in malnutrition status it increase the risk of pneumonia, breast feeding especially exclusive breast feeding in the first six months protect the children from pneumonia (Kiconco, 2021).

Systemic review and meta-analysis study was done in 2020 to estimate the prevalence of pneumonia and identification of its risk factors among under five children in East Africa, the researchers review 34 studies from different websites, the total number of participant was 87,984 children, the study indicate that the pooled prevalence of pneumonia in East Africa is 34%, the most common risk factor is unvaccinated children with OR 2.4, CI 2-2.81 (Beletew et al., 2020).

In another systemic review and meta-analysis study carried out in Ethiopia in 2020, to assess the magnitude of pneumonia among under five years' children and the risk factors, the researcher reviewed 12 heterogenic studies, the pooled prevalence of pneumonia in Ethiopia is 20%, this percentage considered high, this study indicate that child history of respiratory tract infection increase the risk of pneumonia with OR 4.11 CI (1.98, 8.52) its consider the top leading factor for pneumonia, malnutrition the second risk factor for pneumonia OR 2.98 CI (1.84, 4.84) good nutrition consider as protective factor from pneumonia, Lack of vitamin

A supplementation OR 2.85 CI (1.36, 5.56), Mixed breast feeding OR 2.46 CI (1.35, 4.47) exclusive breast feeding especially in the first six months considered protective factor, Food cooking in the main house OR 2.46 CI (1.66, 3.66) and the children who unvaccinated have a higher risk from children who vaccinated OR 2.45 CI (1.13, 5.31). (Alamneh and Adane, 2020).

The supplementation improves immunity and increase the body resistance ability against infections especially vitamins (Haryanto, 2015), Vitamin A supplementation enhances the symptoms, increase the response rate for treatment and decrease the length of stay in the hospital for children with pneumonia, these were the result of systemic review done in china in 2018 (Hu, 2018).

In a hospital-based cross-sectional study done in Sudan, in 2017 with sample size 40 children under five years to examine the risk factors of pneumonia, the results showed that the low socioeconomic status and low mother literacy are risk factors for pneumonia among under five-children (Gritly et al, 2018).

In a cross-sectional study performed in China, poor bedroom aeration, shared bedroom by two or more children and living near road traffic were associated with risk of pneumonia, on the other hand the results indicated that exclusive breastfeeding considered as protective factors among children (Qu et al., 2023)

a case-control study conducted in Nepal the results indicated no significant difference in the occurrence of pneumonia between male and female children as well as another case-control study conducted in Indonesia (Karki et al., 2015; Sutriana et al., 2021). On the other hand, a cohort study conducted in India found that male children were more likely to develop pneumonia, sever pneumonia and require hospitalization than female children (Goyal et al., 2021), another case-control study conducted in Egypt found that male gender was associated with an increased risk of pneumonia among children who were less than five years old (Fadl et al., 2020), while a case-control study conducted in Brazil considered that being male decrease the risk of having pneumonia (Lima et al, 2016), male children are more susceptible to LRI than female which indicate that the immune system of afemale is stronger than male in childhood (Ursin and Klein, 2021).

cross-sectional study conducted in Ethiopia which indicated that younger children (12 months or less) have a higher risk of pneumonia than older children (Abuka, 2017), another cross-sectional study conducted in Somalia indicated that age advancement decrease the risk of pneumonia among under-five children (Adawe et al., 2023).

2.2.8.2 Regional studies

A case control study conducted at Alexandria- Egypt in 2020, with sample size 660 participants (330 cases and 330 controls), showed that the common socio-demographic risk factors for pneumonia among under five years' children were maternal age less than 19 years, low maternal education less than or equal 8 years, more crowded houses have a higher risk for children to have a pneumonia, children who live in house with poor aeriation have increased chance to have pneumonia more than children who live in house with good aeration, passive smoker children are at greater risk more than children who live with non-smoker parents, children who exposed to outdoor pollution have a higher risk to have pneumonia, child age has relation with pneumonia, child under 12 month has a higher risk of pneumonia more than children more than 12 months, male children are higher risk to have pneumonia more than female (Fadl et al., 2020).

A cohort longitudinal study was conducted in Egypt, with sample size of 1470 children diagnosed with pneumonia, the objective of this study is to identify the predictive risk factors behind severe pneumonia, in this study the participants are divided into two groups (mild and severe), the results showed that a low maternal education level, low family income and parents smoking have increased the child likely to develop severe pneumonia, so that the poor people are more likely to have severe pneumonia more than rich people (Azab, 2014).

In prospective hospital-based study conducted in Egypt in 2013, recurrent pneumonia in children considered a public health problem, which face health care providers and considers burden, the risk factors for recurrent pneumonia among children are: aspiration, Tuberculosis (TP), congenital cardiac diseases, bronchial asthma, immune deficiency disorders and vitamin D deficiency (Saad, 2013).

In a hospital based case-control study conducted in Lebanon in 2010, with sample size 200 participants (100 cases and 100 controls) with one case to one control ratio, this study indicates that there is statistically significant relationship between anemia and pneumonia,

anemia increase the risk of having pneumonia among children under twelve years' old P value 0.008 (Mourad et al, 2010).

In a retrospective descriptive study conducted in Jordan in 2022, with a sample size of 238 patients, 163 of them diagnosed with CAP, and the rest of the sample diagnosed with VAP, the result of the study showed that the patients with VAP had a higher risk to sepsis more than patients with CAP, the results also indicate that increase length of stay in the pediatric intensive care unit and taking antibiotics for more than one week are considers as a risk factors for VAP (Garcia et al, 2022).

Chapter Three

Methodology

3.1 Introduction

In this chapter, the researcher indicates the main methodological parts. they include; study design, study sample (study population, sample size, sampling process), study sitting, ethical consideration, study instruments, data collection procedures and data analysis procedure.

3.2 Study design

The researcher used hospital-based matched case-control design for this study, the data collected from hospital sitting, with matching with two variables age and gender, case control study compare between two groups; case group contain people with disease, and control group contain people without disease, this design considered a quantitative approach which depends on numerical data, the chosen of this approach because it considered suitable for identifying disease risk factors, it investigates multiple risk factors for one disease by comparing between case and control groups.

Case-control study is less expensive compared to other study designs, examine multiple risk factors for one disease, and less expensive and need less time for collect data. On the other hand, there are some disadvantages of this designs, recall bias because it depends on recalling previous activities, difficult to find controls in matched case-control study, and cannot identify incidence rate.

The researcher used of this design to identify the main risk factors of pneumonia among under-five children, this design was chosen because it is suitable for the research objectives.

3.3 Study population

The study population is consisting of all children aged 1-59 months at Gaza strip admitted to governmental hospitals (El- Nasser hospital, Mubarak hospital for children and Al- Aqsa Martyr hospital) during the data collection period, the total number of under-five population in Gaza Strip is 317,089 children compose 31.7% of child population in Gaza Strip.

The study population divided into two groups, first group cases contain under-five children diagnosed with pneumonia, and the second group are under-five children without pneumonia.

3.4 Sample Size and sampling process

A sample is a smaller group chosen from a larger population for the purpose of measuring, observing, or asking questions in order to gather statistical data about the entire population, to meet desired statistical constraints, the sample size was calculated by using "epiR sample size for matched case control study" computing the minimum number of necessary sample, the total number of sample size for matched case control study will be 338, number of cases required 169, number of control required 169 with power = 80%, $\alpha = 0.05$ and odds ratio 2, case to control ratio 1 case to 1 control, the researcher calculate the exposure among controls = 50% (Annex 3). Because pneumonia is seasonal and more common in Autumn and Winter, convenient, nonrandom sample was chosen from pneumonia admitted cases to the hospitals.

3.5 Study sitting

The study was conducted in three main hospitals, which provide pediatric health care services, these hospitals were; El- Nasser pediatric hospital in Gaza governorate which provide just pediatric medical services not surgical, Al- Aqsa Martyr hospital which have two pediatric departments which provide medical pediatric services while surgical services provided in other department in the same hospital in the middle area governorate and Naser medical complex (Mubarak pediatric hospital) in Khan-Yonis governorate, the study population chosen from these three hospitals, theses hospitals allocated in three governorates.

3.6 Period of the study

The study started on April 2022 completed by the end of June 2023, the study was for 15months, proposal writing and approval consumed two months and two weeks, then the preparing of the questionnaire consumed one month and two weeks, and the pilot study took two months because of in this month's there were decrease in the number of cases, then

modification of the questionnaire after pilot take three weeks, data collection consumed a four months (November- February) despite the cases of pneumonia have a peak in winter, the researcher took this time due to difficulty in finding controls, then the rest of the process took a five months, the time table of the study described the research process (Annex 4).

3.7 Eligibility criteria

Subjects who was eligible to participate in this study was meet the following criteria:

3.7.1 Case definition

- Children 1- 59 months old male and female.
- Medically diagnosed as a case of pneumonia either on admission or within 48 after admission.

3.7.2 Control definition

- ± 2 months matched to case within age group 1-59 months.
- Admitted to the hospital with any other disease rather than pneumonia.

3.8 Study instrument and measurements

A structured interview questionnaire was used to collect data from child's mother or child's care giver, the researcher chose this type of questionnaire to insure high response rate, the questionnaire in English language no need for Arabic translation, because the researcher and the data collector are trained and qualified personnel and they were collect data by themselves.

The questionnaire consisted of three parts as following (Annex 5):

- First part related to maternal and child's health variables contains: child age, gender, weight, height, birth weight, hemoglobin, type of delivery, prematurity, delivery complication, questions about infancy period (history of admission to NICU,

connection to MV, pneumonia in neonatal period), nutritional status (type of feeding: exclusive breast feeding, bottle feeding or mixed), supplementation, weaning age.

- Second part related to parental and socio-demographic variables: mother and father age, educational level of father and mother, occupational status of father and mother, size of family, place of residency, type of family, and family income.
- Third part related to environmental variable: indoor air pollution (parental smoking and type of fuel used for cooking), outdoor air pollution (electrical generator emits, factory / petrol station emits), crowding index (number of room except bathroom and kitchen divided by the number of family member except newborn), type of housing, roof of house made of, availability of basic sanitation, keep birds/ cattle or bits inside home or near home, dampness inside home, chide hygiene, and house ventilation.

3.9 Ethical and administrative consideration

All ethical considerations required to conduct a research was followed, and approval was obtained from Al-Quds University and Helsinki Committee (Annex 4). A formal letter was submitted from Al-Quds university to the MOH in the Gaza Strip to get approval to start data collection and to facilitate the process of data collection (Official request letter), then the MOH review the data collection instrument and provided an approval for data collection (Annex 5).

The researcher was explained the aim of the study and how he choose the participants in this study it was randomly, efforts made to keep related information confidential, there was not take names or identification number, the participants may refuse to participate in this study without penalty or loss of benefits to which he or she are otherwise, but the choose to participate in this study will be benefit to the community, there is no harm in participation and the participant was signed a consent form.

3.10 Pilot study

Pilot study was conducted before starting real data collection to assess the suitability of the research tool, and to determine the irrelevant and unclear questions to be either modified or

dropped from the questionnaire, pilot study preformed on 30 participants 15 of them were cases and 15 of them were controls, data were collected from Al-Aqsa hospital, then data processing and analysis were done, this process help in improvement of the questionnaire, pilot sample were excluded from the study sample.

3.11 Validity and reliability of the instrument

3.11.1 Validity

Face and content validity should be checked by reviewing the questionnaire by experts to ensure that the topic under investigation is covered well, also the questionnaire was checked for the structure and if there is double and confusing questions, face and content validity were performed by submit the questionnaire to group of experts to add some questions and edit the structure of the questionnaire and delete irrelevant questions, all expert's considerations were taken.

3.11.2 Reliability

To ensure the reliability of the instrument the researcher was trained the data collector well in data collection, the data entry was done immediately after finished collection of data and double check was done on data to confirm data.

The data was collected by the researcher and two colleagues, the data collectors were trained together how to collect data, to ensure that all of them collect data and ask question in the same way to avoid incorrect data and avoid inter researcher bias, pilot study was done to ensure reliability.

Pilot study: before real data collection the pilot study was done to ensure that there were no confused questions in the instrument or any ambiguity data in the instrument, piloting performed on 30 clients, 15 cases and 15 control, where obtained from the selected hospital that allow for further enhancement of validity and reliability of the instrument. The piloting cases and controls were excluded from the sample.

3.12 Data collection

The data was collected by the researcher himself and two colleagues who were trained by the researcher; to minimize enter researcher bias, the total of data collectors were three, each of them were collected data from one research setting (Al-Aqsa hospital, El-Naser pediatric hospital and Nasser medical complex), the purpose of the study was explained to mothers who agreed to participate in the study, data was collected by interviewed questionnaire, the data were collected from child accompany mainly the mothers, some data was taken from the client's files like hemoglobin level, some data collected by direct method like height/length and weight by direct measure, and the rest of data collected by indirect method by asking the mothers.

The data collector and the researcher measured the child height/length and weight by using the same type of meters and weight scale to avoid inter scale bias, then the researcher use WHO anthroplus software to calculate wasting, stunting and underweight by using the available date (weight, height and age). The researcher use Excel program to calculate crowded status by using WHO crowded index formula (The household crowding index (HCI)) was defined as the total number of co-residents per household, excluding the newborn infant, divided by the total number of rooms, excluding the kitchen and bathrooms).

3.13 Statistical analysis

Data analysis was performed after completion of data collection by using SPSS program. Data entry sheet was prepared to complete data entry then data cleaning was done to check for missed data. Definition and coding of variables, frequency tables, percentage calculation to check for the prevalence of risk factors among cases and control, and Odds ratio was used to assess the association between risk factors and the occurrence of pneumonia.

Definition of variables

Variables	Definition
Premature baby	Baby born before complete 37 weeks of gestation (WHO, 2022b).
Low birth weight	Weight of newborn less than 2500g (Blencowe et al., 2019).
Delivery complications	The delivery complication which related to child are; fetal distress and perinatal asphyxia.
Exclusive breastfeeding	Providing feeding to infant with only breast milk without any additional food or drinks including waters, exception for vitamins and drugs (WHO, 2015).
Lower respiratory tract infection (LRTI)	Include pneumonia, bronchitis and bronchiolitis.
Recurrent lower RTI	Occurrence of lower RTI for three or more in one year (Benedictis and Bush, 2018).
Nutritional status	According to the WHO an assessment of wasting, stunting, and underweight considered as nutritional statuses indicator.
Wasting	Weight-for-height below 2 standard deviations from the median of the WHO Child growth standards.
Stunting	Height-for-height below 2 standard deviations from the median of the WHO Child growth standards.
Underweight	Weight-for-age below 2 standard deviations from the median of the WHO Child growth standards.
Anemia	Hemoglobin level below 11 g/dl among under-five children.
Crowding	According to WHO crowding is a result of having more individuals than the capacity of a room, exceeding one person per room.

Chapter Four

Results and Discussion

4.1 Introduction

This chapter presents the results and discussion of the statistical analysis of the data, including descriptive analysis that presents the study and the answers to the study questions. Furthermore, the researcher aims to end each subdivision of this chapter with brief analytical results of multivariate analyses to assess risk factors for pneumonia among under-five children in the Gaza Strip. The study included 338 children under five years of age who were admitted to governmental hospitals in the Gaza Strip. The researcher used non-probability sampling (convenient sample) to select patients, and the participants were divided into two groups: the first group consisted of 169 children under-five years who had pneumonia and were admitted to governmental hospitals in the Gaza Strip (cases), and the second group consisted of 169 children under-five years who were admitted to governmental hospitals in the Gaza Strip but did not have pneumonia (controls). The researcher used proper statistical calculations, including mean and standard deviation (SD) for numerical data. The independent t-test was used to compare whether there was a statistically significant difference between cases and controls with respect to child age (months), weight (kg), height (cm), birth weight (kg), haemoglobin, number of birth order of this child, number of siblings, number of under 5 child siblings, times the child had been admitted to the hospital, mother's age, father's age, number of family members, number of rooms in the house (excluding the bathroom and kitchen), and the number of people in the household (excluding new-borns less than 28 days old). Pearson's chi-squared test was used to determine whether there was a statistically significant difference between the expected frequencies and the observed frequencies in one or more categories of a contingency table, such as child-related data, parental socio-demographic data, and environmental characteristics when compared between cases and controls. Logistic regression analyses were used to identify factors that affected pneumonia cases compared to controls among the study children. The P-value was considered significant at $P \leq 0.05$ and not significant at $P > 0.05$

4.2 Characteristics of the study participants both cases and controls

Table 4.1 displays a comparison of numerical data between cases and controls. According to the independent t-test, significant differences were found between cases and controls in the average number of siblings (2.62±1.86 vs. 2.13±1.94, P = 0.018). On the other hand, no statistically significant differences were observed between cases and controls in terms of child's age (18.82±17.53vs. 18.72±17.09 months, P = 0.958), weight (9.5±4.41 vs. 8.9±3.59 Kg, P = 0.174), height (74.47±17.4 vs. 73±15.33 cm, P = 0.411), birth weight (2.93±0.7 vs. 3.05±0.66 Kg, P = 0.129), hemoglobin (10.07±1.22 vs. 10.19±1.22 g/dl, P = 0.371), number of under-5 child siblings (0.9±0.86 vs. 0.75±0.78, P = 0.085), mother's age (29±5.5 vs. 28.24±5.37 years, P = 0.198), father's age (33.91±6.79 vs. 32.76±6.33 years, P = 0.111), number of family members (5.56±2.2 vs. 5.17±2.23 subjects, P = 0.105), number of rooms in the house excluding the bathroom and kitchen (2.44±1.04 vs. 2.24±0.94 rooms, P = 0.078), and the number of household members excluding the newborn less than 28 days (6.34±3.03 vs. 6.2±2.9, P = 0.673), respectively.

Table 4.1 Characteristics of the study participants both cases and controls

Variable	Case (n=169) Mean ±SD (Min-Max)	Control (n=169) Mean ±SD (Min-Max)	Statistical Analysis	
			t	P-value
Child age (months)	18.82±17.53 (1-59)	18.72±17.09 (1.03-59)	0.053	0.958
Weight (Kg)	9.5±4.41 (2.5-26)	8.9±3.59 (2.6-20)	1.362	0.174
Height (CM)	74.47±17.4 (41-120)	73±15.33 (41-110)	0.823	0.411
Birth weight (Kg)	2.93±0.7 (1-4.5)	3.05±0.66 (1-4.5)	-1.524	0.129
Haemoglobin	10.07±1.22 (7-14.1)	10.19±1.22 (7-13.8)	-0.896	0.371
Number of siblings	2.62±1.86 (0-9)	2.13±1.94 (0-12)	2.372	**0.018***
Number of under 5 child siblings	0.9±0.86 (0-3)	0.75±0.78 (0-4)	1.727	0.085
Mother age	29±5.5 (18-44)	28.24±5.37 (18-46)	1.291	0.198
Father age	33.91±6.79 (22-62)	32.76±6.33 (20-58)	1.599	0.111
Number of family members	5.56±2.2 (2-18)	5.17±2.23 (2-13)	1.624	0.105
Number of rooms in the house except the bathroom and kitchen	2.44±1.04 (1-7)	2.24±0.94 (1-4)	2.045	0.078
Number of people in the household except the newborn	6.34±3.03 (1-19)	6.2±2.9 (3-20)	0.422	0.673

*P < 0.05: significant, P ≥ 0.05: not significant; t: independent t test; & n: number.

4.3 The relationship between parental socio-demographic characteristics and pneumonia among the study participants

Table 4.2 displays the socioeconomic variables of children's parents, parental education level, occupational status, and income among cases and controls as shown below.

The educational level of the mother; the results of the analysis indicate no significant relationship between pneumonia and maternal education. Specifically, odds ratios (ORs) and 95% confidence intervals (CIs) for preparatory or less (OR 1.46, 95% CI 0.70-3.04, P = 0.316) indicated a positive relationship but not significant, and secondary education (OR 1.0, 95% CI 0.64-1.57, P = 1.000) show no differences between cases and controls.

The educational level of the father; as well as the maternal education there was no significant association between pneumonia and the father's educational level. Specifically,

odds ratios (ORs) and 95% confidence intervals (CIs) for preparatory or less (OR: 1.26; 95% CI: 0.72-2.22; P = 0.418) indicated a positive relationship but not significant, and secondary education (OR: 0.94; 95% CI: 0.58-1.54; P = 0.818) reveal negative not significant differences between cases and controls.

The occupational status of the mother; 35 (20.7%) cases compared to 4 (2.4%) controls among children of employee mothers. Logistic regression analysis revealed a strong positive significant association between the employee status of the mother and pneumonia among under-five children (P = 0.000). The odds of pneumonia among under-five children with an employed mother were 10.7 times higher (OR: 10.7; 95% CI: (3.74-, 1.08)) in cases compared to controls.

The occupational status of the father; table below showed the classification of the occupational status of the father into three categories, employee, unemployed and worker. The results indicated that there were 52 (30.8%) cases compared to 40 (23.7%) controls among children of worker fathers. There was positive not significant statistical association between the father's worker status and pneumonia among under-five children (P = 0.457). The odds of pneumonia among cases compared to controls for the father's occupational status were 1.21-fold (OR: 1.21; 95% CI: (0.73, 2.01)).

Similarly, the unemployed status of the father was also analyzed. The results showed that there were 69 (40.8%) cases compared to 70 (41.4%) controls, analysis indicated a positive not statistically significant association between the unemployed status of the father and pneumonia among under-five children (P = 0.102). The odds of pneumonia among cases compared to controls for the unemployed status of the father were 1.6-fold (OR: 1.6; 95% CI: (0.9, -2.8)).

The family income per month; with a cut-off of 1450 NIS or less, the results showed that out of the total cases, 140 (82.8%) had low income, whereas out of the total controls, 147 (87.0%) had low income. To investigate the correlation between family income and pneumonia in children under five, a logistic regression analysis was carried out. The analysis revealed that there was no significant association between these two variables (P = 0.289). The data demonstrated that the odds of developing pneumonia were 1.38 times higher in children with low income (OR: 1.38; 95% CI: 0.76-2.52) as compared to those with higher income.

Table 4.2 indicate that there is positive but not statistically significant relationship between parental education level and the occurrence of pneumonia, similar results from other studies conducted in Ethiopia showed that fathers' educational and occupational levels had no relationship with pneumonia among under-five children (Chekole et al., 2022; Seramo et al., 2022) also the study showed that there is no significant relationship between variation within income and the occurrence of pneumonia among children under 5 years old (Seramo et al., 2022) a case-control study performed In Brazil the results showed that there was no relationship between mother's education level with an incidence of pneumonia (Lima et al, 2016), also results in another cross-sectional study conducted in Nepal showed that there is no significant relationship between fathers' and mothers' occupational and educational status with the occurrence of under-five pneumonia, in contrast to the study results in respect to mothers' occupational status that showed a significant relationship with pneumonia (Ghimire et al, 2022). On the other hand, results from a case-control study conducted in Egypt showed that there is a significant relationship between a mother's level of education and the mother's occupation status with the occurrence of pneumonia among children (Fadl et al, 2020), another studies conducted in Bangladesh and Indonesia showed that a higher level of economic status and family income decreased the incidence of pneumonia than a lower level among under 5 children (*Luthfiyana et al, 2018;* Nasrin et al, 2022).

From the table below, the educational level of mothers is higher than fathers, as manifested by mothers who had primary or preparatory education, were less than fathers, percentage of mothers who had secondary and university education was more than fathers, this data reflect the extent to which Palestinian society cares about female education, this is considered progress towards achieving the fourth goal (ensure inclusive and equitable quality education and promote lifelong learning opportunities for all) and fifth goal (achieve gender equality and empower all women and girls) of sustainable development goals (SDGs), also in Palestine UNRWA and ministry of education (MOE) provide free primary education at UNRWA and MOE schools, there an improvement in education especially female education in Gaza strip which demonstrated by an increase of schooling years over years from 1997 until now, also literacy rate improved by years (PCBS, 2022).

Gaza Strip is undergoing successive economic crises, starting from the blockade imposed for more than 15 years, prevention of travel and free movement of the population, passing through unemployment crises, according to PCBS unemployment rate in the Gaza Strip is

approximately 45% in 2022, so there is no difference in the standard of living among most of the residents of the Gaza Strip, the study population is a part of Gaza Strip population so that there were no differences between cases and controls.

The most of study population's families have income below minimum wage in the Gaza Strip, which indicates that most of them had low income, as well as the most of Gaza Strip citizens who suffer from poverty, according to the United Nations Office for the Coordination of Humanitarian Affairs (OCHA) the poverty rate in Gaza Strip is nearly 65% in 2022 so that no differences between case and control in respect of family income.

The data shows that there was a significant relationship between employed mothers and the occurrence of pneumonia among their children, from my point of view, this relationship can be explained by the employed mothers didn't have time for child care, they will look for another caregiver to provide proper care for children, where we find that most of the families are nuclear families, so children of the employed mother were be sent to nurseries, where crowded with children and not adequate ventilation, these factors increase risk of spread of contagious respiratory disease like pneumonia.

Also, this table demonstrates the features of the Gaza Strip in general so that we found that there were no significant differences between socioeconomic variables except the occupational status of the mothers regarding the occurrence of pneumonia among under-five children in the Gaza Strip.

Table 4.2: Parental Socio-demographic characteristics among Study participants

Variables	Categories	Case (n=169) N (%)	Control (n=169) N (%)	Statistical Analysis		
				χ^2	P-value	OR (95%CI)
Mothers educational level	Preparatory or less	21 (12.4)	15 (8.8)	1.119	0.316	1.46 (0.7-3.04)
	Secondary	74 (43.8)	77 (45.6)		1.000	1 (0.64-1.57)
	University (Ref.)	74 (43.8)	77 (45.6)			1.0
Father's educational level	Preparatory or less	44 (26.0)	36 (21.3)	1.101	0.418	1.26 (0.72-2.22)
	Secondary	64 (37.9)	70 (41.4)		0.818	0.94 (0.58-1.54)
	University (Ref.)	61 (36.1)	63 (37.3)			1.0
Mother's occupation	Employee	35 (20.7)	4 (2.4)	27.855	**0.000***	10.77 (3.74-31.08)
	Unemployed	134 (79.3)	165 (97.6)			1.0
Father's occupation	Worker	52 (30.8)	40 (23.7)	2.703	0.457	1.21 (0.73-2.01)
	Unemployed	69 (40.8)	70 (41.4)		0.102	1.6 (0.91-2.8)
	Employee (Ref.)	48 (28.4)	59 (34.9)			1.0
Family type	Nuclear family	134 (79.3)	129 (76.3)	0.428	0.513	1.19 (0.71-1.98)
	Extended family	35 (20.7)	40 (23.7)			1.0
Family's income per month by NIS	1450 or less	147 (87.0)	140 (82.8)	1.132	0.289	1.38 (0.76-2.52)
	More than 1450 (Ref.)	22 (13.0)	29 (17.2)			1.0

*P < 0.05: significant, P ≥ 0.05: not significant; χ^2**:** Chi-square; **n:** number; **OR**: odds ratio & 95%CI: 95%confidence interval

4.4 The relationship between child-related risk factors and pneumonia among study participants

4.4.1 Natal history and postnatal risk factors

Gender

This study results showed that there were 97 males among cases (57.4%) and equal among controls. There was no association between gender and pneumonia among under-five children (P = 1.000). The odds ratio was 1.00, the gender variable was matched between case and control (OR: 1.00; 95% CI: 0.65-1.53), as shown in (Table 4.3.1).

Child age

The study population was classified by age into two groups; 12 months or less and more than 12 months. About (51.5%) of cases were 12 months or less, similarly 51.5% of controls were in the same age. There was no association found between age and pneumonia in children under the age of five (P = 1.00) the child age variable was matched between case and control. (OR: 1.00; 95% CI: 0.65, 1.53) (Table 4.3.1).

Birth order of the child

Table 4.3.1 depicts the birth order distribution among cases and controls. The results suggest that there is a significant positive relationship between pneumonia and birth order. Specifically, the odds ratios (ORs) and 95% confidence intervals (CIs) for 2^{nd} to 3^{rd} children (OR 2.21, 95% CI 1.09-4.13, P = 0.026) and children with birth order 4^{th} (OR 2.32, 95% CI 1.31-4.10, P = 0.004) demonstrate significant variations between cases and controls. These results resemble a study conducted in Ethiopia which indicated that children with fourth birth order or more have a greater risk to have pneumonia than child with lower birth order (Ferede, 2020), similarly a case-control study conducted in Brazel indicated that there was a relationship between pneumonia and maternal multiple past pregnancies, child whose mother had two childbirths having an odds ratio of 4.60 and those with three or more having an odds ratio of 3.25 Why this differences maybe according to differences in culture and tradition (Pina et al., 2017).

It can be explained by high birth order considered one of the most common risk factor for hospitalization among under-five children (Hassan et al., 2020), birth order combined with other factors such as poor nutritional status of child which effect child's immunity and resistance to communicable disease (Murarkar et al., 2020), when the successive births increase the number of children increases also, the mother will not be able to take care of all the children with the same efficiency, the first births take the largest and efficient care and attention, while the subsequent births have less attention.

Birth weight

The categorization of the study population according to low birth weight revealed that among cases 30 children (17.8%) had low birth, whereas among control 26 children (15.4%) had low birth weight. The results indicated that there was a negative not significant statistical association between normal birth weight and pneumonia among under-five children (P = 0.559). The odds of having pneumonia were 0.84 times higher for cases with low birth weight (OR: 0.84; 95% CI: 0.47-1.49) compared to controls, as shown in (Table 4.3.1), several studies have explored the relationship between low birth weight and pneumonia in children, in a case-control study conducted in Brazil show consistent results with our study it found negative but not statistically significant association between LBW and the risk of pneumonia among under-five children (Lima et al, 2016). Other studies have reported such an association, in studies conducted in Indonesia and Egypt found that low birth weight was associated with a higher risk of pneumonia among children aged under five years old (Fadl et al., 2020; Sutriana et al., 2021). LBW is known to be a risk factor for various health problems, and it is important to monitor the health of low birth weight infants carefully (Njim et al, 2018). From table below the number of children with normal birth weight was more than children with LBW by nearly five folds, there is no significant differences between case and control due to increase attention for Preconception care and prenatal care for mothers in primary health care especially UNRWA clinics, which increase the chance to have well and healthy children with normal weight, and all mothers lives nearly in the same living standards and situations, Gaza strip has a small geographical area so that almost all of the citizens share same living standards except few differences.

Type of delivery

Based on the type of delivery the study population was categorized into 74 (43.8%) cases and 49 (29%) controls delivered by the CS method. Logistic regression analysis indicated that there was a positive and statistically significant association between CS delivery and pneumonia among under-five children (P = 0.005). The odds of having pneumonia were 1.91 times higher for cases delivered by CS (OR: 1.91; 95% CI: 1.22-2.99) compared to controls, as shown in (Table 4.3.1), there are other studies performed to explore the relationship between CS delivery and pneumonia among under five children, the results of case-control study performed in Indonesia showed that there is indirect significant relationship between CS delivery and pneumonia (Nikmah et al., 2018) and this consistent with our study, the indirect relationship between CS delivery and pneumonia among under-five children may be explained by the study conducted in Canada to identify the relation between CS delivery and breastfeeding, the result showed that there is a significant relation between CS delivery and the breastfeeding pattern, a mother who undergoes CS delivery had a problem in breastfeeding which make child suspected to has a disease in his first months of life, women who undergo CS delivery had difficulties in breastfeeding (Hobbs et al., 2016). In my opinion, as Hobbs et al. 2016 study as this study, mothers in Gaza Strip who undergo CS delivery will face difficulties in initiation breastfeeding and substitute with formula feeding, breast milk contains important antibodies which needs to form the immune system for children (Morales et al., 2021).

Prematurity

The study population was classified based on whether the child was born prematurely. The results indicate that 26 (15.4%) of the cases and 13 (7.7%) of the control were identified as being born prematurely. Logistic regression analysis indicated that there was positive and statistically significant association between the child born prematurely and pneumonia among under-five children (P = 0.030). The odds of having pneumonia were 2.18 times higher for children born prematurely (OR: 2.18; 95% CI: 1.08-4.41) in cases compared to controls, as shown in (Table 4.3.1), some studies have found similar results, with premature birth being identified as a risk factor for pneumonia in children. For example, a case-control study found that preterm birth was associated with an increased risk of pneumonia in children under five years of age (Fadl et al., 2020). Other studies have reported conflicting results. For instance, a study conducted in Nepal found that while preterm birth was associated with

an increased risk of pneumonia in young children, this association was not statistically significant (Ghimire et al., 2022).

From my point of view, the explanation of this result is a preterm baby has a higher risk for disease and hospitalization as manifested by the Pryhuber study in 2015, full-term babies delivered with mature systems, but preterm babies have immaturity, immaturity determined according to gestational age of the baby.

Exposure to delivery complication.

The distribution of the study population according to the child's exposure to delivery complications showed 17 (10.1%) controls compared to 27 (16%) cases. Logistic regression analysis showed there was positive but not statistically significant association between the child's exposure to delivery complications and pneumonia among under-five children (P = 0.109). The odds of pneumonia among under-five children who were exposed to delivery complications were 1.7-fold (OR: 1.7; 95% CI: 0.89, 3.25) higher in cases compared to controls (Table 4.3.1).

History of Admission to NICU in the neonatal period and History of mechanical ventilator

Admission to NICU in the neonatal period; the results showed that 43 (25.4%) cases and 20 (11.8%) control was admitted to NICU. There is a positive and statistically significant association between the child admitted to NICU in the neonatal period and pneumonia among under-five children (P = 0.002). The odds of pneumonia among under-five children had the child admitted to NICU in the neonatal period 2.54 - fold (OR: 2.54; 95% CI: (1.42, 4.55)) cases compared to controls. ***History of a mechanical ventilator (MV);*** the results showed 26 (15.4%) cases compared to 13 (7.7%) controls were had a history of connection to MV. Regression analysis showed a positive and statistically significant association between the child being connected to the mechanical ventilator and pneumonia among under-five children (P = 0.030). The odds of pneumonia among under-five children who were connected to the mechanical ventilator were 2.18-fold higher (OR: 2.18; 95% CI: 1.08, 4.41) compared to controls (Table 4.3.1). Some study found similar results, which indicates that the duration of intubation was found to be the most important risk factor associated with ventilator-acquired pneumonia (VAP) (Aelami et al., 2014; Lee et al, 2017), other studies indicate that low birth weight was considered as a risk factor for VAP, patients diagnosed

with VAP has increased the length of stay in hospital more than patients who don't diagnose with VAP (Aelami et al., 2014; Thatrimontrichai et al, 2017). This relation can be explained by the number of premature baby and the number of children who had a history of connected to MV as mentioned in the table below, the observed was the numbers are equal, child who was connected to MV almost premature baby, prematurity increase risk to develop disease more than mature baby.

Basic vaccination

The study population was divided into groups based on whether the child received scheduled vaccinations, the results showed that 167 (98.8%) cases and 166 (98.2%) controls received vaccinations as per the schedule. The results also revealed negative not significant association between the child receiving scheduled not vaccinations and pneumonia among under-five children (P = 0.654). The odds of pneumonia among under-five children when the child received scheduled vaccinations were 0.66-fold (OR: 0.66; 95% CI: (0.11, 4.17)) for cases compared to controls (Table 4.3.1). As well as in a cross-sectional study performed in Nepal the results indicated that there was a negative not significant relationship between pneumonia and vaccination status of the child among under-five children (Ghimire et al, 2022). another study conducted in Egypt indicates that complete immunization protects from pneumonia among under-five children (Fadl et al, 2020). In contrast, a systemic review and meta-analysis study performed in East Africa the results show that unvaccinated children have a higher chance to have pneumonia than vaccinated children (Beletew et al, 2020),

In Palestine, vaccinations are available for free for all children so we found approximately all children vaccinated, there are no differences between case and control in respect of vaccination as scheduled, all children in Palestine have a right to take vaccination without disparities or discrimination, the reason behind this may be attributed to the widespread administration of the Hib vaccination and PCV vaccine, this vaccine provides protection against pneumonia.

Table 4.3.1 Natal history and postnatal risk factors among the study participants

Variables	Categories	Case (n=169) N (%)	Control (n=169) N (%)	Statistical Analysis		
				χ^2	P-value	OR (95%CI)
Gender**	Male	97 (57.4)	97 (57.4)	0.000	1.000	1.00 (0.65-1.53)
	Female (Ref.)	72 (42.6)	72 (42.6)			1.0
Age (Month)**	More than 12	82 (48.5)	82 (48.5)	0.000	1.000	1.00 (0.65-1.53)
	12 or less (Ref.)	87 (51.5)	87 (51.5)			1.0
Birth order	1st (Ref.)	24 (14.2)	46 (27.2)	8.825		1.0
	2nd -3rd	41 (24.3)	37 (21.9)		**0.026***	2.12 (1.09-4.13)
	4th or More than	104 (61.5)	86 (50.9)		**0.004***	2.32 (1.31-4.1)
Birth weight (Kg)	Normal	139 (82.2)	143 (84.6)	0.342	0.559	0.84 (0.47-1.49)
	LBW (Ref.)	30 (17.8)	26 (15.4)			1.0
Type of delivery	CS	74 (43.8)	49 (29)	7.988	**0.005***	1.91 (1.22-2.99)
	Normal (Ref.)	95 (56.2)	120 (71)			1.0
Prematurity	Yes	26 (15.4)	13 (7.7)	4.899	**0.030 ***	2.18 (1.08-4.41)
	No(Ref.)	143 (84.6)	156 (92.3)			1.0
Exposure to delivery complications**	Yes	27 (16)	17 (10.1)	2.613	0.109	1.7 (0.89-3.25)
	No (Ref.)	142 (84)	152 (89.9)			1.0
Admission to NICU in the neonatal period	Yes	43 (25.4)	20 (11.8)	10.320	**0.002 ***	2.54 (1.42-4.55)
	No (Ref.)	126 (74.6)	149 (88.2)			
History of mechanical ventilation	Yes	26 (15.4)	13 (7.7)	4.899	**0.030***	2.18 (1.08-4.41)
	No (Ref.)	143 (84.6)	156 (92.3)			1.0
Basic vaccination	No (Ref.)	2 (1.2)	3 (1.8)	0.203	0.654	0.66 (0.11-4.17)
	Yes	167 (98.8)	166 (98.2)			1.0

*P < 0.05: significant, P ≥ 0.05: not significant; χ2: Chi-square; n: number; OR: odds ratio & 95%CI: 95%confidence interval

** Matching variables

*** Delivery complications (fetal distress and perinatal asphyxia)

4.4.2 History of Lower RTI and other disorders among study subjects

History of pneumonia in the first month of his life; Table 4.3.2. showed that 17.2% of cases were suffer from pneumonia during the first month of life compared to 11.8% of controls. The odds ratio was OR: 1.54; 95% CI: (0.83, 2.85), which reflects positive but not significant statistical association between whether the child has pneumonia in the first month of his life or not (P = 0.166). ***History of recurrent Lower RTI;*** about 42 children (24.9%) of cases and 25 children (14.8%) of controls had a recurrent Lower RTI, the results indicated that there was a positive significant statistical relationship between the occurrence of pneumonia in children under the age of five and their previous history of recurrent Lower RTI (P = 0.022). The chances of developing pneumonia in under-five children with a history of recurrent Lower RTIs were 1.90 times greater (OR: 1.90; 95% CI: (1.10, 3.30)) in comparison to those without such a history. ***History of hospitalization due to a Lower RTI;*** the results showed that the child had been admitted to the hospital due to a Lower RTI were 80 (47.3%) of cases were compared to 26 (15.4%) of controls, there is a strong positive relationship between the history of hospitalization due to a Lower RTI and occurrence of pneumonia, the odds of pneumonia among under-five children who were admitted to the hospital due to a Lower RTI were 4.94-fold higher (OR: 4.94; 95% CI: (2.95, 8.28)) than cases compared to controls as manifested by (P = 0.000). ***History of bronchial asthma or episodes of wheezing episodes;*** The study population was divided based on whether the child had a previous history of bronchial asthma or wheezing episodes, with 38 (22.5%) cases compared to 21 (12.4%) controls, the results demonstrated positive significant correlation between a history of bronchial asthma or wheezing episodes and the occurrence of pneumonia among under-five children (P = 0.016). The odds of pneumonia in under-five children with a history of bronchial asthma or wheezing episodes were 2.04 times greater (OR: 2.04; 95% CI: 1.14, 3.66) compared to controls. ***History of URTI in the last 2 weeks;*** there were 72 (42.6%) cases, and 67 (39.6%) controls had an upper respiratory tract infection in the last 2 weeks, there was positive not significant statistical association between the child having an upper respiratory tract infection in the last 2 weeks and pneumonia among under-five children (P = 0.581). The odds of pneumonia among under-five children who had an upper respiratory tract infection in the last 2 weeks was 1.13 times higher (OR: 1.13; 95% CI: (0.73, 1.74)) compared to controls. ***Presence of chronic disease;*** The distribution of the study population according to the child has any chronic disease. showed 20 (11.8%) cases compared to 14 (8.3%) controls. The analysis showed there is positive not significant association between

the child having any chronic disease and pneumonia among under-five children (P = 0.280). The odds of pneumonia among under-five children had the child have any chronic disease 1.49 - fold (OR: 1.49; 95% CI: (0.72, 3.05)) cases compared to controls. ***History of neurological disease;*** The study population was analyzed based on whether the child had a neurological disease (such as CP and convulsion), out of the total population, 23 (13.6%) cases and 6 (3.6%) controls had neurological diseases, history of neurological disorders significantly increases the chance of occurrence of pneumonia among under-five children by 4.28 times more than children without a history of neurological diseases (OR: 4.28; 95% CI: (1.7, 10.8), as manifested by (P = 0.002).

Among variables history of recurrent Lower RTI and hospital admission due to Lower RTI, history of bronchial asthma or wheezing episodes, and history of neurological disease have a significant relationship with pneumonia among under-five years' children, while History of pneumonia in the first month of life, History of URTI in the last 2 weeks and Presence chronic disease didn't have a significant relationship.

There are several studies conducted to examine the relationship between a history of Lower RTI or chronic disease and the occurrence of pneumonia among under-five children, a case-control study conducted in Ethiopia showed similar results, and survey conducted in Philippine found that history of bronchial asthma has a positive relationship with incidence of pneumonia, history of presence asthma increases the risk to develop pneumonia among under five children (Kosai et al., 2015; Seramo et al., 2022), a systemic review and meta-analysis done in East Africa showed similar results which indicate that there is no significant relationship between history of acute respiratory tract infection which include upper respiratory tract infection with pneumonia among under-five children (Beletew et al., 2020), on the other hand a study conducted in Ethiopia showed that there was a significant relationship between upper respiratory tract infection within two weeks before onset of pneumonia and pneumonia among under-five children (Seramo et al., 2022; Tegenu et al., 2022), there is a significant relationship between history of URTI and severity of pneumonia even with death from pneumonia (Tegenu et al., 2022).

Several studies showed that chronic disease increase the risk of occurrence of pneumonia such as; heard disease associated increased severity of pneumonia and worsens the prognosis and outcome among children aged under-five years' old (Nimdet and Techakehakij, 2016), similarly in a retrospective study conducted in Indonesia the results show that heart disease

increase the risk for intensive care unit admission and bad prognosis , non-cyanotic congenital heart disease considered as risk factor for developing pneumonia among children under five years old especially infants, these also risk factor for recurrent pneumonia (Rahayuningsih et al, 2021), another retrospective study conducted in Taiwan indicated that chronic disorders increase the risk of recurrent Lower RTI and pneumonia, children with chronic disease (chronic heart disease and chronic neurological diseases) have a higher chance to develop bacterial pneumonia than children without any chronic disorder, (Chen et al, 2022).

From the table below, the percentage of recurrent pneumonia among cases is around 25% of total cases, recurrent pneumonia increases the chance to have another episode of pneumonia later by one out of four cases, and the percentage of cases admitted to the hospital due to Lower RTI is nearly 47% of the total cases, it indicated that nearly half of the pneumonia cases need hospitalization, from the total participants approximately one-third of them was admitted to hospital due to pneumonia at least one time before time of data collection, From my point of view these high percentages can be explained by the parents do not adhere to the treatment plan for the child, when he has mild pneumonia, so it dramatically develops into severe which require hospitalization, the reasons for not adhering to the treatment plan is the high price of medications, as well as high poverty rate, this factors decrease the purchasing power, so that sick child will not take the prescribed medication and the deterioration will occur. Recurrent pneumonia occurs because the child exposes to the risk factors again, the problem will not resolve until remove of the modifiable risk factors which lead to pneumonia.

It is possible that both asthma and its treatment can affect the likelihood of pneumonia, asthma change the composition of the lining epithelial cells of the respiratory system, these changes may be caused by inflammation related to the disease or immunosuppression caused by treatment such as inhaled corticosteroids (Zaidi and Blakey, 2019)

According to the results below, children with chronic neurological diseases are more likely to develop pneumonia than children without neurological diseases. In my opinion. this is due to children with neurological diseases, especially CP, who spend most of their time in supine position, therefore, the secretions of the respiratory system cannot be excreted by the child, which leads to creates a suitable media for bacteria growth.

Table 4.3.2 History of Lower RTI and other disorders among study participants

Variables	Categories	Case (n=169) N (%)	Control (n=169) N (%)	Statistical Analysis		
				χ^2	P-value	OR (95%CI)
History of pneumonia in the first month of life.	Yes	29 (17.2)	20 (11.8)	1.933	0.166	1.54 (0.83-2.85)
	No (Ref.)	140 (82.8)	149 (88.2)			1.0
History of recurrent Lower RTI**	Yes	42 (24.9)	25 (14.8)	5.380	**0.022***	1.9 (1.1-3.3)
	No (Ref.)	127 (75.1)	144 (85.2)			1.0
History of hospital admission due to Lower RTI	Yes	80 (47.3)	26 (15.4)	40.078	**0.000 ***	4.94 (2.95-8.28)
	No (Ref.)	89 (52.7)	143 (84.6)			1.0
History of bronchial asthma or wheezing episodes	Yes	38 (22.5)	21 (12.4)	5.934	**0.016 ***	2.04 (1.14-3.66)
	No (Ref.)	131 (77.5)	148 (87.6)			1.0
History of URTI in the last 2 weeks	Yes	72 (42.6)	67 (39.6)	0.305	0.581	1.13 (0.73-1.74)
	No (Ref.)	97 (57.4)	102 (60.4)			
Presence chronic disease***	Yes	20 (11.8)	14 (8.3)	1.177	0.280	1.49 (0.72-3.05)
	No (Ref.)	149 (88.2)	155 (91.7)			1.0
History of neurological disease****	Yes	23 (13.6)	6 (3.6)	10.901	**0.002***	4.28 (1.7-10.8)
	No (Ref.)	146 (86.4)	163 (96.4)			1.0

*P < 0.05: significant, P ≥ 0.05: not significant; χ2: Chi-square; n: number; OR: odds ratio & 95%CI: 95%confidence interval

**Lower RTI (pneumonia, bronchitis and bronchiolitis)

***chronic diseases (heart disease, pulmonary disease and immune disorders)

**** neurological disease (CP and convulsion)

4.4.3 Feeding history and nutritional status risk factors

Type of feeding

Exclusive breastfeeding (only breast milk for up to 6 months); The study found that 72 (42.6%) of cases and 67 (39.6%) of controls received exclusive breastfeeding. However, logistic regression analysis revealed positive not significant association between exclusive breastfeeding and pneumonia among children under five (P = 0.581). The odds of developing pneumonia were 1.13 times higher for children who received exclusive breastfeeding compared to the control group (OR: 1.13; 95% CI: 0.73-1.74). ***Bottle feeding only;*** The study found that 17.8% of cases and controls were exclusively bottle-fed. However, no association between bottle feeding and pneumonia among children under five (P = 1.000). The odds of developing pneumonia were not significantly different between children who were exclusively bottle-fed and those who were not (OR: 1.00; 95% CI: 0.57-1.75). ***Mixed feeding (breast milk and formula milk);*** The study found that 76 (45%) of cases and 81 (47.9%) of controls were given mixed feeding. There is a negative not significant association between mixed feeding and pneumonia among children under five (P = 0.586). The odds of developing pneumonia were not significantly different between children who received mixed feeding and those who did not (OR: 0.89; 95% CI: 0.58-1.36), according to (Table 4.3.3).

There are several studies examine the relationship between type of feeding and pneumonia among under five children, showing consistent with our study for example, a case-control study conducted in Southern Ethiopia found that exclusive breastfeeding for six months did not have a significant effect on the incidence of pneumonia among under-five years' children (OR: 0.89; 95% CI: 0.58, 1.37) (Seramo et al., 2022).

On the other hand, there were a studies that find a significant association between exclusive breastfeeding and pneumonia among under-five children. For instance, a systematic review and meta-analysis of 34 studies in East Africa found that non-exclusive breastfeeding for six months was increases the risk of pneumonia in young children (Beletew et al, 2020), another study conducted in Ethiopia found that exclusive breastfeeding was associated with a significantly reduced risk of pneumonia in under five children in comparison with mixed feeding (breast feeding and bottle feeding) (OR 0.108, 95% CI: 0.040, 0.292) (Chekole et al, 2022), similarly in a case-control study conducted in Egypt indicate that the exclusive

breastfeeding considered as a protective factor from pneumonia among under five-years children (Fadl et al, 2020).

From my point of view, this result was not significant due to several causes, from the results above most of the mothers have higher education (table 4.2), which would raise the level of knowledge of the importance of breastfeeding for the child, as we note that the number of children who receive breastfeeding and mixed-fed their numbers exceed the number of children who receive formula only, but there was a positive not significant relationship between breastfeeding and occurrence of pneumonia, this is maybe due to the position of child during feeding, Therefore, there are no differences between the child feeding, also the ages of the mothers are relatively close between the cases and the control (table 4.1), and this would make a similarity between the mothers in the way of feeding the child because most of the mothers are in average age, neither too old nor too young, in my opinion, the women at this age they have sufficient knowledge of the importance of breastfeeding for children. And when looking at the employment status of women (table 4.2), we find that most of the mothers are unemployed, so the mothers find enough time to breastfeed the child and not depend on Formula.

Supplementation

To examine whether the child took a supplement, the study population was divided into those who did and did not. The analysis revealed that 92 (54.4%) cases and 95 (56.2%) controls took a supplement. Results showed that there was a negative not significant association between taking a supplement and pneumonia in under-five children (P = 0.743). The odds of pneumonia among under-five children who took a supplement were 0.93 times (OR: 0.93; 95% CI: (0.61, 1.43)) that of controls (Table 4.3.3), A randomized control study conducted in India and another one conducted in Bangladesh showed that there is no significant relationship between vitamin D and the incidence of pneumonia among under-five children (Singh, 2019; Chowdhury, et al., 2021), another case-control study conducted in Ethiopia showed that there is no significant relationship between taking zinc supplements and the incidence of pneumonia, zinc doesn't have a role in protecting under-five children from pneumonia (Seramo et al, 2022), although another cross-sectional study performed in Ethiopia also showed that vitamin A considered as a protective factor from pneumonia among under-five years children, a child who didn't take a vitamin A as a supplement has a

high chance to suffer from pneumonia nearly five folds than child how takes vitamin A (Solomon et al, 2021).

As stated by the mothers, the percentage of children who received vitamin and iron supplements was 55%, usually, those supplements are given by UNRWA, and other charity organizations free of charge, the most available supplement is iron supplements. According to the literature, the most effective supplement protecting against pneumonia among those under-five is vitamin A.

Nutritional status (wasting, stunting and body mass index BMI)

Wasting*;* The study population was categorized based on the severity of wasting: severe, mild, and moderate. The distribution showed that 15 (8.9%) cases and 3 (1.8%) controls had severe wasting, 28 (16.6%) cases and 13 (7.7%) controls had moderate wasting, and 35 (20.7%) cases and 18 (10.7%) controls had mild wasting. Logistic regression analysis revealed strong positive significant associations between severe (P = 0.002), moderate (P = 0.001), and mild wasting (P = 0.001), and pneumonia in under-five children. The odds of pneumonia were 7.42 times higher for severe wasting (OR: 7.42; 95% CI: 2.09, 26.35), 3.2 times higher for moderate wasting (OR: 3.2; 95% CI: 1.5, 6.5), and2.88 times higher for mild wasting (OR: 2.88; 95% CI: 1.5, 5.4) compared to controls. ***Stunting***; the study population was categorized based on the severity of stunting, with 11 (6.5%) cases and 1 (0.6%) control being severely stunted. Results analysis revealed a strong positive significant association between severe stunting and pneumonia in under-five children (P = 0.008), with the odds of pneumonia being 16.5 times higher for severely stunted children (OR: 16.5; 95% CI: 2.09-1, 0.03) compared to controls (Table 4.3.3). for moderate stunting, there were 33 (19.5%) cases and 14 (8.3%) controls, with logistic regression analysis indicating a positive significant association with pneumonia (P = 0.000) and odds 3.54 times higher (OR: 3.54; 95% CI: (1.79, 6.98)) for cases compared to controls. Similarly, for mild stunting, 35 (20.7%) cases and 19 (11.2%) controls were observed, the results also showed a significant association with pneumonia (P = 0.001), with odds 2.76 times higher (OR: 2.76; 95% CI: (1.49, 5.13)) for cases compared to controls. ***BMI;*** The study population was categorized to underweight and overweight in comparison with normal weight, with 66 (39.1%) cases and 32 (18.9%) controls being underweight. The logistic regression analysis indicated a significant association between underweight and pneumonia among under-five children (P = 0.000). Underweight children had 2.87 times higher odds of pneumonia than controls (OR:

2.87; 95% CI: (1.74, 4.71)) (Table 4.3.3). On the other hand, 8 (4.7%) cases and 5 (3%) controls were overweight, and the logistic regression analysis showed no significant association between overweight and pneumonia (P = 0.173). Overweight children had 2.22 times higher odds of pneumonia than controls (OR: 2.22; 95% CI: (0.71, 7.01)) (Table 4.3.3).

The results of this study show that there are a significant association between nutritional status and occurrence of pneumonia among the study population, studies conducted and showed similar result in order to nutritional status, in South Africa a cohort study indicate that wasting and underweight are considered as a risk factor for pneumonia among infant, in general these factors indicate for poor nutritional status (Le Roux et al, 2015), in a case-control study conducted in Ethiopia showed that stunting has a significant relationship with incidence of pneumonia, but it found also that wasting and underweight were not have a significant relationship with incidence of pneumonia among under-five children (Seramo et al, 2022), in a case-control study conducted in Bangladesh examine the relationship between nutritional status as independent variable with incidence of pneumonia, the results showed that there was a significant relationship with sever stunting, but there wasn't significant relationship with severe underweight (Nasrin et al 2022), in another retrospective study conducted in Ethiopia showed that malnutrition increase the chance of occurring death among pneumonia patients, in other words malnutrition has a significant relationship with increase pneumonia mortality rate (Tegenu et al, 2022). On the other hand, in a cross-sectional study conducted in Nepal, nutritional status didn't have a significant relationship with the incidence of acute respiratory tract infection which includes pneumonia (Ghimire et al, 2022).

The table below shows that the percentage of wasting is 33% from all participants, wasting among cases 23% while among controls 10%, among children with wasting, mild wasting was around 47%, and the rest of them were moderate and severe wasting, For stunting also, a percentage of 33% of all participants, stunting among cases 23.3% while among controls 9.6%, among children with stunting, mild stunting was around 48%, and the rest of them were moderate and severe stunting, The underweight percentage was approximately 29% of all participants, approximately one-third of the study percipients are undernutrition. These results are relatively high, this can be explained by a high percentage of people suffering from food insecurity Gaza Strip (World Food Program [WFP], 2023; OCHA 2018), there is a high percentage of people suffer from food insecurity despite UN provision of food aid

(capon) for refugees in Gaza Strip, indeed food insecurity increases during crisis time, Gaza Strip suffer from blockade for more than 15 years, high poverty and unemployment rates, and the global rise in food prices after Ukraine crises, according to El-Bilbeisi et al. study in 2022, which conducted in Gaza Strip, the results indicated that food insecurity increases the occurrence of underweight and undernutrition among under-five children. In a study conducted to examine the relationship between undernutrition and the occurrence of infectious disease, the results indicated that children who are undernourished face increased vulnerability to infectious pathogens and have a higher likelihood of mortality due to infectious diseases (pneumonia, diarrhea, and measles) (Gwela et al., 2019), these results explain the significant relationship between undernutrition and occurrence of pneumonia.

Presence of anemia

The distribution of the study population according to anemia showed that there were 133 (78.7%) cases and 130 (76.9%) controls. Logistic regression analysis indicated that there was a positive not significant association between anemia and pneumonia among under-five children (P = 0.695). The odds of having pneumonia were 1.11 times higher for cases with anemia (OR: 1.11; 95% CI: 0.66-1.85) compared to controls, as shown in Table 4.3.3.

It's important to mention that the researcher adopt the hemoglobin cut-off point of 11g/dl among under-five children (WHO, 2019), the previous studies used the same hemoglobin cut-off point, a study conducted in Gaza Strip, the prevalence of anemia is around 60% of preschool children in Gaza strip, anemia increase by a decrease of age (EL-Kishawi et al., 2015), around 78% of the study participants had anemia.

Our study had differ from other studies, in a study performed in Bangladesh, to assess the effect of anemia on pneumonia patients, the result showed that the presence of anemia worsens the prognosis of pneumonia patients and has a fatal outcome, there is a significant relationship between pneumonia mortality and anemia (Chisti et al, 2022),similarly, in a case-control study performed in India the results showed that iron deficiency anemia is a significant risk factor for pneumonia among children who aged up to five years (Choudhary and Kumar, 2020).

From my point of view, the high prevalence of anemia among children in Gaza Strip makes no difference between children in respect of the occurrence of pneumonia, so in this study, there was no significant relationship between pneumonia and anemia.

Table 4.3.3. Feeding history and nutritional status risk factors among the study participants

Variables	Categories	Case (n=169) N (%)	Control (n=169) N (%)	Statistical Analysis		
				χ^2	P-value	OR (95%CI)
Exclusive breastfeeding	Yes	72 (42.6)	67 (39.6)	0.305	0.581	1.13 (0.73-1.74)
	No (Ref.)	97 (57.4)	102 (60.4)			1.0
Bottle feeding only.	Yes	30 (17.8)	30 (17.8)	0.000	1.000	1 (0.57-1.75)
	No	139 (82.2)	139 (82.2)			1.0
Mixed feeding	Yes	76 (45)	81 (47.9)	0.297	0.586	0.89 (0.58-1.36)
	No (Ref.)	93 (55)	88 (52.1)			1.0
Supplement	Yes	92 (54.4)	95 (56.2)	0.108	0.743	0.93 (0.61-1.43)
	No (Ref.)	77 (45.6)	74 (43.8)			1.0
Wasting	Normal (Ref.)	91 (53.8)	135 (79.9)	27.507		1.0
	Mild	35 (20.7)	18 (10.7)		**0.001***	2.88 (1.54-5.4)
	Moderate	28 (16.6)	13 (7.7)		**0.001***	3.2 (1.57-6.5)
	Sever	15 (8.9)	3 (1.8)		**0.002***	7.42 (2.09-26.35)
Stunting	Normal (Ref.)	90 (53.3)	135 (79.9)	29.755		1.0
	Mild	35 (20.7)	19 (11.2)		**0.001***	2.76 (1.49-5.13)
	Moderate	33 (19.5)	14 (8.3)		**0.000***	3.54 (1.79-6.98)
	Sever	11 (6.5)	1 (0.6)		**0.008***	16.5 (2.09-130.03)
BMI	Normal (Ref.)	95 (56.2)	132 (78.1)	18.519		1.0
	Underweight	66 (39.1)	32 (18.9)		**0.000***	2.87 (1.74-4.71)
	Overweight	8 (4.7)	5 (3)		0.173	2.22 (0.71-7.01)
Presence of anaemia	Anaemia	133 (78.7)	130 (76.9)	0.154	0.695	1.11 (0.66-1.85)
	Normal(Ref.)	36 (21.3)	39 (23.1)			1.0

*P < 0.05: significant, P ≥ 0.05: not significant; χ2: Chi-square; n: number; OR: odds ratio & 95%CI: 95%confidence interval

4.4. The relationship between environmental risk factors and pneumonia among study participants

Indoor air pollution

Parental smoking; Out of the total sample, 80 (47.3%) cases and 68 (40.2%) controls had parents who smoked. There is a positive not significant association between parental smoking and pneumonia among under-five children (P = 0.189). The odds of pneumonia among under-five children whose parents smoked were 1.34 times higher (OR: 1.34; 95% CI: (0.87, 2.05)) compared to controls. ***Type of fuel used for cooking***; The study population was divided according to the type of fuel used for cooking, and the results showed that 163 (96.4%) of the cases and 165 (97.6%) of the controls used cooking gas. However, logistic regression analysis revealed no significant association between the type of fuel used for cooking and pneumonia among under-five children (P = 0.524). The odds of developing pneumonia among under-five children who used cooking gas were 0.66-fold (OR: 0.66; 95% CI: (0.18, 2.38)) compared to controls.

There were studies showed different results from our study, in studies conducted in Bangladesh, South Africa, and India, smoking increases the incidence of ARI especially pneumonia (Islam et al, 2021; le Roux et al, 2015; Mondal and Paul, 2020), other studies indicated that using of unclean fuel for cooking increases the incidence of pneumonia among under-five children (Beletew et al, 2020; Mondal and Paul, 2020; Naz and Ghimire, 2020).

There is no significant relationship between indoor air pollution and the occurrence of pneumonia among study participants, in my opinion, the results were not significantly different between the case and control due to several reasons, around 56% of participants' parents were not smokers and the most of smoker was smoke outside the home, children were not exposed directly with smoke, the other reason for this relationship is the wide use of cooking gas as a fuel for cooking, approximately 97% of the families participants using cooking gas.

Outdoor air pollution

Electrical generator near your residency; according to the study, the study population was divided based on the presence of an electrical generator near their residency, 13 (7.7%) cases and 3 (1.8%) controls. The results showed that there was a strong positive significant

association between the presence of electrical generators near the residency and pneumonia among under-five children (P = 0.019). The odds of having pneumonia among under-five children who had an electrical generator near their residency were 4.61 times higher (OR: 4.61; 95% CI: (1.29, 6.49)) compared to controls. ***Factory/ petrol station near your residence***; the results showed that 19 cases (11.2%) and 8 controls (4.7%) had such establishments near their homes. Logistic regression analysis found there was a positive significant relationship between having a factory or petrol station nearby and the occurrence of pneumonia in children under the age of five (P = 0.032). However, the odds of developing pneumonia were 2.55 times higher for children under five who lived near a factory or petrol station compared to the control group (OR: 2.55; 95% CI: 1.08-6)

Factory exhaust and electrical generator exhaust produce toxic gases which have effects on the respiratory tract system as manifested by several studies a study conducted in China showed that child exposure to outdoor air pollution in the neonatal period increases the risk of having pneumonia in children at age 3-5 years (Jiang et al, 2018), in a systemic review and meta-analysis study the results showed that exposure to toxic gases which considered outdoor air pollution, increase the risk of hospital admission due to pneumonia, in other words, increase outdoor air pollution increase the risk and severity of pneumonia (Nhung et al, 2017).

In Gaza Strip, the distribution of factories is far from the residential areas, but the increased population makes people live near factories, factory smoke is usually emitted and directly affects the population, whereas the electrical generator places were not far away population residential, in my opinion, the population is exposed directly to electrical generators emits, and the distribution of the electrical generator in a certain region without other especially high-density areas, so that there was a significant relationship with the occurrence of pneumonia.

Type of housing

Type of house; the study population was distributed according to apartment housing, revealing 131 (77.5%) cases and135 (79.9%) controls. There was no significant correlation between the type of housing and pneumonia among children under the age of five (P = 0.595). The data showed that the odds of developing pneumonia were 0.87 times lower in cases with apartment housing (OR: 0.87; 95% CI: 0.52-1.46) when compared to controls.

Type of house roof; The study participants were split into two groups based on the type of house roof: concrete and asbestos, and compared to the reference group (Iron Sheet). Of those with a concrete house roof, 127 cases (75.1%) and 128 controls (75.7%) were identified, and logistic regression analysis did not find any significant correlation between having a concrete house roof and the incidence of pneumonia in children under five (P = 0.681). The odds of developing pneumonia were 1.15 times higher among children under five with a concrete house roof compared to the control group (OR: 1.15; 95% CI: 0.59-2.23).

In addition, the distribution of the study population according to a house roof made of asbestos showed 23 (13.6%) cases compared to 19 (11.2%) controls. Also, there was a positive not significant association between an asbestos house roof and pneumonia among under-five children (P = 0.444). The odds of pneumonia among under-five children who had a house roof made of asbestos was 1.4-fold (OR: 1.4; 95% CI: (0.59, 3.32)) compared to controls (Table 4.4).

In a cross-sectional study conducted in Nepal, the results showed similarity, in respect of that variation in the type of housing, finding that there was a relationship but not significant between the type of housing and the occurrence of ARI which includes pneumonia among children (Ghimire et al, 2022).

The percentage of families living in apartments is nearly 79% of all participants' families, this percentage goes alongside the percentage of houses with concrete roofs, its nearly 75%, which indicated good houses structures, this is a common feature of the Gaza Strip houses, I think there are little differences among participants' houses so the relationship was not significant between the type of housing (include roof made off) and the occurrence of pneumonia among under-five children.

Sanitation

Availability of basic sanitation; the study population was distributed based on the availability of basic sanitation, which showed compared to 14 (8.3%) cases 7 (4.1%) controls. However, there was no significant association between the availability of basic sanitation and pneumonia among under-five children (P = 0.122). The odds of pneumonia among under-five children who had the availability of basic sanitation were 2.09 - fold (OR:

2.09; 95% CI: (0.82, 5.32)) cases compared to controls. ***Presence of Molding spots in the house***; the study population was classified based on the presence of molding spots/ damp stains in the house, with 98 (58%) cases and 108 (63.9%) controls. Negative not significant association between the presence of molding spots/ damp stains and pneumonia among under-five children (P = 0.265). The odds of pneumonia in children under five years old with molding spots in the house were 0.78 times (OR: 0.78; 95% CI: 0.5, 1.21) compared to controls. ***The child's bed washed and cleaned regularly;*** washing and cleaning of the child's bed negative not significant association with pneumonia among under-five children the categorization of the population study was 157 (92.9%) cases compared to 164 (97%) controls as manifested by (P = 0.091). The odds of pneumonia among under-five children who had their bed washed and cleaned regularly were 0.4-fold (OR: 0.4; 95% CI: (0.14, 1.16)) compared to controls. ***The child's bed (below and covers) expos to sunlight***; the study population was categorized based on whether the child's bed (below and covers) was exposed to sunlight. Out of the total study population, 143 (84.6%) cases and 152 (89.9%) controls had the child's bed exposed to sunlight. There was a negative no significant association between the child's bed exposure to sunlight and pneumonia among under-five children (P = 0.144). The odds of pneumonia among under-five children with the child's bed exposed to sunlight were 0.62-fold (OR: 0.62; 95% CI: (0.32, 1.18)) cases compared to controls (Table 4.4).

In a cross-sectional study conducted in Philippines, showed houses with good sanitation, improved drinking water and availability of basic sanitation protect the children from pneumonia (Kosai et al., 2015), in another cross-sectional study conducted in Ethiopia, the result showed that the presence of molding spots in the house was considered a risk factor for pneumonia (Andualem et al., 2020).

Almost houses in the Gaza Strip have sewage systems, not depend on septic tanks as in the past except in some marginalized rural areas, as well as the study participants' houses depend on the sewage system, which is considered the clean and safe way to discard wastewater. Molding spots are common in houses, it is evidence of dampness in the house, according to the table below dampness in control houses is more than in cases contrary to expected, but these differences are not statistically significant. When asked about a child's hygiene at home in terms of washing mattresses and covers, and exposing them to the sun, the answers are often positive, regardless of the real behavior. From my point of view, the mothers may tell

the truth or may not, and the best way to assess the child's hygiene is by observational assessment.

Presence of animals or birds around the child

Presence of Cattle near the house; the study population was distributed according to the presence of cattle near the house, with 27 (16%) cases and 24 (14.2%) controls. The logistic regression analysis revealed that there was no significant association between the presence of cattle near the house and pneumonia among under-five children (P = 0.649). The odds of pneumonia among under-five children who had cattle near their house were found to be 1.15-fold higher (OR: 1.15; 95% CI: (0.63, 2.09)) than controls. ***The presence of birds kept inside the house***; the study population was categorized based on whether birds were kept inside their house or not, with 20 (11.8%) cases and 14 (8.3%) controls. There was a positive not significant association between the presence of birds inside the house and pneumonia among under-five children (P = 0.28). The odds of pneumonia in under-five children who had birds kept inside their house were 1.49-fold higher (OR: 1.49; 95% CI: 0.72-3.05) compared to controls. ***Presence of pets kept inside the house***; the study population was analyzed based on whether they kept pets inside their house, with 12 (7.1%) cases and 7 (4.1%) controls. There was positive not significant association between keeping pets inside the house and pneumonia among under-five children (P = 0.243). The odds of pneumonia among under-five children who kept pets inside the house were 1.77 times higher (OR: 1.77; 95% CI: (0.68, 4.61)) compared to controls.

A cross-sectional study performed in Ethiopia found contradictory results, which indicated that keeping cattle was considered strongly associated with pneumonia among under-five children (Fekadu et al., 2014), in another studies performed in an India and Brazil the results indicated that a high pneumonia rate among children living in a home where there are pets (Meilantika et al, 2018; Ramani et al., 2016), there are several diseases transmitted from animals and birds to human, Psittacosis or also know (avian chlamydiosis) transmitted from birds to human, its effects mainly on the respiratory system causing URTI and pneumonia (Rodriguez et al., 2022), and H5N1 also known (avian influenza) effect mainly on lower respiratory tract system causing pneumonia even respiratory failure (Rajabali et al., 2015).

In the table below, the number of families that own cattle or birds is a small number, the data from the same table, the majority of the participants in the study live in an apartment dwelling, so it is difficult to keep birds and livestock in them.

House ventilation

In this study the results showed that good house ventilation didn't have a significant relationship with reducing pneumonia, the cases who live in the well-ventilated house were 148 (87.6%) cases compared to 138 (81.7%) controls, as manifested by (P = 0.134). The odds of pneumonia among under-five children who had a well-ventilated house were 1.58 times (OR: 1.58; 95% CI: (0.87, 2.89)) the cases compared to controls (Table 4.4), a cross-sectional study conducted in Nepal showed consistent with this study results, there was a positive not significant relationship between house ventilation and occurrence of ARI which includes pneumonia (Ghimire et al, 2022), on the other hand, case-control studies conducted in Brazil and Egypt showed that poor house ventilation is considered a risk factor for pneumonia among under-five children (Fadl et al, 2020; Meilantika et al, 2018).

The answers about house ventilation question based on the participants' judgment about the ventilation on their houses, I think this question need direct assessment.

Crowdness

The distribution of the study population according to crowded conditions showed 92 (54.4%) controls compared to 91 (53.8%) cases. Logistic regression analysis showed there is a postitive not significant association between crowded conditions and pneumonia among under-five children (P = 0.913). The odds of pneumonia among under-five children with crowded conditions were 1.02-fold (OR: 1.02; 95% CI: (0.67, 1.57)) cases compared to controls (Table 4.4).

In this study case and controls are shared in many of themes like crowded conditions due to high density of population in small area, more than half of population sample (case and control) live in crowded houses, there are several studies conducted examined the relationship between crowded and incidence of pneumonia among children, one of them a case-control study conducted in Ethiopia showed consistent with the study result, which indicated the crowded have a positive significant relationship in increasing the risk of pneumonia among children (Seramo et al, 2022), there were studies conducted in Ethiopia

and Pakistan showed than there was a significant relationship between overcrowded and incidence of pneumonia among under-five children (Chekole et al, 2021; Naz and Ghimire, 2020), also in Bangladesh the overcrowded is a risk factor for respiratory tract infection, and increase the incidence of hospitalization (Islam et al, 2021).

Table 4.4a: Distribution of environmental risk factors among the study participants

Variables	Categories	Case (n=169) N (%)	Control (n=169) N (%)	Statistical Analysis		
				χ^2	P-value	OR (95%CI)
Parental smoking	Yes	80 (47.3)	68 (40.2)	1.731	0.189	1.34 (0.87-2.05)
	No (Ref.)	89 (52.7)	101 (59.8)			1.0
Parents smoke at home	Yes	57 (33.7)	47 (27.8)	1.389	0.239	1.32 (0.83-2.1)
	No (Ref.)	112 (66.3)	122 (72.2)			1.0
Type of fuel used for cooking	Cooking gas	163 (96.4)	165 (97.6)	0.412	0.524	0.66 (0.18-2.38)
	Others (Ref.)	6 (3.6)	4 (2.4)			1.0
Electrical generator near your residency	Yes	13 (7.7)	3 (1.8)	6.561	**0.019***	4.61 (1.29-16.49)
	No (Ref.)	156 (92.3)	166 (98.2)			1.0
Factory/ petrol station near your residence?	Yes	19 (11.2)	8 (4.7)	4.871	**0.032***	2.55 (1.08-6)
	No (Ref.)	150 (88.8)	161 (95.3)			1.0
Type of housing	Apartment	131 (77.5)	135 (79.9)	0.282	0.595	0.87 (0.52-1.46)
	Others (Ref.)	38 (22.5)	34 (20.1)			1.0
Type of the house roof	concrete	127 (75.1)	128 (75.7)	0.604	0.681	1.15 (0.59-2.23)
	Asbestos	23 (13.6)	19 (11.2)		0.444	1.4 (0.59-3.32)
	Iron sheet (Ref.)	19 (11.2)	22 (13)			1.0
Availability of basic sanitation	Septic tank	14 (8.3)	7 (4.1)	2.488	0.122	2.09 (0.82-5.32)
	Sewage system (Ref.)	155 (91.7)	162 (95.9)			
Presence of cattle near the house	Yes	27 (16)	24 (14.2)	0.208	0.649	1.15 (0.63-2.09)
	No (Ref.)	142 (84)	145 (85.8)			1.0
Presence of birds kept inside the house	Yes	20 (11.8)	14 (8.3)	1.177	0.280	1.49 (0.72-3.05)
	No (Ref.)	149 (88.2)	155 (91.7)			1.0
Pets kept inside the house	Yes	12 (7.1)	7 (4.1)	1.394	0.243	1.77 (0.68-4.61)
	No (Ref.)	157 (92.9)	162 (95.9)			1.0

Table 4.4b: Distribution of environmental risk factors among the study participants

Variables	Categories	Case (n=169) N (%)	Control (n=169) N (%)	Statistical Analysis		
				χ^2	P-value	OR (95%CI)
Molding spots in the house	Yes	98 (58)	108 (63.9)	1.243	d0.265	0.78 (0.5-1.21)
	No (Ref.)	71 (42)	61 (36.1)			1.0
The child's bed washed and cleaned regularly	Yes	157 (92.9)	164 (97)	3.035	0.091	0.4 (0.14-1.16)
	No (Ref.)	12 (7.1)	5 (3)			1.0
The child's bed (below and covers) expos to sunlight?	Yes	143 (84.6)	152 (89.9)	2.158	0.144	0.62 (0.32-1.18)
	No (Ref.)	26 (15.4)	17 (10.1)			1.0
House ventilation	Yes	148 (87.6)	138 (81.7)	2.273	0.134	1.58 (0.87-2.89)
	No (Ref.)	21 (12.4)	31 (18.3)			1.0
Crowd	Yes	91 (53.8)	92 (54.4)	0.012	0.913	1.02 (0.67-1.57)
	No (Ref.)	78 (46.2)	77 (45.6)			1.0

*P < 0.05: significant, P ≥ 0.05: not significant; χ2: Chi-square; n: number; OR: odds ratio & 95%CI: 95%confidence interval

4.5 Study limitation

There are several limitations faced by the researcher during this study:

- Dearth of local and regional studies about risk factors of pneumonia among under-five children.
- Difficulty in finding cases and controls according to inclusion criteria, especially controls, matching according to age and gender.
- The data collected by the interviewed questionnaire, consumed time and effort.
- This study is a case-control one, there was recall bias such as when asking mothers of older children about the first month of life and the type of feeding.
- There were questions about sanitation and the environment, which need direct assessment, the participants sometimes don't answer these questions correctly.

4.6 Conclusion

This study is aimed to investigate the potential factors of pneumonia among under-five children in the Gaza Strip, using a hospital-based, matched case-control method, the main risk factors investigated were parental socio-demographic factors, child-related factors, and environmental factors, the study population were children from 1-59 months admitted to hospital in the study period, the study population number were 338 they are divided to two comparable groups 169 case and 169 control, with age and gender matching between cases and controls, the data were collected from child accompany mainly from mothers, by using interviewed questionnaire, then data analyzed by using independent t-test, Pearson's chi-squared test, and logistic regression analyses, the study results were compared with previous studies, there were findings aligned with expectations and were consistent with previous studies while other findings contradicted with previous studies.

The results are as the following:

Firstly, the relationship with parental socio-demographic variables; pneumonia was positively and strongly associated with maternal occupation status (employed mother), while the mother's educational level, father's educational level, father's occupation, family type, and family's income were not significant statistically associated with pneumonia among under-five children.

Secondly, the relationship with child-related variables; is divided into three categories; natal history and postnatal variables, history of Lower RTI and other disorders, and feeding history and nutritional status.

For natal history and postnatal variables; pneumonia was a positive significant association with birth order, CS delivery, prematurity, admission to NICU in the neonatal period, and history of MV, while the Birth weight, exposure to delivery complications, and vaccination status were not significant association with pneumonia among under-five children.

History of Lower RTI and other disorders; pneumonia was a positive significant association with a history of recurrent Lower RTI, history of bronchial asthma or wheezing episodes, and a strong positive association with a history of hospital admission due to Lower RTI and history of neurological disease, while the history of pneumonia in the first month of life.

History of URTI in the last 2 weeks, and presence of chronic disease were not significant association with pneumonia among under-five children.

Feeding history and nutritional status; pneumonia was a positive significant association with wasting (Mild and Moderate), stunting (Mild and Moderate), Underweight, and a strong positive significant association with severe wasting and severe stunting, while exclusive breastfeeding, mixed feeding, using a supplement, overweight, and anemia were not significant association with pneumonia among under-five children.

Finally, regarding the relationship with environmental variables; pneumonia was a positive significant association with outdoor air pollution (factory, petro station, and electrical generator emits), while there was no significant association with indoor air pollution, outdoor air pollution, type of house, sanitation, presence of animals or birds kept inside or near the home, house ventilation, and crowd.

Recommendations

5.1 Recommendations for policymakers

- Trying to limit the occurrence of pneumonia, by limiting outdoor air pollution, and increasing the level of awareness among people.
- The percentage of stunting and wasting in this study may be not the actual prevalence among children in the Gaza Strip but need more attention.
- Monitoring trends of pneumonia, enforcing good documentation for cases and providing reliable medical records with availability for researchers.
- Provide continuous and reliable statistics about the incidence of pneumonia and the severity of cases.
- Provide a surveillance system for anemia and nutritional status among under-five children.

5.2 Recommendations for healthcare worker

- The healthcare worker should be careful with documentation, and provide the full history of the patients.
- Trying to pay attention to CP patients, by good monitoring, providing special care, and providing health education to the family in order to minimize the occurrence of pneumonia.
- Provide health education for families with children who have recurrent Lower RTIs, the education about the risk factors to minimize recurrent pneumonia.
- The healthcare worker should monitor children's weight and height; this is done in primary health clinics regularly but should be done completely in hospitals for clients, trying to find out children with wasting, stunting, and underweight.
- Provide care for the neonates by trained personnel and using aseptic techniques to prevent the spread of communicable diseases, especially VAP in patients connected to MV.
- Provide good diagnosis and classification of cases according to the severity.

5.3 Recommendations for the future research

- Need more research to investigate more risk factors for pneumonia among children using various methods, like using community-based studies.
- Need more research to identify the incidence of pneumonia among age groups.
- Need to include neonatal period besides under-five children in the study population, or as a separate study population.
- Focus on anemia prevalence and risk factors among under-five children, community-based studies.
- More studies about nutritional status among children.
- Investigates the NICU infection prevention controls, to identify the most common risk factors for VAP among neonates.

References

Abuaka, T. (2017). Prevalence of pneumonia and factors associated among children 2-59 months old in Wondo Genet district, Sidama zone, SNNPR, Ethiopia, *Current Pediatric journal, 21*(1). https://www.currentpediatrics.com/articles/prevalence-of-pneumonia-and-factors-associated-among-children-259-months-old-in-wondo-genet-district-sidama-zone-snnpr-ethiopia.html.

Adawe, M., Odongo, A., and Kariuki, J. (2023). Risk Factors Associated with Pneumonia among under 5 Years Children at Banadir Hospital, Mogadishu, Somalia, *Asian Journal of Medicine and Health, 21*(8), 1-11. https://doi.org/10.9734/ajmah/2023/v21i8832.

Aelami, M., Lotfi, M. and Zingg, W. (2014). Ventilator-associated pneumonia in neonates, infants and children, *Antimicrobial Resistance and Infect Control 3*(1). https://doi.org/10.1186/2047-2994-3-30.

Afonso, E., Minamisava, R., Bierrenbach, A., Escalante, J., Alencar, A., Domingues, C., Morais-Neto, O., Toscano, C., and Andrade, A. (2013). Effect of 10-valent pneumococcal vaccine on pneumonia among children, Brazil, *Emerging Infectious Diseases, 19*(4), 589-97. https://doi.org/10.3201/eid1904.121198.

Alamneh, Y. and Adane, F. (2020). Magnitude and Predictors of Pneumonia among Under-Five children in Ethiopia: A Systematic Review and Meta-Analysis, *Journal of Environmental and Public Health*, 2022, 9. https://doi.org/10.1155/2020/1606783.

Alemayehu, S., Kidanu, K., Kahsay, T., and Kassa, M. (2019). Risk factors of acute respiratory infections among under five children attending public hospitals in southern Tigray, Ethiopia, 2016/2017, *BMC Pediatrics 19*(1), 380. https://doi.org/10.1186/s12887-019-1767-1 .

Andualem, Z., Adane, T., Tigabu, A., Yallew, W., Wami, S., Dagne, H., Azanaw, J., Guyasa, G., Azene, Z., and Endalew, M. (2020). Pneumonia among Under-Five Children in Northwest Ethiopia: Prevalence and Predictors—A Community-Based Cross-Sectional Study, *International Journal of Pediatrics, 2020*(1). https://doi.org/10.1155/2020/3464907.

Azab, S., Sherief, L., Saleh, S., Elsaeed, W., Elshafie, M., and Abdelsalam, S. (2014). Impact of the socioeconomic status on the severity and outcome of community-acquired pneumonia among Egyptian children: a cohort study, *Infectious Disease of Poverty, 3*(14). https://doi.org/10.1186/2049-9957-3-14.

Beletew, B., Bimerew, M., Mengesha, A. Wudu, M., and Azmeraw, M. (2020). Prevalence of pneumonia and its associated factors among under-five children in East Africa: a systematic review and meta-analysis, *BMC Pediatrics 20*, article 254. https://doi.org/10.1186/s12887-020-02083-z.

Benedictis, F. and Bush, A. (2018). Recurrent lower respiratory tract infections in children, *BMJ, 362*(8162). https://doi.org/10.1136/bmj.k2698.

Bhat, J., Charoo, B., Mukherjee, A., Ahad, R., Das, R, Goyal, J, Vyas, B., Ratageri, V., Lodha, R., Khera, D., Singhal, D., Jat, K., Singh, K., Ray, P., Kumar, P., Mahapatro, S., and Kabra, S. (2021). Risk of Hospitalization in Under-five Children with Community-Acquired Pneumonia: A Multicentric Prospective Cohort Study, *Indian Pediatrics, 58*(11), 1019–1023. https://doi.org/10.1007/s13312-021-2366-4 .

Blencowe, H., Krasevec, J., de Onis, M., Black R., An, X., Stevens, G., Borghi, E., Hayashi, Ch., Estevez, D., Cegolon, L. Shiekh, S., Hardy, V., Lawn, J., and Cousens, S. (2019). National, regional, and worldwide estimates of low birthweight in 2015, with trends from 2000: a systematic analysis, *Lancet Global Health, 7*(7) e849-e60. doi:10.1016/S2214-109X(18)30565-5.

Brooks, A., Goswami, D., Rahman, M., Nahar, K., Fry, A., Balish, A., Iftekharuddin, N., Azim, T., Xu, X., Klimov, A., Bresee, J., Bridges, C., and Luby, S. (2010). Influenza is a Major Contributor to Childhood Pneumonia in a Tropical Developing Country, *The Pediatric Infectious Disease Journal*, *29*(3), 216-221, DOI: 10.1097/INF.0b013e3181bc23fd.

Chekole, D., Andargie, A., Yosuf, K., Mekonen, M., Geremew, B., and Fetene, M. (2022). Prevalence and associated risk factors of pneumonia in under-five years' children using the data of the University of Gondar Referral Hospital, *Cogent public health,* 9(1). https://doi.org/10.1080/2331205X.2022.2029245.

Chen, L., Liu, Y., Lin, H., Hsing, T., Liu, Y., Yen, T., Lu, Ch., Chen, J., Lee, P., Huang, L., Lai, F., and Chang, L. (2022). Clinical characteristics of recurrent pneumonia in children with or without underlying diseases, *Journal of the Formosan Medical Association, 121*(6), 1073-1080. https://doi.org/10.1016/j.jfma.2021.08.0

Chen, S., Walker, P., Mulholland, and K., Graham, H. (2022). Childhood pneumonia in humanitarian emergencies in low- and middle-income countries: A systematic scoping review, *Journal of global health, 12*. https://jogh.org/2022/jogh-12-10001 .

Chisti, M., Kawser, C., Rahman, S., Shahid, S., Afroze F, Shahunja, K., Shahrin, L., Sarmin, M., Nuzhat, S., Rahman, A., Alam, T., Parvin, I., Ackhter, M., Mamun, G., Shaima, S., Faruque, S., and Ahmed, T. (2022). Prevalence and outcome of anemia among children hospitalized for pneumonia and their risk of mortality in a developing country, *Scientific Reports. 12*(1), article 10741. DOI: 10.1038/s41598-022-14818-2.

Choudhary, S., and Kumar, B. (2020), "Iron deficiency anemia as a risk factor for pneumonia in children: a hospital beased study", *International Journal of Current Research, 12*(5), 11441-11444. https://www.journalcra.com/sites/default/files/issue-pdf/38630.pdf.

Dadonaite, B. and Roser, M. (2019). "Pneumonia". *Our World in Data*. https://ourworldindata.org/pneumonia.

Divino V, Schranz J, Early M, Shah H, Jiang M, and DeKoven M. (2020). The 1-year economic burden of community-acquired pneumonia (CAP) initially managed in the outpatient setting in the USA, *J Comp Eff Res*, 9(2):127-140. https://pubmed.ncbi.nlm.nih.gov/31840552/.

Ebeledike C, Ahmad T. Pediatric Pneumonia. [Updated 2023 Jan 16]. In: StatPearls [Internet]. Available from: https://www.ncbi.nlm.nih.gov/books/NBK536940/.

Eichler, N., Joseph, L., Megged, O., Goldberg, Sh., and Picard, E. (2022). The impact of pneumococcal conjugate vaccine on the prevalence and severity of hospitalizations for pneumonia in children, *European Journal of Clinical Microbiology and Infectious disease 41*, 439–444. https://doi.org/10.1007/s10096-021-04386-0

Ekaru, H., Mbarak, N., Shurie, S., Kosgei, E., Oyungu, E., and Kwena, A. (2012). Community-acquired pneumonia among children admitted in a tertiary hospital: the burden and related factors, *East Africa Medical Journal, 89*(9), 301- 305. Risk of Hospitalization in Under-five Children With Community-Acquired Pneumonia: A Multicentric Prospective Cohort Study - PubMed (nih.gov) .

El Kishawi, R., Soo, K., Abed, Y., and Muda, W. (2015). Anemia among children aged 2-5 years in the Gaza Strip- Palestinian: a cross-sectional study, *BMC Public Health, 1*(15), article 319. DOI: 10.1186/s12889-015-1652-2.

El-Bilbeisi, AH., Al-Jawaldeh, A., El-belbeisi, A., Abuzerr, S., El-Madfa, I., and Nasreddine, L. (2022). Households' Food Insecurity and Their Association with Dietary Intakes, Nutrition-Related Knowledge, Attitudes and Practices Among Under-five Children in Gaza Strip, Palestine, *Front Public Health, 10*,1-10. https://doi.org/10.3389/fpubh.2022.808700.

Fadl, N., Ashour, A., and Yousry Muhammad, Y. (2020). Pneumonia among under-five children in Alexandria, Egypt: a case-control study, *The Journal of the Egyptian Public Health Association, 95*(1), 7. https://doi.org/10.1186/s42506-020-00043-0.

Fakih, A., Okafor, Ch., Yusuf, S., Mahmoud, S., Masud, M., Obeagu, E., Nyabukika, A., Omar, M., Sheha, B., and Khamis, A. (2021). Evaluation of Risk Factors of Pneumonia in Children under Five Years Old at Mnazi Mmoja Hospital- Zanzibar, *Bulletin of Environment Pharmacology and Life Sciences,10*(3), 69-75. (PDF) Evaluation of Risk Factors of Pneumonia in Children under Five Years Old at Mnazi Mmoja Hospital-Zanzibar (researchgate.net).

Fekadu, G., Terefe, M., and Alemie, G. (2014). Prevalence of pneumonia among under-five children in Este town and the surrounding rural kebeles, Northwest Ethiopia; A community based cross sectional study, *Science Journal of Public Health, 2*(3), 150-155. https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=f6d17cdd18aa886c1c188e1cf2918c7bd5c8d6cf .

Ferede, M. (2020). Socio-demographic, environmental and behavioural risk factors of diarrhoea among under-five children in rural Ethiopia: further analysis of the 2016 Ethiopian demographic and health survey, *BMC Pediatrics 20(1), 1-9*. https://doi.org/10.1186/s12887-020-02141-6 .

Garcia, M., Alarcon, M., Perez, S., Ayala, M., Ribalta, A., Balaguer, M., Cambra, F., and Kordan, I. (2022). Ventilator-associated pneumonia is linked to a worse prognosis than community-acquired pneumonia in children, *Plos One 17*(7). https://doi.org/10.1371/journal.pone.0271450.

Ghimire, P., Gachhadar, R., Piya, N., Shrestha, K. and Shrestha, K. (2022). Prevalence and factors associated with acute respiratory infection among under-five children in selected tertiary hospitals of Kathmandu Valley, *Plos One 17*(4). https://doi.org/10.1371/journal.pone.0265933.

Giuliano, K., Baker, D., and Quinn, B. (2018). The epidemiology of non-ventilator hospit0al-acquired pneumonia in the United States American, *Journal of Infection Control, 46*(3), 322-327, https://doi.org/10.1016/j.ajic.2017.09.005.

Goyal, J., Kumar, P., Mukherjee, A. Das, R., Bhat, J., Ratageri, V., Vyas, B., Lodha, R., Charoo, B., Khera, D., Singhal, D., Jat, K., Singh, K., Ray, P., Mahapatro, S., and Kabra, S. (2021). Risk Factors for the Development of Pneumonia and Severe Pneumonia in Children, *Indian Pediatrics, 58*, 1036–1039. https://doi.org/10.1007/s13312-021-2369-1.

Gritly, S., Elamin, M., Rahimtullah, H., Ali, A., Yabarow, A., Mohamed, E., and Adetunji, H. (2018). Risk Factors of Pneumonia Among Children Under 5 Years at a Pediatric Hospital in Sudan, *International Journal of Medical Research and Health Sciences, 7*(4), 60-68. https://www.ijmrhs.com/medical-research/risk-factors-of-pneumonia-among-children-under-5-years-at-a-pediatric-hospital-in-sudan.pdf.

Gwela, A., Mupere, E., Berkley, J., and Lancioni, C. (2019). Undernutrition, Host Immunity and Vulnerability to Infection Among Young Children, *The Pediatric Infectious Disease Journal 38*(8), e175- e177. https://journals.lww.com/pidj/Fulltext/2019/08000/Undernutrition,_Host_Immunity_and_Vulnerability_to.24.aspx.

Haryanto, B., Suksmasari, T., Wintergerst, E., and Maggini, S. (2015). Multivitamin supplementation supports immune function and ameliorates conditions triggered by reduced air quality, *Vitamins and Minerals*, *4*(2). https://pdfs.semanticscholar.org/d556/ee510dae113e1505ec788143c3bb7c81f2bf.pdf

Hassan, A., Taha, Z., Abdulla, M., Ali, A., and Adam, I. (2020). Causes and risk factors of hospitalization among under-five children in kassala, eastern Sudan, *All Works*, *8*(E), 451-457. https://zuscholars.zu.ac.ae/works/846.

Hobbs, A., Mannion, C., McDonald, S., Brochway, M., and Tough, S. (2016). The impact of caesarean section on breastfeeding initiation, duration and difficulties in the first four months postpartum, *BMC Pregnancy Childbirth 16*, article 90. https://doi.org/10.1186/s12884-016-0876-1.

Hossain, M. (2020). Effects of socio-demographic and climatic factors on childhood pneumonia in Bangladesh, (Doctoral dissertation), Queensland University of Technology. eprints.qut.edu.au/203940/1/Mohammad Zahid_Hossain_Thesis.pdf.

Hu, N., Li, Q., and Zou, S. (2018). Effect of vitamin A as an adjuvant therapy for pneumonia in children: Meta-analysis, *Chinese Journal of Contemporary Pediatrics*, *20*(2):146-153. http://www.zgddek.com/EN/10.7499/j.issn.1008-8830.2018.02.013 .

Islam, M., Sultana, Z., Iqbal, A., Ali, M., and Hossain, A. (2021). Effect of in-house crowding on childhood hospital admissions for acute respiratory infection: A matched case–control study in Bangladesh, *International Journal of Infectious Diseases, 105*, 639-645, https://doi.org/10.1016/j.ijid.2021.03.002.

Izadneghader, R., Cohen, A., Klugman, K., and Qazi, Sh. (2013). Childhood pneumonia in developing country, *The lancet, 1*(7), 574-584. https://doi.org/10.1016/S2213-2600(13)70075-4 .

Jain, S., Williams, D., Arnold, S., Ampofo, K., Bramley, A., Reed, C., Stockmann, C., Anderson, E., Grijalva, C., Self, W., Zhu, Y., Patel, A., Hymas, W., Chappell, J., Kaufman, R., Kan, J., Dansie, D., Lenny, N., Hillyard, D., Haynes, L., Levine, M., Lindstrom, S., Winchell, J., Katz, J., Erdman, D., Schneider, E., Hicks, L., Wunderink, R., Edwards, K., Pavia, A., McCullers, J., and Finelli, L. (2015). Community-acquired pneumonia requiring hospitalization among U.S. children, *The New England journal of medicine, 372*(9), 835-45. DOI: 10.1056/NEJMoa1405870.

Jiang, W., Lu, Ch., Miao, Y., Xiang, Y., Chen, L., and Deng, Q. (2018). Outdoor particulate air pollution and indoor renovation associated with childhood pneumonia in China, *Atmospheric Environment,174*, 76-81. https://doi.org/10.1016/j.atmosenv.2017.11.043.

Karki, S., Fitzpatrick, A., and Shrestha, S. (2015). Risk Factors for Pneumonia in Children under 5 Years in a Teaching Hospital in Nepal, *Kathmandu University Medical Journal*, *12*(4), 247–252. https://doi.org/10.3126/kumj.v12i4.13729.

Kasundriya, S., Dhaneria, M., Mathur, A., and Pathak, A. (2020). Incidence and Risk Factors for Severe Pneumonia in Children Hospitalized with Pneumonia in Ujjain, India, *International Journal of Environmental Research and Public Health, 17*(13). http://dx.doi.org/10.3390/ijerph17134637 .

Kiconco, G., Turyasiima, M., Ndamira, A., Yamile, O., Egesa, W., Ndiwimana, M., and Maren, M. (2021). Prevalence and associated factors of pneumonia among under-fives with acute respiratory symptoms: a cross sectional study at a Teaching Hospital in Bushenyi District, Western Uganda, *African Health Science, 21*(4) 1701-10. https://dx.doi.org/10.4314/ahs.v21i4.25.

Kiracho E, Broucker G, Ssebagereka A, Mutebi A, Apolot R, Patenaude B, and Constenla D. (2021). The economic burden of pneumonia in children under five in Uganda, *Vaccine X*, *2*(8) https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8135046/

Kliegman, R. (2020). Nelson textbook of pediatrics (Edition 21). Philadelphia, PA: Elsevier.

Kosai, H., Tamaki, R., Saito, M., Tohma, K., Alday, P.,Tan, A., Inobaya, M., Suzuki, A., Kamigaki, T., Lupisan, S., Tallo, V. and Oshitani, H. (2015). Incidence and Risk Factors of Childhood Pneumonia-Like Episodes in Biliran Island, Philippines a Community-Based Study, *Plos One, 10*(5). https://doi.org/10.1371/journal.pone.0125009.

Lange, J., Kozielski, J., Bartolik, K., Kabicz, P., and Targowski, T. (2021). The incidence of pneumonia in the paediatric population in Poland in light of the maps of health needs, *Journal of Public Health 31*,457–465. https://doi.org/10.1007/s10389-021-01503-3.

Lee, P., Lee, W., and Chen, H. (2017). Ventilator-Associated Pneumonia in Low Birth Weight Neonates at a Neonatal Intensive Care Unit: A Retrospective Observational Study, *Pediatric and neonatology, 58*(1), 16-21. https://doi.org/10.1016/j.pedneo.2015.10.014 .

le Roux, D., and Zar, H. (2017). Community-acquired pneumonia in children — a changing spectrum of disease, *Pediatr Radiol 47*, 1392–1398 https://doi.org/10.1007/s00247-017-3827-8.

Li, Y., An, Z., Yin, D., Liu, Y., Huang, Z., Ma, Y., Li, H., Li, Q., and Wang, H. (2017). Disease burden of community acquired pneumonia among children under 5 y old in China: A population based survey, *Human vaccine and immunotherapeutic, 13(7), 1681-1687.* https://doi.org/10.1080/21645515.2017.1304335.

Lima, E., Mello, M., Albuquerque, M., Lopes, M., Serra, G., Lima, D., and Correia, J. (2016). Risk factors for community-acquired pneumonia in children under five years of age in the post-pneumococcal conjugate vaccine era in Brazil: a case control study, *BMC Pediatrics, 16*, article 157. https://doi.org/10.1186/s12887-016-0695-6 .

Lissauer, T. (2017). Illustrated textbook of paediatrics (5th ed.). Elsevier Science, Amsterdam.

Luthfiyana, N., Rahardjo, S., and Murti, B. (2018). Multilevel Analysis on the Biological, Social Economic, and Environmental Factors on the Risk of Pneumonia in Children Under Five in Klaten, Central Java, *Journal of Epidemiology and Public health, 3*(2), 128-142. https://doi.org/10.26911/jepublichealth.2018.03.02.03.

Meilantika, A., Hadisaputro, S., Mexitalia, M., Sakundarno, M., and Rahardjani, K. (2018). Study of family behavior that at risk for pneumonia in under five children in Mempawah district, *Health Notion, 2*(4), 490-493. http://www.heanoti.com/index.php/hn/article/view/182.

MOH (2023), *annual health report 2022*, MOH التقرير-السنوي-لوزارة-الصحة-الفلسطينية-قطاع-غزة-2022-Final.pdf (moh.gov.ps).

Mondal, D., and Paul, P. (2020). Effects of indoor pollution on acute respiratory infections among under-five children in India: Evidence from a nationally representative population-based study, *Plos One, 15*(8). https://doi.org/10.1371/journal.pone.0237611.

Morales, A., Caba, M., Juárez, M., Flores, M., Contreras, R., and Valenzuela, C. (2021). Breastfeeding Contributes to Physiological Immune Programming in the Newborn, *Front Pediatrics, 9*, 1-9 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8567139/ .

Mourad, S., Rajab, M., Alameddine, A., Fares, M., Ziade, F., and Merhi, B. (2010). Hemoglobin level as a risk factor for lower respiratory tract infections in Lebanese children, *North American journal of medical sciences, 2*(10),461–466. https://doi.org/10.4297/najms.2010.2461.

Mulambya, N., Nanzaluka, F., Sinyangwe, N., and Makasa, M. (2020). Trend and factors associated with acute respiratory infection among under five children in Zambia 1996-2014, *Pan African Medical Journal, 36*(197). https://www.panafrican-med-journal.com/content/article/36/197/full.

Murarkar, S., Gothankar, J., Doke, P., Pore, P., Lalwani, S., Dhumale, G., Quraishi, S., Patil, R., Waghachacare, V., Dhobale, R., Rasote, K., Palkar, S., and Malshe, N. (2020). Prevalence and determinants of undernutrition among under-five children residing in urban slums and rural area, Maharashtra, India: a community-based cross-sectional study, *BMC Public Health 20*(1), 1-15. https://doi.org/10.1186/s12889-020-09642-0 .

Mwananyanda L, Thea DM, Chipeta J, Kwenda G, Mulindwa M, Mwenechanya M, Prosperi C, Higdon MM, Haddix M, Hammitt LL, Feikin DR, Murdoch DR, O'Brien L, Deloria Knoll M, Mwansa J, Wa Somwe S, and Seidenberg P (2021). The Etiology of Pneumonia in Zambian Children: Findings From the Pneumonia Etiology Research for Child Health (PERCH) Study, *Pediatr Infect Dis J*. *40*(9S): S40-S49. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8448410/.

Nasrin, S., Tariqujjaman, M., Sultana, M., Zaman, R., Ali, S., Chisti, M., Farouqe, S., Ahmad, T., Fuchs, G., Gry, N. and Alam, N. (2022). Factors associated with community acquired severe pneumonia among under five children in Dhaka, Bangladesh: A case control analysis, *Plos One*, *17*(3). https://doi.org/10.1371/journal.pone.0265871.

Naz, L., and Ghimire, U. (2020). Assessing the prevalence trend of childhood pneumonia associated with indoor air pollution in Pakistan, *Environmental Science and Pollution Research 27*, 44540–44551. https://doi.org/10.1007/s11356-020-10346-6.

Nhung, N., Amini, H., Schindler, Ch., Joss, M., Dien, T., Hensch, N., Perez, L., and Künzli, N. (2017). Short-term association between ambient air pollution and pneumonia in children: A systematic review and meta-analysis of time-series and case-crossover studies, *Environmental Pollution, 230*,1000-1008. https://doi.org/10.1016/j.envpol.2017.07.063.

Nikmah, A., Qadrijati, I., and Rahardjo, S. (2018). Indoor Smoke Exposure and Other Risk Factors of Pneumonia among Children Under Five in Karanganyar, Central Java, *Journal of Epidemiology and Public Health,* 3(1), 25-40. https://doi.org/10.26911/jepublichealth.2018.03.01.03.

Nimdet, K. and Techakehakij, W., (2016). Congestive heart failure in children with pneumonia and respiratory failure, *Pediatrics International, 59*(3) 258-264. https://doi.org/10.1111/ped.13153.

Ning, G., Wang, X., Wu, D., Yin, Z., Li, Y., Wang, H., and Yang, W. (2017). The etiology of community-acquired pneumonia among children under 5 years of age in mainland China, 2001–2015: A systematic review, *Human Vaccines \& Immunotherapeutics, 13*(11), 2742-2750. https://doi.org/10.1080/21645515.2017.1371381.

Njim, T., Atashili, J., Mbu, R., and Choukem, S. (2015). Low birth weight in a sub-urban area of Cameroon: an analysis of the clinical cut-off, incidence, predictors and complications, *BMC Pregnancy Childbirth 15*, article 288. https://doi.org/10.1186/s12884-015-0723-9.

OCHA (2022, Jun 30), Gaza Strip| The humanitarian impact of 15 years of the blockade-June 2022, OCHA. https://www.ochaopt.org/content/gaza-strip-humanitarian-impact-15-years-blockade-june-2022 .

OCHA. (2018). Food insecurity in the oPt: 1.3 million Palestinians in the Gaza strip are food insecure. OCHA. https://www.ochaopt.org/content/food-insecurity-opt-13-million-palestinians-gaza-strip-are-food-insecure#ftn1 .

OCHA. (2023 Feb 22). *Movement in and out of Gaza in 2022*, OCHA. https://www.ochaopt.org/content/movement-and-out-gaza-2022 accessed on (21st March 2023).

PCBS (2021 April 5). Palestinian children's situation on the Occasion of the Palestinian Child Day", PCBS. https://www.pcbs.gov.ps/site/512/default.aspx?lang=en&ItemID=3964. (accessed on 4th April, 2022).

PCBS (2021). *Indicator*. PCBS. http://www.pcbs.gov.ps/site/881/default.aspx. (accessed on 4th April, 2022).

PCBS. (2022), *Presents the Main Findings of Labour Force Survey in 2022*, PCBS. https://www.pcbs.gov.ps/post.aspx?lang=en&ItemID=4421 accessed on (21st March 2023).

PCBS. (2022). *Education Statistics: Literacy Rate of Persons (15 Years and Over) in Gaza Strip by Age Groups and Sex, 1995, 1997, 2000-2022*. PCBS. https://www.pcbs.gov.ps/Portals/_Rainbow/Documents/Education-1994-2022-11E3.html accessed on (21st March 2023).

PCBS. (2022). *Percentage Distribution of Persons (10 years and Over) by Completed Years of Schooling, Sex and Region, 1997, 2000-2006, 2014-2022*, PCBS. https://www.pcbs.gov.ps/Portals/_Rainbow/Documents/Education-1994-2022-14E.html accessed on (21st March 2023).

Pelton, S., Shea, K., Farkouh, R., Strutton, D., Braun, S., Jacob, C., Klok, R., Gruen, E., and Weycker D. (2015). Rates of pneumonia among children and adults with chronic medical conditions in Germany, *BMC Infectious Diseases, 15*(1). https://doi.org/10.1186/s12879-015-1162-y.

Pina, J., Moraes, S., Freitas, I., and Mello, D. (2017). Role of Primary Health Care in child hospitalization due to pneumonia: a case-control study, *Rev Lat Am Enfermagem, 25*(1), 1-10. https://pubmed.ncbi.nlm.nih.gov/28562701/.

Pryhuber, G. (2015). Postnatal Infections and Immunology Affecting Chronic Lung Disease of Prematurity, *Clinics in Perinatology, 42*(4), 697-718. https://doi.org/10.1016/j.clp.2015.08.002.

Qu, F., Weschler, L., Zhang, Y., and Spengler, J. (2023). Childhood pneumonia in Beijing: Associations and interactions among selected demographic and environmental factors, *Environmental Research, 231*(3) https://doi.org/10.1016/j.envres.2023.116211.

Rahayuningsih, S., Kuswiyanto, R., Suryaningrat, F., Nataprawira, H. and Sukadi, A. (2021). Left to right shunt congenital heart disease as a risk factor of recurrent pneumonia in under five-year-old children: a single centre experience in Bandung Indonesia, *Medicinski Glasnik, 18*(1), 33-37. doi: 10.17392/1196-21.

Rajabali, N., Lim, T., Sokolowski, C., Prevost, J., and Lee, E. (2015). Avian influenza A (H5N1) infection with respiratory failure and meningoencephalitis in a Canadian traveler, *Canadian journal of Infectious Diseases Medical Microbiology. 26*(4), 221-3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4556185/ .

Ramani, V., Pattankar, J., and Puttahonnappa, S. (2016). Acute Respiratory Infections among Under-Five Age Group Children at Urban Slums of Gulbarga City: A Longitudinal Study, *Journal of Clinical and Diagnostic Research, 10*(5), 8-13. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4948425/ .

Rodriguez, J., Modi, P., and Brady, M. (2022) Psittacosis Pneumonia. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing. https://www.ncbi.nlm.nih.gov/books/NBK526005/ .

Roux, D., Myer, L., Nicol, M. and Zar, H. (2015). Incidence and severity of childhood pneumonia in the first year of life in a South Africa birth cohort: The Drakenstein child health study, *The Lancet Global Health*, *3*(2) E95-E103. https://doi.org/10.1016/S2214-109X(14)70360-2.

Rueda, Z., Aguilar, Y., Maya, M., Lopez, L., Restripto, A., Garces, C., Morales, O., Pabon, C., Trujilo, M., Arango, C., Copete, A., Vera, C., Giraldo, M., Herrera, M., and Velez, L. (2022). Etiology and the challenge of diagnostic testing of community-acquired pneumonia in children and adolescents, *BMC Pediatrics 22*(1). https://doi.org/10.1186/s12887-022-03235-z.

Saad, K., Mohamed, S., and Metwalley, K. (2013). Recurrent/Persistent Pneumonia among Children in Upper Egypt, Mediterranean Journal of Hematology and Infectious Diseases, *5*(1). doi: 10.4084/MJHID.2013.028.

Seramo, R., Awol, S., Wabe, Y., and Ali, M. (2022). Determinants of pneumonia among children attending public health facilities in Worabe town, *Scientific Reports, 12*, article 6175. https://doi.org/10.1038/s41598-022-10194-z.

Shahid, S., Rahman, A., Shahunja, K., Afroze, F., Sarmin, M., Nuzhat, S., Alam, T., Chowdhury, F., Sultana, M., Ackhter, M., Parvin, I., Saha, H., Islam, S., Shahrin, L., Ahmed, T., and Chisti, M. (2023). Vaccination following the expanded programme on immunization schedule could help to reduce deaths in children under five hospitalized for pneumonia and severe pneumonia in a developing country, *Front Pediatrics,11*. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10083391/

Singh, N., Kamble, D., and Mahantshetti, N. (2019). Effect of Vitamin D Supplementation in the Prevention of Recurrent Pneumonia in Under-Five Children, *Indian Journal of Pediatrics 86*, 1105–1111. https://doi.org/10.1007/s12098-019-03025-z.

Solomon, Y., Kofole, Z., Fantaye, T., and Ejigu, S. (2022). Prevalence of pneumonia and its determinant factors among under-five children in Gamo Zone, southern Ethiopia, 2021, *Frontiers in Pediatrics, 10*(1). https://doi.org/10.3389/fped.2022.1017386.

Sutriana, V., Sitaresmi, M. and Wahab, A. (2021). Risk factors for childhood pneumonia: a case-control study in a high prevalence area in Indonesia, *Clin Exp Pediatr*, *64*(11), 588–595. https://doi.org/10.3345/cep.2020.00339.

Sultana, M., Alam, N., Ali,N., Faruque, A., Fuchs, G., Gyr, N., Chisti, J., Ahmed, T., and Gold, L. (2021). Household economic burden of childhood severe pneumonia in Bangladesh: a cost-of-illness study, *BMJ, 6*(106), 539-546 https://adc.bmj.com/content/106/6/539 .

Sutriana, V., Sitaresmi, M., and Wahab, A. (2021). Risk factors for childhood pneumonia: a case-control study in a high prevalence area in Indonesia. *Clin Exp Pediatr*, *64*(11),588-95. https://doi.org/10.3345/cep.2020.00339 .

Tegenu, K., Geleto, G., Tilahun, D., Ebissa Bayana, E., and Bereke, B. (2022). Severe pneumonia: Treatment outcome and its determinant factors among under-five patients, Jimma, Ethiopia, *SAGE Open Medicine, 10*,1-7 https://journals.sagepub.com/doi/pdf/10.1177/20503121221078445.

Thatrimontrichai, A., Rujeerapaiboon, N., Janjindamai, W., Dissaneevate, S., Maneenil, G., Kritsaneepaiboon, S., and Tanaanantarak, P. (2017). Outcomes and risk factors of ventilator-associated pneumonia in neonates, *World Journal Pediatrics 13*, 328–334. https://doi.org/10.1007/s12519-017-0010-0.

Thorn, K., Minamisava, R., Nouer, S., Ribeiro, H., and Andrade, L. (2011). Pneumonia and poverty: a prospective population-based study among children in Brazil. *BMC infectious diseases*, *11*(1). https://doi.org/10.1186/1471-2334-11-180.

UNCTAD. (2019 Sep. 10). *Palestinian socioeconomic crisis now at breaking point.* UNCTAD.https://unctad.org/news/palestinian-socioeconomic-crisis-now-breaking-point. (accessed on 4th April, 2022).

UNCTAD, (2020). The Economic Costs of the Israeli Occupation for the Palestinian People: The Impoverishment of Gaza under Blockade, United Nation. https://unctad.org/publication/economic-costs-israeli-occupation-palestinian-people-impoverishment-gaza-under-blockade.

Unicef. (2021). *Pneumonia in Children Statistics*, UNICEF Data. https://data.unicef.org/topic/child-health/pneumonia/. (accessed on 4th April, 2022).

Up to date (2023), *Pneumonia terminology*. Up to date. https://www.uptodate.com/contents/image?imageKey=ID%2F130821&topicKey=ID%2F117561&source=see_link (accessed on 15th Jan. 2023).

Ursin, R. and Klein, S. (2021). Sex Differences in Respiratory Viral Pathogenesis and Treatments. *Annual Review, 8*(1), 393-414. https://doi.org/10.1146/annurev-virology-091919-092720.

Wahl, B., Knoll, M., Shet, A., Gupta, M., Kumar, R., Liu, L., Chu, Y., Sauer, M., O'Brien, K., Santosham, M., Black, R., Campbell, H., Nair, H., and McAllister, D. (2020). National, regional, and state-level pneumonia and severe pneumonia morbidity in children in India: modelled estimates for 2000 and 2015. *The lancet child and adolescent health, 4*(9), 678-687. https://doi.org/10.1016/S2352-4642(20)30129-2 .

Wallen, B. (2014). Pneumonia Among Children Less Than 5 Years in Cameroon following introduction of a 13-valent Pneumococcal Conjugate Vaccine (master dissertation), University of Gothenburg, Cameroon. http://hdl.handle.net/2077/41864.

Waterston, T., and Nasser, D. (2017). Access to healthcare for children in Palestine. *BMJ pediatrics open, 1*(1). https://doi.org/10.1136/bmjpo-2017-000115 .

Wei, S., Ting, S., Kaile, Ch., Jian, X., Yin, W., Jia, Y., Genming, Z., Jianmei, T., and Tao, Z. (2019). Risk Factors for Severe Community-aquired Pneumonia Among Children Hospitalized with CAP Younger Than 5 Years of Age. *The Pediatric Infectious Disease Journal, 38*(3), 224-229. DOI: 10.1097/INF.0000000000002098.

WFP (2023). WFP Palestine Country Brief March 2023. https://docs.wfp.org/api/documents/WFP 0000148660/download/?_ga=2.90855322.1619710366.1684226412-922238730.1684226412 .

WHO (2015). *Breastfeeding*. World Health Organization. https://www.who.int/news-room/questions-and-answers/item/breastfeeding (accessed on 12th Oct. 2022) .

WHO (2018), Housing and Health Guidelines. World Health Organization. Table 3.1, Measures of crowding. https://www.ncbi.nlm.nih.gov/books/NBK535289/table/ch3.tab2/ (accessed on 12th Oct. 2022).

WHO (2019). *Nutrition Landscape Information System (NLiS) country profile indicators: interpretation guide 2nd edition*, World Health Organization, Available from: ISBN 978-92-4-151695-2 9789241516952-eng.pdf (who.int).

WHO (2020 Dec. 9), *The top ten cause of death*, World Health Organization, https://www.who.int/news-room/fact-sheets/detail/the-top-10-causes-of-death. (accessed on 8th April, 2022).

WHO (2021 Nov. 11), *Pneumonia*, Word health organization. Pneumonia (who.int). (accessed on 29th May, 2022).

WHO (2022a), *Child mortality (under 5 years)*, World Health Organization. https://www.who.int/news-room/fact-sheets/detail/levels-and-trends-in-child-under-5-mortality-in-2020. (accessed 4th April, 2022).

WHO (2022b), *Recommendations for care of the preterm or low birth weight infant*. World Health Organization. https://apps.who.int/iris/rest/bitstreams/1474473/retrieve.

WHO, (2013). Pocket book of hospital care for children: guidelines for the management of common illnesses with limited resources 2nd edition. World Health Organization. Pocket book of hospital care for children: Second edition (who.int) .

World data atlas. (2020). *Palestine under five mortality rate*, Knomia. https://knoema.com/atlas/Palestine/topics/Demographics/Mortality/Under-5-mortality-rate.

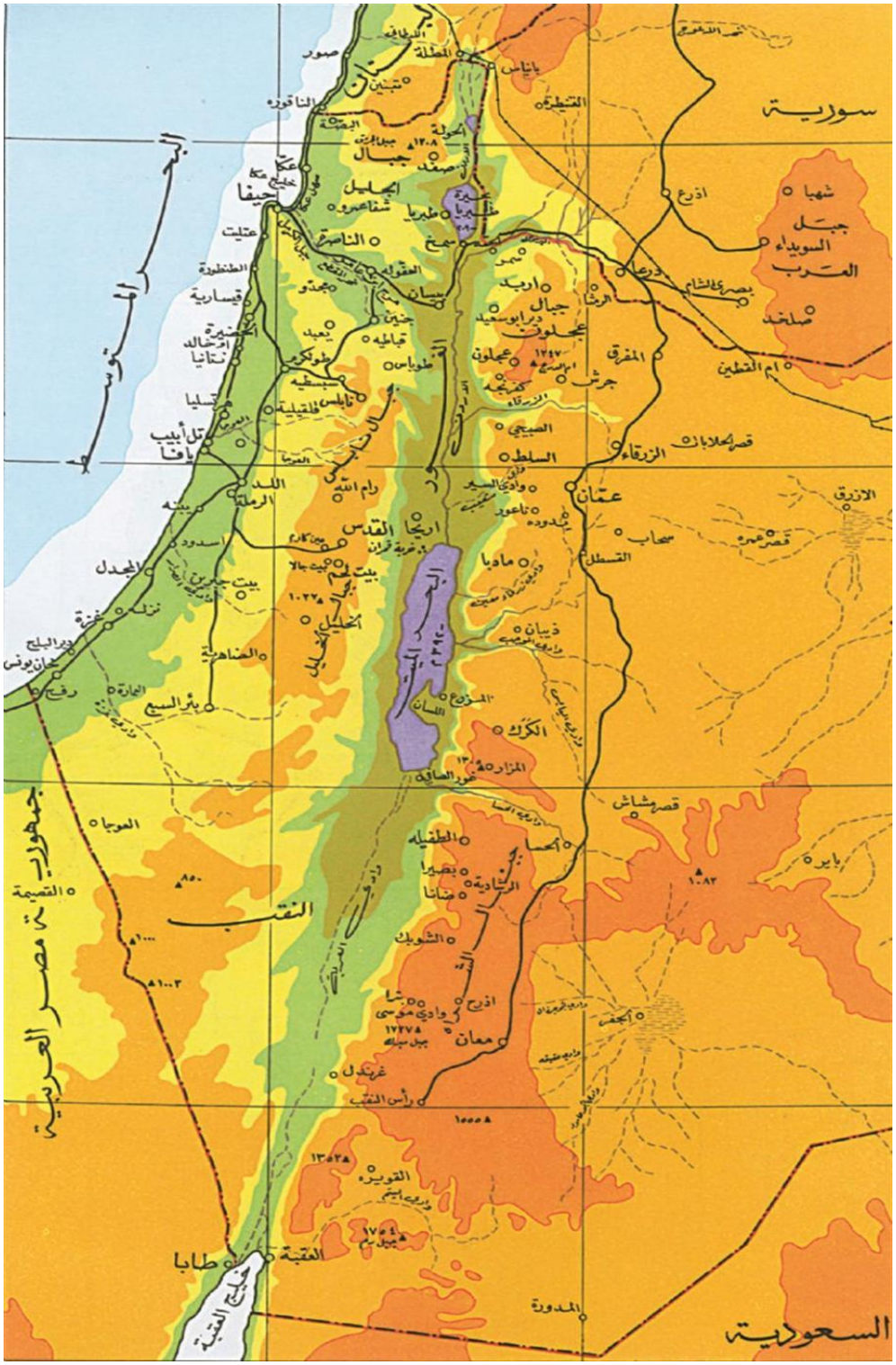
Yi-Chien, H., Pei-Lun, L., Yu-Chiao, W., Shiou-Chien, Ch., and Kow-Tong, Ch. (2015). The economic burden of childhood invasive pneumococcal diseases and pneumonia in Taiwan: Implications for a pneumococcal vaccination program, *Human Vaccines & Immunotherapeutics, 11*(5), 1081- 1071. https://doi.org/10.1080/21645515.2015.1023969.

Yun W, Wallihan R, Desai A, Alter S, Ambroggio L, Cohen DM, El-Assal O, Marzec S, Florin A, Keaton M, Shah SS, Ruddy RM, Sharpe S, Leber AL, Everhart K, Mejias A, and Ramilo O (2022). Children's Hospitals Initiative for Research in Pneumonia. Clinical Characteristics and Etiology of Community-acquired Pneumonia in US Children, 2015-2018. *Pediatr Infect Dis J*. *41*(5):381-387. https://doi.org/10.1097/INF.0000000000003475.

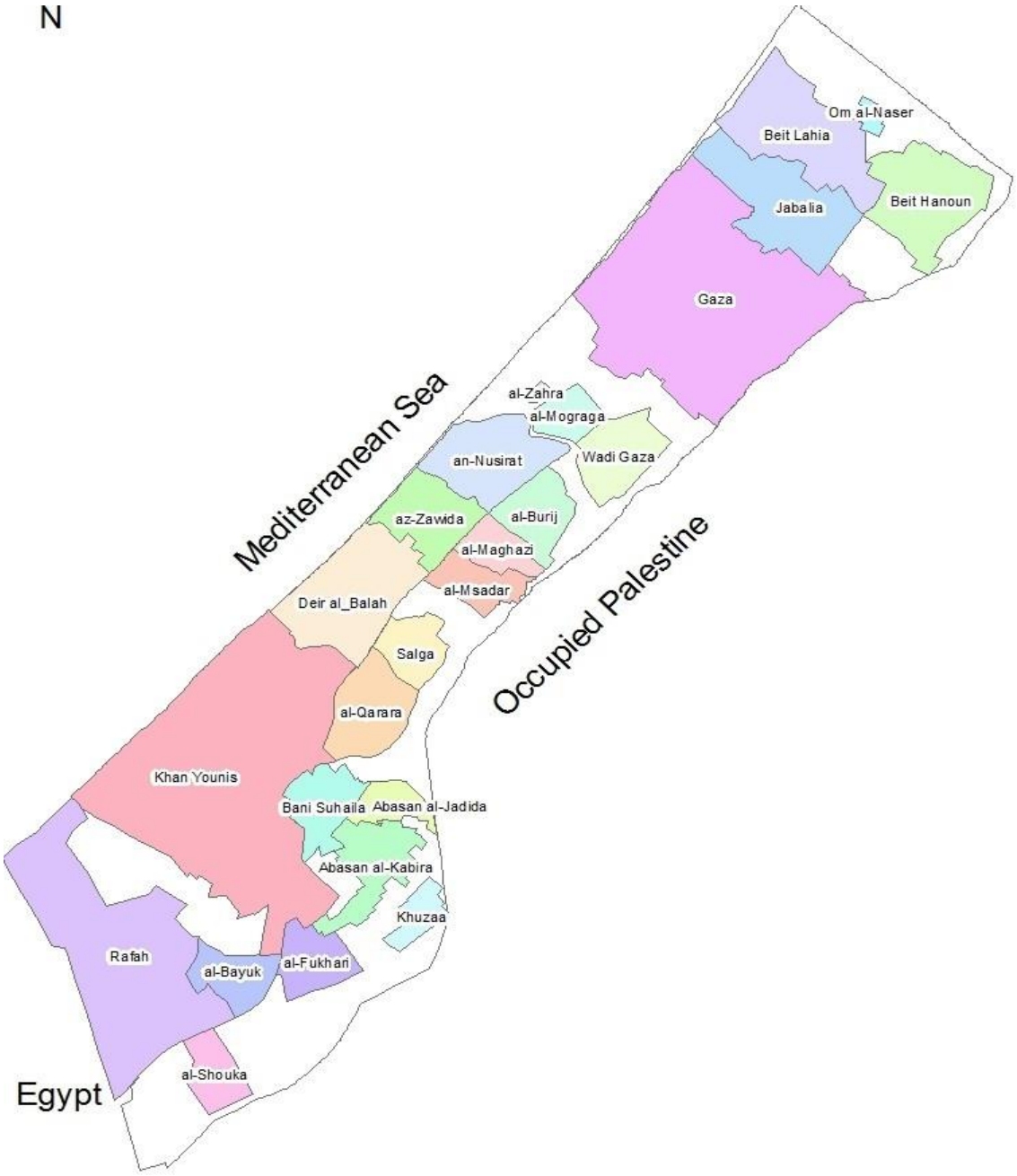
Zaidi, S., and Blakey, J. (2019). Why are people with asthma susceptible to pneumonia? A review of factors related to upper airway bacteria, *Respirology, 24*(5), 423- 430. https://doi.org/10.1111/resp.13528.

Annexes

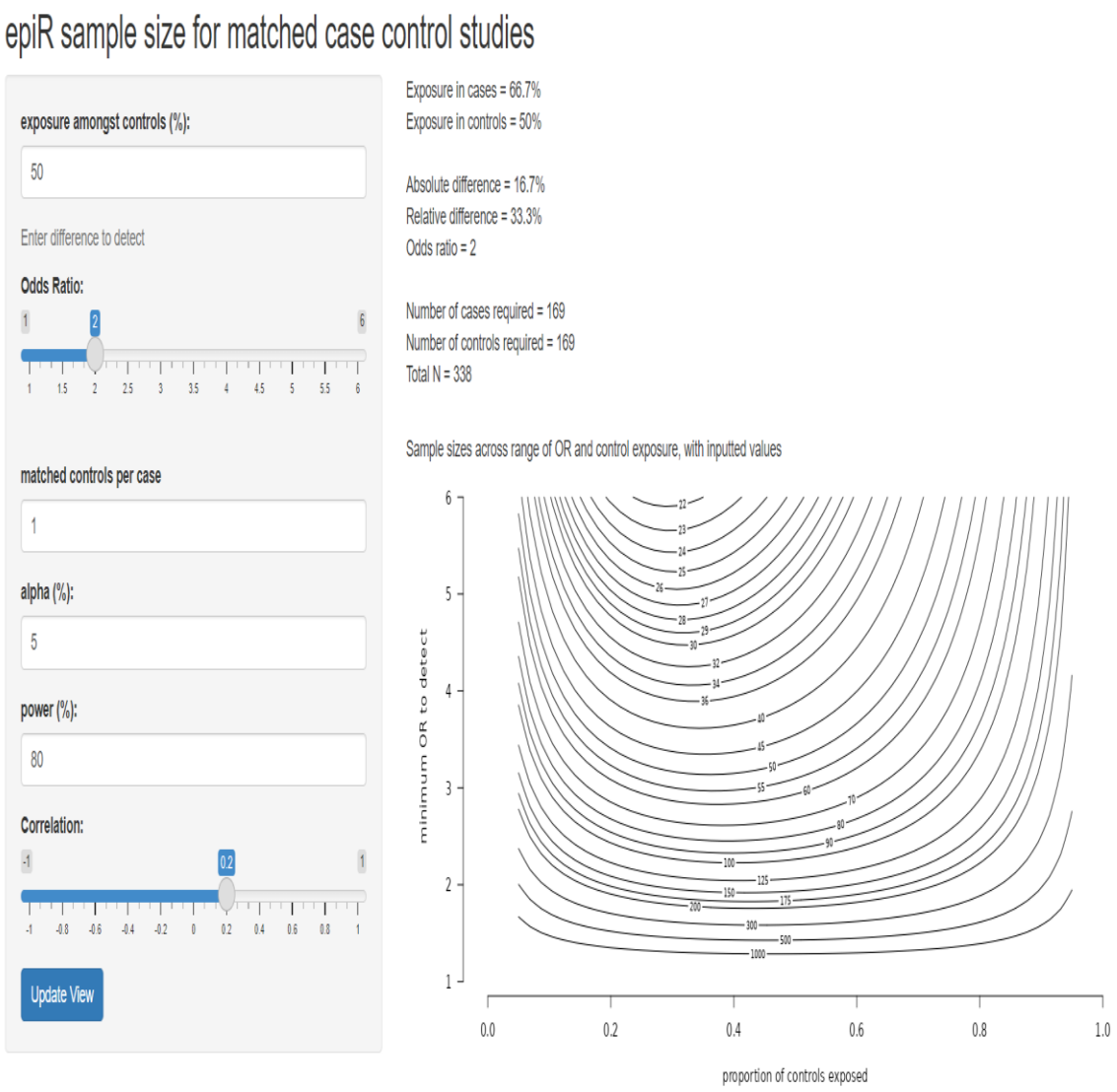
Annex 1: Palestine map



Annex 2: Gaza Strip map



Annex 3: Sample size calculation



Annex 4: Timetable

Activity	Duration	2022									2023					
		April	May	June	July	Aug.	Sep	Oct	Nov.	Dec.	Jan	Feb	Mar	April	May	June
Proposal writing	2months															
Proposal defense and approval	2 weeks															
Preparing tools and evaluation	6 weeks															
Pilot Study	2 months															
Modification	3 weeks															
Data collection	4 months															
Data entry	1 month															
Data analysis	1 month															
Research writing	3months															

Annex 5: Questionnaire

Questionnaire

Dear participant:

Firstly, I would introduce myself, my name is Amro Mohammad Rabah a master's student in the public health faculty at Al-Quds University/ Department of Epidemiology, I am conducting this research as a major health requirement of obtaining the Master's degree.

Secondly, the main objectives of this study are to assess the main risk factors associated with pneumonia among under-five children in the Gaza Strip, for developing effective prevention strategies and a better understanding of the underlying risk factors.

I highly appreciate your participation in this study, which can take about 15 minutes. Note that participation is optional and you have the right to withdraw whenever necessary while ensuring the confidentiality of the information provided and that this research will be used for scientific research only.

Finally, please answer all the research questions in the questionnaire as it deems appropriate in practice and reality, where there is no wrong answer and others correct.

Thank you very much

Researcher/ Amro Rabah

E-mail/ amro.rabah@students.alquds.edu

Mobile/ 0597559498

Signature of participant to participate _____

Basic data	
Questionnaire Number:	Interviewer name:
Hospital:	Subject: □ Case □ Control
Date of interview: ……. /……. /…….	Address:
Child name:	Child Date of Birth:
Interviewee: □ Mother □Father □Relative: Specify:	

1. Child-related data					
1.1	Child age (months):	1.2	Gender: M / F	1.3	Weight (Kg):
1.4	Height(CM):	1.5	Birth weight(Kg):	1.6	Hemoglobin:
1.7	What was the type of delivery?			□Normal Cesarean section	
1.8	Was the child born Prematurely (< 37 weeks of gestation)?			□ Yes No	
1.9	Did the child expose to delivery complications?			□ Yes No	
1.10	Was the child admitted to NICU in the neonatal period?			□ Yes No	
1.11	Did the child connect to the mechanical ventilator?			□ Yes No	
1.12	Did the child have pneumonia in the first month of his life?			□ Yes No	
1.13	Does the child take exclusive breastfeeding (only breast milk for up to 6 months)?			□ Yes No	
1.14	Does the child take bottle feeding only?			□ Yes No	
1.15	Does the child take mixed feeding (breast milk and formula milk)?			□ Yes No	
1.16	Does the child take a supplement?			□ Yes No (if yes, Explain what type?) …….	
1.17	Does the child take the vaccination as scheduled?			□ Yes No	
1.18	When was the child weaned?				
1.19	What is the birth order of this child?				
1.20	Number of siblings				
1.21	Number of under 5 child siblings				

1.22	Does the child have any chronic disease?	□ Yes No (if yes, what is the disease? …….
1.23	Does the child have a recurrent Lower RTI?	□ Yes No
	If the mother answers the question above (yes) answer the following related questions?	
1.24	Did the child admit to the hospital due to a Lower RTI?	□ Yes No
1.25	How many times has the child been admitted to the hospital?	
1.26	Does the child have a neurological disease? (CP, convulsion or any neurological disorders)	□ Yes No (if yes, Explain what disease?) …….
1.27	History of bronchial asthma or wheezy chest?	□ Yes No
1.28	Did the child have an upper respiratory tract infection in the last 2 weeks?	□ Yes No

2. Parental Socio-demographic data			
2.1	Mother age:	2.2	Father age:
2.3	What's the educational level of the mother?	□ Illiterate Primary Preparatory □ Secondary University	
2.4	What's the educational level of the father?	□ Illiterate Primary Preparatory Secondary University	
2.5	What's the occupational status of the mother?	□ Employee Unemployed Worker	
2.6	What's the occupational status of the father?	□ Employee Unemployed Worker	
2.7	How many family members?		
2.8	Place of residence?	□ Middle Gaza North □ KhanYounis Rafah	
2.9	What's the type of family?	□ Nuclear family Extended family	
2.10	The family income per month by NIS	□less than 1450 NIS □1450 NIS (minimal wage in Gaza) □ more than 1450 NIS	
3. Environmental characteristic			
3.1	Is either of the parent's smoker?	□ Yes No (if yes, who is?.....	
3.2	Does he/she smoke at home?	□ Yes No	

3.3	What type of fuel is used for cooking?	□ Cooking gas Wood Charcoal □ Kerosene electricity
3.4	Is there an electrical generator near your residency?	□ Yes No
3.5	Is there a factory/ petrol station near your residence?	□ Yes No (if yes, what type of factory?) ……
3.6	How many rooms are there in your house except the bathroom and kitchen?	
3.7	How many people are there in your household except the newborn (less than 28 days)?	
3.8	What type of housing?	□ Apartment Single family house □ Multifamily house Hut Container
3.9	What is the house roof made of?	□ concreate asbestos iron sheet
3.10	Availability of basic sanitation	□Sewage system Septic tank
3.11	Are there cattle near the house?	□ Yes No
3.12	Are there birds kept inside the house?	□ Yes No
3.13	Are there pets kept inside the house?	□ Yes No
3.14	Are there molding spots/ damp stains in the house?	□ Yes No
3.15	Is the child's bed washed and cleaned regularly?	□ Yes No
3.16	Is the child's bed (below and covers) expos to sunlight?	□ Yes No
3.17	Is the house ventilated well?	□ Yes No

Annex 6: Helsinki Committee Approval

المجلس الفلسطيني للبحث الصحي

Palestinian Health Research Council

تعزيز النظام الصحي الفلسطيني من خلال مأسسة استخدام المعلومات البحثية في صنع القرار

Developing the Palestinian health system through institutionalizing the use of information in decision making

Helsinki Committee

For Ethical Approval

Date: 06/06/2022 **Number:** PHRC/HC/1143/22

Name: Amro M.A. Rabah الاسم:

We would like to inform you that the committee had discussed the proposal of your study about:

نفيدكم علماً بأن اللجنة قد ناقشت مقترح دراستكم حول:

Risk factors of pneumonia among under-five children in Gaza Strip, Palestine: a case- control study

The committee has decided to approve the above mentioned research. Approval number PHRC/HC/1143/22 in its meeting on 06/06/2022

و قد قررت الموافقة على البحث المذكور عاليه بالرقم والتاريخ المذكوران عاليه

Signature

Member **Member**

Chairman

Genral Conditions:-

1. Valid for 2 years from the date of approval.
2. It is necessary to notify the committee of any change in the approved study protocol.
3. The committee appreciates receiving a copy of your final research when completed.

Specific Conditions:-

E-Mail:pal.phrc@gmail.com

Gaza - Palestine غزة - فلسطين

شارع النصر - مفترق العيون

Annex 7: Official request letters

Al-Quds University
Jerusalem
School of Public Health

جامعة القدس
القدس
كلية الصحة العامة

التاريخ: 2022/11/16

حضرة الدكتور/ هاني الوحيدي المحترم
مدير عام وحدة المعلومات الصحية– وزارة الصحة

تحية طيبة وبعد،،،

الموضوع: مساعدة الطالب عمرو محمد رباح

نشكر لكم دعمكم الدائم لمسيرة العلم والتعليم وخصوصاً دعم كلية الصحة العامة وطلابها، ونود أعلامكم بأن الطالب المذكور أعلاه تقوم بعمل بحث كمتطلب للحصول على درجة الماجستير في الصحة العامة–مسار علم الأوبئة بعنوان:

"Risk factors of pneumonia among under-five children in Gaza Strip, Palestine: a case- control study"

وعليه نرجو من سيادتكم التكرم بالموافقة على تسهيل مهمة الطالب في إنجاز هذا البحث حيث أن عينة الدراسة هم الاطفال تحت سن 5 سنوات (1 شهر - 59 شهر)، المترددي على مستشفى شهداء الاقصى، مستشفى النصر للأطفال، مجمع ناصر الطبي.
علماً بأنه سيتم جمع البيانات من خلال استبانة تعبأ من قبل الأم أو الشخص المرافق للطفل المريض.

و اقبلوا فائق التحية و الاحترام،،،

د. بسام أبو حمد
منسق عام برامج الصحة العامة
فرع غزة

State of Palestine
Ministry of health

دولة فلسطين
وزارة الصحة

السيد : هاني سلطان الوحيدي المحترم

التاريخ:21/11/2022

رقم المراسلة 1117082

مدير عام بالوزارة /الإدارة العامة للوحدات الإدارية المساعدة /وزارة الصحة

السلام عليكم ,,,

الموضوع/ تسهيل مهمة الباحث عمرو محمد أحمد رباح

التفاصيل //
السلام عليكم
نهديكم أطيب التحيات ونود منكم تسهيل مهمة الباحث/ة عمرو محمد أحمد رباح الملتحق/ة ببرنامج ماجستير الصحة العامة – جامعة القدس أبو ديس في اجراء بحث بعنوان:
عوامل الخطر لمرض الالتهاب الرئوي عند الاطفال ما دون سن خمس سنوات في قطاع غزة، فلسطين، دراسة حالة- ضابطة.
حيث الباحث/ة بحاجة لتعبئة استبانة من أولياء امور عدد من المرضى المراجعين في مرافق وزارة الصحة (مجمع ناصر الطبي - مستشفى النصر للأطفال– مستشفى شهداء الأقصى) والاطلاع على ملفاتهم الطبية، دون اجراء أي تدخل طبي او سحب عينات دم ، نأمل توجيهاتكم لذوى الاختصاص بضرورة الحصول على الموافقة المستنيرة من المشاركين ، بما لا يتعارض مع مصلحة العمل وضمن أخلاقيات البحث العلمي، ودون تحمل الوزارة أي أعباء أو مسئولية

وتفضلوا بقبول التحية والتقدير

ملاحظات /
تسهيل المهمة الخاص بالدراسة أعلاه صالح لمدة 3 أشهر من تاريخه.
يرجى التأكد من توافق الاستبانة المرفقة والتي يتم تعبئتها ميدانيا على ان لا يتم أي إضافة او تعديل على الاستبانة المرفقة

علي حسن البلبيسى
حكيم جامعي

المرفقات

- أدوات البحث عمرو محمد أحمد رباح.pdf

Gaza Tel. (+970) 8-2846949
Fax. (+970) 8-2826295

غزة تلفون. (+970) 8-2846949
فاكس. (+970) 8-2826295

عنوان الدراسة: عوامل الخطورة للالتهابات الرئوية عند الأطفال دون سن الخمس سنوات في قطاع غزة: دراسة حالة – ضابطة

إعداد: عمرو محمد أحمد رباح

إشراف: د. حاتم الدباكة

الملخص

الخلفية :لا تزال الالتهاب الرئوي من بين الأسباب الرئيسية للوفاة بين الأطفال في جميع أنحاء العالم، وخاصة في البلدان ذات الدخل المنخفض والمتوسط. الأطفال دون سن الخامسة هم الفئة العمرية الأكثر تأثراً بالالتهاب الرئوي. هناك العديد من عوامل الخطر للالتهاب الرئوي بين الأطفال دون سن الخامسة، وقد يساعد تحديد هذه العوامل في تقليل حدوث وانتشار الالتهاب الرئوي.

الهدف :تقييم العوامل الرئيسية المرتبطة بالالتهاب الرئوي بين الأطفال دون سن الخامسة في قطاع غزة، وذلك من أجل تطوير استراتيجيات وقاية فعالة وفهم أفضل لعوامل الخطر الأساسية.

المنهجية :دراسة حالة- ضبط يتم تطبيقها في إطار المستشفى، تتضمن عينة الدراسة الأطفال الذين تتراوح أعمارهم بين 1-59 شهراً في قطاع غزة الذين يترددون على المستشفيات الحكومية (مستشفى النصر للأطفال، مستشفى مبارك للأطفال بمجمع ناصر الطبي، ومستشفى شهداء الأقصى) خلال فترة جمع البيانات، مع حجم عينة قدره 338 طفلاً (169 حالة و169 ضابط). تم استخدام طريقة عينة مريحة غير عشوائية، وتم جمع البيانات باستخدام استبيان موجه يتم تعبئته من خلال اجراء مقابلة وجاهية وتقديم الأسئلة لمرافق الطفل المريض. تم تحليل البيانات باستخدام برنامج SPSS النسخة 25، واستخدمت اختبارات t-test وPearson's chi-squared، وتحليل الانحدار اللوجستي لتحديد العوامل التي أثرت على حالات الالتهاب الرئوي مقارنة بالضوابط بين الأطفال في الدراسة. اعتبر الـ p-value دالاً عند $P \leq 0.05$ وغير دال عند.$P > 0.05$

النتائج :كان متوسط أعمار الأطفال 18.82±17.53 شهرًا (حالات) و18.72±17.09 شهرًا (مجموعة التحكم) بمدى يتراوح من 1 إلى 59 شهرًا. تم العثور على عدة عوامل مرتبطة بالتهاب الرئة: حالة وظيفة الأم (أم موظفة) (OR = 10.77)، ترتيب الولادة للطفل (الثاني - الثالث(OR = 2.12) الرابع فأكثر (OR=2.32) ولادة قيصرية للطفل (OR = 1.9) الولادة المبكرة للطفل (OR = 2.18) ، دخول الطفل لوحدة العناية المركزة لحديثي الولادة (OR = 2.54) استخدام جهاز التنفس الصناعي للطفل (OR = 2.18) الإصابة المتكررة بالتهاب الجهاز التنفسي السفلي (OR = 1.9) تاريخ للمبيت في المستشفى بسبب التهاب الجهاز التنفسي السفلي (OR = 4.94)الربو (OR = 2.04)الأمراض العصبية(OR = 2.88) الهزال (طفيف (OR=4.28) ، متوسط (OR= 3.2) ، شديد (OR= 7.42)) ، التقزم (طفيف (OR= 2.76) ، متوسط (OR= 3.54) ، شديد (OR= 16.5)) نقص الوزن (النحافة) (OR= 2.87) التعرض لتلوث الهواء الخارجي (OR= 4.61)

الخلاصة :يمكن أن يساعد تحديد عوامل خطر الالتهاب الرئوي في تقليل فرصة حدوث المرض. درست هذه الدراسة العوامل الرئيسية لخطر الالتهاب الرئوي بين الأطفال دون سن الخامسة في قطاع غزة، والتي تشمل (عوامل اجتماعية ديموغرافية للأهل، وعوامل متعلقة بالأم والطفل، والعوامل البيئية). أظهرت النتائج أن عدة عوامل لها علاقة كبيرة بحدوث الالتهاب الرئوي بين الأطفال دون سن الخامسة، وكانت معظم هذه العوامل قابلة للتعديل. يمكن أن يؤدي تصحيح هذه العوامل إلى تقليل عبء الالتهاب الرئوي.