Arab American University

Faculty of Graduate Studies

Department of Health Sciences

Master Program in Neonatal Nursing

Risk Factors for Broncho Pulmonary Dysplasia among Premature Infants Less than 32 Weeks at Palestinian Private Hospitals in the North-West Bank, A Retrospective Study

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Declaration

I declare that, except where explicit reference is made to the contribution of others, this thesis is substantially my own work and has not been submitted for any other degree at the Arab American University or any other institution.

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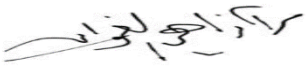
Signature: 

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Abstract

Bronchopulmonary dysplasia (BPD) is the most prevalent lung condition among premature infants and poses major global healthcare challenges. This disorder, which is characterized by abnormal lung development, affects respiratory function, neurodevelopment, and general growth in the long run, in addition to causing acute respiratory problems.

The main purpose of the current study is to identify the risk factors for Bronchopulmonary Dysplasia among premature infants less than 32 weeks at Palestinian private hospitals in the North West Bank.

A quantitative, retrospective design was conducted at tertiary care private hospitals in the North West Bank, which includes a Neonatal Intensive Care Unit. The population was all premature infants less than 32 weeks. The total population sample method was used to select the data. The sample size was 119. The data collection tool was self-developed, and the survey contains five sections.

With a mean birth weight of 1257.45 grams, the majority (88.2%) were delivered between 28 and 32 weeks of gestation and were male (65.5%). Preeclampsia and Patent Ductus Arteriosus (PDA) were significantly correlated ($p=0.045$), and maternal variables such as preeclampsia (44.5%) and eclampsia (47.9%) were common. PDA (58.5%), retinopathy of prematurity (ROP) (31%), and sepsis (60.5%) were among the frequent problems in neonates. All infants got mechanical ventilation but none were given surfactant therapy. Furthermore, 75.6% of newborns needed to be intubated right away, demonstrating the seriousness of respiratory distress. To improve outcomes for preterm children, the data highlight the necessity of improved prenatal care, early neonatal therapies, and focused management techniques.

This study identifies low birth weight, gestational age, prolonged mechanical ventilation, and oxygen exposure as major risk factors for BPD in preterm newborns. In addition to highlighting the significance of respiratory control, it names other factors such as sepsis and intrauterine growth restriction. Results back up preventative and early detection strategies in NICUs.

Key Words: Bronchopulmonary Dysplasia, premature infants, risk factors, Neonatal Intensive Care Unit.

Table of Contents

List of Tables

List of Figures

List of Appendices

List of Definitions of Abbreviations

Abbreviations	Title
AAUP	Arab American University-Palestine
AKI	Acute Kidney Injury
AUC	Area Under the Curve
ANOVA	Analysis of Variance
BPD	Bronchopulmonary Dysplasia
CA	Corrected Age
CPR	Cardiopulmonary Resuscitation
CRIB	Critical Risk Index for Babies
ELGANs	Extremely Low Gestational Age Neonates
ETT	Endotracheal Tube
EMR	early membrane rupture
FGR	Fetal Growth Restriction
FiO2	fraction of inspired oxygen
GW	Gestational Week
IRB	Institutional Review Board
IUGR	Intrauterine Growth Restriction
MBD	Metabolic Bone Disease
SOD	Superoxide Dismutase
SPSS	Statistical Package for the Social Sciences
MDA	Malondialdehyde
MV	Mechanical Ventilation
NEC	Necrotizing Enterocolitis
NHLBI	National Heart, Lung, and Blood Institute
NICHD	National Institute of Child Health and Human Development
NICU	Neonatal Critical Care unit
NIV	Non-invasive Ventilation
NRDS	Neonatal Respiratory Distress Syndrome
PDA	Patent Ductus Arteriosus
PH	Pulmonary Hypertension
PMA	Post-menstrual Age
PROM	Premature Rupture Of Membranes
RDS	Respiratory Distress Syndrome
ROP	Retinopathy Of Prematurity
SGA	Small for Gestational Age
VAP	Ventilator-associated Pneumonia
VLBW	Very Low Birth Weight
VLBWIs	Very Low Birth Weight Infants
USA	United states of America

Chapter One: Introduction

1.1 Background

Many very premature infants suffer from a persistent lung disease called Bronchopulmonary Dysplasia (BPD). Although Northway initially defined BPD in 1967, the illness's meaning and comprehension have changed over time (Huang et al., 2023). Regarding severity and the requirement for supplementary oxygen for at least 28 days, the current definition of BPD is more specific. Based on their oxygen needs at 36 weeks corrected gestational age, infants born at less than 32 weeks gestation are divided into three categories: mild (no need for oxygen), moderate (requiring 21% to 30% oxygen), or severe (requiring more than 30% oxygen or positive pressure support) (Yang et al., 2022).

Premature infant's survival rates have increased dramatically due to advances in perinatal and neonatal care, including exogenous surfactant therapy and prenatal corticosteroids. Despite a decrease in problems such as Neonatal Respiratory Distress Syndrome (NRDS), Necrotizing Enterocolitis (NEC), and Intraventricular Hemorrhage, BPD remains a common and increasing issue in premature infants. This is may be related to the greater survival probability of infants born very early (Cokyaman & Kavuncuoglu, 2020).

The prevalence of BPD, which varies from 11% to 50% and varies significantly by region, influenced by various diagnostic and therapeutic approaches (Ramos-Navarro et al., 2022). The risk of BPD increases with declining gestational age and birth weight, and it affects about 30% of infants born extremely low. The frequency of BPD in premature infants born before 32 weeks ranges from 12.9% to 41%, with rates as high as 80% in very premature infants, following a research by Ramos-Navarro et al. (2022).

Premature infants with BPD are more likely to die and to have respiratory, cardiovascular, and neurodevelopmental problems, which can lower their quality of life and increase their need for medical care (Alonso et al., 2021).

It is particularly challenging to manage severe BPD, which raises the possibility of death, extended hospital stays, and ongoing respiratory support requirements. 50% of neonate's premature infants with severe BPD who survive have to be readmitted after a

year, and about 25% of them pass away. These newborns are two to three times more likely to have neurodevelopmental issues than their term peers (Alonso et al., 2021).

Recent clinical prediction models have linked a number of risk factors to BPD, such lower gestational age, birth weight, gender, intrauterine growth restriction, chorioamnionitis, maternal smoking, and race (Sharma et al., 2020). Postnatal factors include pulmonary inflammation, patent ductus arteriosus (PDA), NRDS, and the need for invasive ventilation significantly raise the risk of BPD (Alonso et al., 2021).

The particular manners in which these factors influence the severity of BPD, however, are not well understood. By enabling early detection and treatment, being aware of these factors of risk can assist in preventing moderate or severe BPD (Geetha et al., 2021).

1.2 Introduction

According to Huang et al. (2023), BPD is the most common lung disorder in premature newborns and presents significant global healthcare challenges. In addition to producing immediate respiratory issues, this condition, which is defined by faulty lung development, has long-term effects on respiratory function, neurodevelopment, and overall growth.

About 50% of premature infants born before 28 weeks of gestation and 30% of those born before 32 weeks develop BPD, a chronic lung disease (Alonso et al., 2021). Newborns with BPD are more likely to die, and those who live are more likely to have worse quality of life, respiratory and cardiovascular issues, and neurodevelopmental issues, all of which raise the demand for medical resources. BPD is a complicated and poorly understood etiology (Alonso et al., 2021).

Even while improvements in neonatology have improved the survival rates for premature infants and early surfactant administration and less invasive breathing techniques have helped lower the oxygen requirements at BPD evaluation, the incidence of BPD is either steady or increasing. Although the incidence of BPD reduced for infants delivered after 28 weeks, this is particularly true for babies born well before their due date (Cokyaman & Kavuncuoglu, 2020).

The most common risk factors, which are present during the prenatal and postnatal phases, are preterm and low birth weight. Premature infants under 1500 grams are particularly susceptible and often require prolonged mechanical breathing and oxygen therapy (Valenzuela-Stutman et al., 2019). Additionally, these infants are more likely to suffer from respiratory distress syndrome, which raises their demand for oxygen and ventilatory assistance than full-term babies. Other significant risk factors include male gender, restriction of intrauterine growth, chorioamnionitis, pregnant smoking, infections, and racial or ethnic disparities in the parents (Sharma et al., 2020).

The classic variety of BPD, often referred to as old BPD, has significant alveolar septal fibrosis, soft tissue hyperplasia, and extensive airway injury on a histological level as a result of high oxygen levels and forceful breathing. The modern version of alveolar simplification (new BPD) reduces the amount of surface area accessible to gas exchange by producing fewer and larger alveoli. While less severe than old BPD, new BPD nevertheless exhibits some septal fibrosis and increased airway smooth muscle hyperplasia. Deficits in surfactant synthesis and abnormal vascular development exacerbate the problem (Geetha et al., 2021).

The criteria for diagnosing BPD have evolved since the first reports of progressive emphysema brought on by oxygen toxicity and ventilator damage in 1967. By 1988, the standards were expanded to include the need for extra oxygen at 36 weeks post-menstrual age (PMA). A revised severity classification and an oxygen requirement beginning 28 days postpartum in 2001 were further advancements. A 28-day oxygen supplement was no longer necessary after the National Heart, Lung, and Blood Institute (NHLBI) workshop revised the criteria in 2018 (Kardum et al., 2019). To categorize BPD at 36 weeks postpartum, the National Institute of Child Health and Human Development (NICHD) changed its emphasis from oxygen supplementation to positive pressure usage (Kardum et al., 2019).

The prevalence of BPD varies by country of birth; in the US, it is 30%, in Canada, it is 12%, and in Japan, it is 14% (Alonso et al., 2021). BPD is a significant medical condition that increases the risk of morbidity and mortality in very low birth weight infants (VLBWIs). This chronic respiratory disease impacts the development of the respiratory,

cardiovascular, and neurological systems from early childhood into adulthood. It was caused by lung injury in preterm children (Ramos-Navarro et al., 2022).

One of the most dangerous consequences in this group is BPD, a chronic lung condition that is frequently observed in extremely preterm newborns (born at 22–27 weeks gestation). Neonatal critical care units (NICUs) often have to admit infants with BPD for prolonged periods, and upon discharge, they can need home oxygen therapy. Additionally, they have a higher risk of viral infections and reactive airway disease, which can lead to frequent re-hospitalizations. BPD causes persistent morbidity, such as neurodevelopmental abnormalities, in addition to long-term respiratory problems (Nakashima et al., 2021).

Pediatricians have paid close attention to the changing definition and categorization of BPD. The original definition, first proposed by Northway et al. (2003) over 50 years ago, was revised by the NICHD in 2000 to include infants at and beyond 32 weeks postmenstrual age (PMA) and to incorporate a severity classification system (mild, moderate, severe) (Kim et al., 2020).

Several variables contribute to the development of BPD, but two main ones are oxygen toxicity and ventilator-induced lung injury. To reduce these hazards, a variety of treatments have been employed worldwide in the treatment of extremely preterm infants, including as lung-protective techniques, prenatal steroids, surfactant therapy, and less intrusive breathing (Jensen et al., 2021). BPD, a chronic lung disease in preterm infants, necessitates long-term oxygen therapy at concentrations of ≥21% utilizing a range of techniques. Prior to the 2000s, the need for oxygen until the 28th day after delivery was a sign of BPD. Since then, the diagnosis has been separated into three groups: mild, moderate, and severe, depending on the Gestational week (GW). Both low birth weight (BW) and GW have an inverse linear connection with BPD, making them common risk factors. BPD are linked to perinatal risk factors, including male gender, prenatal corticosteroids, early membrane rupture (EMR), chorioamnionitis, short for GA, postnatal surfactant, respiratory distress syndrome (RDS), early and late-onset sepsis, PDA, and apnea (Cokyaman & Kavuncuoglu, 2020).

The survival rates of extremely low gestational age neonates (ELGANs) have increased thanks to developments in contemporary perinatal and neonatal intensive care. But although the survival rate of ELGANs has increased, the incidence of BPD has stayed

the same or even gone up. Every year, 10,000–15,000 new cases of BPD are recorded in the US, and over the past few decades, the incidence of the disorder in surviving ELGANs has been 40–45%. Substantial newborn morbidity, BPD is linked to both immediate and long-term outcomes, including increased mortality, extended hospital stays, pulmonary hypertension, asthma, chronic obstructive pulmonary disease, and neurodevelopmental deficits. Multidisciplinary care is necessary to manage BPD, which raises healthcare expenditures and uses resources more heavily for families and healthcare systems (Geetha et al., 2021).

The idea of "New BPD," as defined by Jobe and Bancalari (2021) may be the etiology of the consistently high BPD rates in ELGANs. According to their proposal, "New BPD" is a syndrome marked by inflammatory processes that impact immature lungs and vary in terms of damage, healing, and halt of lung development after extremely preterm birth. "New BPD" has been associated with a number of diseases, including as inflammation and infection, pulmonary air leaks, PDA, and lung damage from using oxygen and a ventilator. Because these two outcomes may compete in ELGANs, authors usually use composite outcomes of mortality or BPD in their research (Geetha et al., 2021).

Bronchopulmonary dysplasia (BPD), the most common outcome of preterm birth, can lead to significant long-term health issues and expensive medical bills. It is typified by underdeveloped alveoli, airways, and pulmonary vasculature, which are commonly accompanied by structural anomalies in these areas. The primary risk factor for BPD is prematurity, and the condition's occurrence increases as gestational age decreases. In the early stages of BPD, several variables can interfere with normal lung growth, such as oxidative stress, infections, inflammation, pulmonary over-distension, lung injury from invasive mechanical ventilation, and nutritional deficits (Ramos-Navarro et al., 2022).

Premature infants continue to have a high risk of death and severe respiratory issues, such as BPD, despite important advancements in perinatal care over the past few decades. Babies born very preterm are susceptible to BPD, a persistent lung condition. It is brought on by anomalies in the vascular and alveolar development of the lungs, which lowers the ability to exchange gases (Rutkowska et al., 2019). This condition often requires continuous oxygen therapy and respiratory medications. As a result, infants with BPD are more likely to experience early hospital readmissions. In addition, severe cases may

necessitate ventilator support, tracheostomy, and home oxygen therapy, all of which increase the risk of death (Rocha et al., 2019).

Research has examined the impact of prenatal factors on the development of BPD. Fetal growth restriction (FGR), short for GA, maternal smoking, and hypertensive disorders have all been linked to an increased risk of BPD. Although intrauterine infection or inflammation has not been identified as a distinct risk factor, it appears to increase the chance to develop BPD (Yang et al., 2022; Cokyaman & Kavuncuoglu, 2020; Kim et al., 2020).

Prenatal risk factors such chorioamnionitis, maternal hypertension, and intrauterine growth restriction (IUGR) commonly discussed in the literature. Perinatal risk factors include things like lower GA, low birth weight (LBW), male gender, low Apgar score, and the need for resuscitation. Postnatal risk factors include RDS, sepsis, air leaks, inadequate feeding, PDA, oxygen therapy, and the kind and level of respiratory support. According to histology, new BPD causes a decrease in blood vessels and alveoli due to a change in the lung parenchyma's structure (Valenzuela-Stutman et al., 2019).

Only a few treatments, such as vitamin A and postnatal steroids, are successful in lowering BPD at this time; however, systemic steroids have undesirable long-term side effects. Although the quality of the data is poor, early caffeine medication has been linked to a decrease in the prevalence of BPD. Mesenchymal cell therapy and intratracheal steroid injection are ongoing studies. Less intrusive respiratory treatments have somewhat reduced the risk of BPD. To prevent BPD in its early stages or lessen its severity, new therapies and approaches are desperately needed (Valenzuela-Stutman et al., 2019).

Improved methods of caring for very premature infants have been made possible by advances in our understanding of the factors that contribute to lung damage. These include improving diet, preventing infections, early and less intrusive surfactant treatment, noninvasive respiratory support, and more controlled oxygen therapy. The goal of these measures is to reduce lung damage and encourage better lung development. (Ramos-Navarro et al., 2022).

Few research has looked into how prenatal problems, the early stages of pregnancy, or postnatal factors like ventilation methods might affect the severity of BPD beyond GA

and birth weight, even though numerous studies have explored the pathophysiology and risk factors linked with BPD.

1.3 Problem Statement

Extremely premature delivery is associated with substantial problems, one of which is BPD. The diagnostic criteria for BPD are still being developed, in contrast to many other significant newborn disorders. Improvements in neonatal medicine, higher survival rates for extremely preterm infants, and modifications to the pathophysiology and epidemiology of neonatal respiratory disorders have all contributed to these improvements (Jensen et al., 2021).

There has been a great deal of research on BPD, but no safe and effective treatment has been discovered. However, there may be a crucial window of opportunity for intervention before clinical diagnosis. Preventive measures should be put into place during pregnancy or in the early postpartum period, especially during the first week of life (Higgins et al., 2018). While there is evidence that these therapies can lower infant mortality and some preterm problems, the incidence of BPD has not been substantially reduced. These results partially explain the improved survival of very premature infants-, who are more prone to BPD; yet, they also underscore the continued difficulty in preventing BPD (Alonso et al., 2021).

This chronic lung condition leads to significant long-term health problems, higher death rates, and higher healthcare expenses. Though many research works have found different BPD risk factors, there is little information specifically about the Palestinian community.

1.4 Significance of the Study

This study is important in several ways that go beyond its immediate goal of determining the risk variables for BPD in premature infants in Palestine. Premature babies are more likely to develop chronic lung illness due to BPD, which can have long-term effects on respiratory health, neurodevelopment, and general quality of life. In an area with distinct socioeconomic, environmental, and healthcare dynamics, this study addresses a crucial healthcare issue by concentrating on premature infants born in Palestinian private

hospitals before 32 weeks of gestation. The findings will provide a comprehensive understanding of how certain maternal, newborn, and prenatal factors affects the beginning of BPD in this population.

This study is significant because it will generate statistics based on evidence specific to the Palestinian healthcare system, which is often underrepresented in infant research conducted globally. The new knowledge will be very helpful to healthcare practitioners since it will enable them to better tailor preventative and therapeutic interventions to the needs of their patients. Additionally, the study's findings can direct national health policy and resource allocation, promoting better medical practices and potentially reducing the incidence and severity of BPD.

Furthermore, the current study can serve as a foundation for other research and projects aimed at improving newborn care in Palestinians and similar settings. By emphasizing the most significant risk factors and useful management strategies, the study will further our understanding of BPD and promote international cooperation and innovation in neonatal care. The ultimate goals are to improve the long-term wellness and survival of preterm infants, alleviate the burden on families, and make the most of Palestine's healthcare resources.

1.5 Study Objective

1.5.1 General Objective

The main purpose of the current study is to identify the risk factors for BPD among premature infants less than 32 weeks at Palestinian private hospitals in the North West Banks.

1.5.2 Specific Objectives

1. To identify the maternal risk factors regarding BPD among premature infants less than 32 weeks at Palestinian private hospitals in the North West Bank.
2. To identify the neonatal risk factors regarding BPD among premature infants less than 32 weeks at Palestinian private hospitals in the North West Bank.
3. To identify the perinatal risk factors regarding BPD among premature infants less than 32 weeks at Palestinian private hospitals in the North West Bank.

4. To identify the post-natal risk factors regarding BPD among premature infants less than 32 weeks at Palestinian private hospitals in the North West Bank.
5. To identify the relationship between maternal and neonatal variables that are associated with BPD?

1.6 Study Questions

1. What are the maternal risk factors regarding BPD among premature infants less than 32 weeks at Palestinian private hospitals in the North West Bank?
2. What are the neonatal risk factors regarding BPD among premature infants less than 32 weeks at Palestinian private hospitals in the North West Bank?
3. What are the perinatal risk factors regarding BPD among premature infants less than 32 weeks at Palestinian private hospitals in the North West Bank?
4. What are the post-natal risk factors regarding BPD among premature infants less than 32 weeks at Palestinian private hospitals in the North West Bank?
5. What is the correlation between maternal and neonatal variables that are associated with BPD?

1.7 Study Hypothesis

1. There are statistically significant differences at ($p \leq 0.05$) between BPD among premature infants less than 32 weeks at Palestinian private hospitals regarding maternal factors.
2. There are statistically significant differences at ($p \leq 0.05$) between BPD among premature infants less than 32 weeks at Palestinian private hospitals regarding neonatal factors.
3. There are statistically significant differences at ($p \leq 0.05$) between BPD among premature infants less than 32 weeks at Palestinian private hospitals regarding prenatal factors.
4. There are statistically significant differences at ($p \leq 0.05$) between BPD among premature infants less than 32 weeks at Palestinian private hospitals regarding postnatal factors.

5. There are statistically significant correlation at ($p \leq 0.05$) between maternal and neonatal variables that are associated with BPD among premature infants less than 32 weeks at Palestinian private hospitals regarding postnatal factors.

1.8 Study Variables

1.8.1 Dependent Variables: Bronchopulmonary Dysplasia among premature infants less than 32 weeks.

1.8.2 Independent Variables: Maternal factors, Neonatal factors, prenatal factors, and postnatal factors.

1.9 Variable Framework

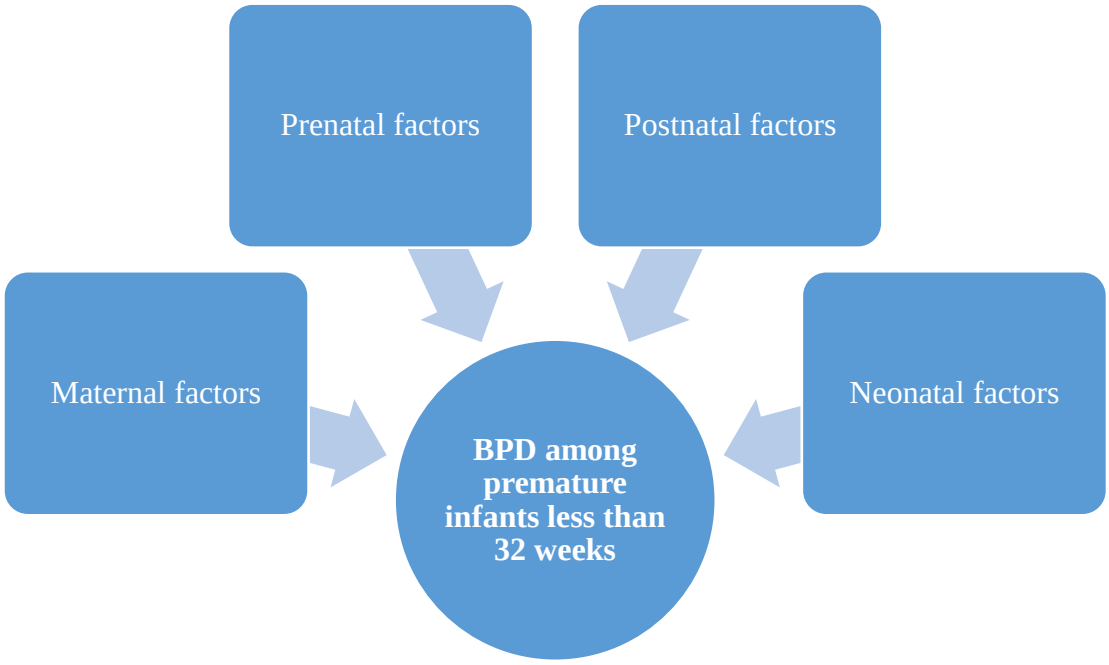

Figure 1.1: Study variables framework

1.10 Conceptual Definition

1. **Bronchopulmonary dysplasia (BPD)**: A chronic lung disease that premature infants are exposed to. Pulmonary inflammation and impaired alveolar growth are their hallmarks, and they frequently result in chronic respiratory problems and the requirement for more oxygen or respiratory support (Yang et al., 2022).

2. **A premature infant**: Infants born before 37 weeks of pregnancy are considered severely preterm, as are those born before 28 weeks (Cokyaman & Kavuncuoglu, 2020).
3. **Risk factors:** are elements that raise the possibility of getting a disease or other ailment. These include maternal, neonatal, perinatal, and postnatal variables in the setting of BPD.

1.11 Operational Definition

1. **Bronchopulmonary dysplasia (BPD)**: According to medical records, it was classified as mild, moderate, or severe based on the degree of breathing assistance required. The need for additional oxygen or respiratory support served as the starting point for the diagnosis.
2. **Premature Infant**: based on BW recorded in medical records, a infants born before 32 weeks of pregnancy.
3. **Risk Factor**s:

- Maternal Risk Factors: Information about pregnant age, antenatal corticosteroid usage, and the existence of pregnancy problems can be found in the mother's medical records and prenatal history.
- Neonatal risk factors: Data on BW, GA, sex, and the kind of respiratory support required.
- Perinatal risk factors: Conditions reported in maternal and birth records.
- Postnatal Risk Factors: Details found in NICU records include things like the length of oxygen therapy, the duration of mechanical ventilation, and sepsis episodes.

Chapter Two: Literature Review

2.1 Introduction

The chapter on literature review presents a summary of previous research concerning risk factors for bronchopulmonary dysplasia among premature infants less than 32 weeks, emphasizing significant discoveries and pinpointing knowledge gaps.

This chapter aids in demonstrating the applicability of the current research and its contribution to the area by reviewing earlier investigations. In addition, it provides a framework for comprehending how earlier research influences the present investigation and highlights the necessity for more research in particular areas. In general, this chapter establishes the framework for the study and places it within the larger scholarly framework.

Concepts that are critical to the study of this phenomenon include risk factors, BPD, and premature infants. Each concept is individually discussed.

The collection of literature was conducted utilizing a computerized search of databases. Databases were used for relevant articles and journals. The studies reviewed were published from 2016 to 2023.

2.2 Prevalence of BPD

There is currently a lack of specific information on the prevalence of BPD in Palestine; estimations must instead be derived from regional trends and comparisons with nations having comparable healthcare systems. In general, preterm birth rates and neonatal care techniques probably have an impact on Palestine's BPD rates.

The frequency of BPD varies greatly between countries. Huang et al. (2023) discovered that male gender, short for gestational age, and the requirement for endotracheal intubation (ETT) or cardiopulmonary resuscitation (CPR) were significant risk factors for the development of BPD in 23.7% of children delivered in Taiwan weighing less than 1500 grams or before 30 weeks gestation. According to Yang et al. (2022), there is a 10.4% prevalence of severe BPD in China, which is linked to neonatal respiratory distress syndrome and intrauterine hypoxia. 1,780 infants in Spain had a 22.6% prevalence of severe BPD (Ramos-Navarro et al., 2022); in the United state of America USA, 36.9% of

very preterm infants had grade 1-2 BPD and 3.7% had grade 3 BPD (Jensen et al., 2021). According to Kim et al. (2020), 43% of infants delivered in Korea at 24 weeks gestation had moderate-to-severe BPD, while the mortality rate decreased as gestational age increased.

Other international viewpoints include reports from several countries: In the USA, the prevalence of BPD or mortality among VLBW neonates is 37.3%, with 15.7% of them developing BPD, according to Valenzuela-Stutman et al. (2019). Portugal identified an 8.0% prevalence of BPD in VLBW babies, but Austria and Croatia had high prevalences of 59.6% (Reiterer et al., 2019; Kardum et al., 2019). In Poland, 45.2% of premature babies had BPD, with 6% having severe BPD, according to Rutkowska et al. (2019). According to Vayalthrikkovil et al. (2019), pulmonary hypertension affects 38% of babies born in Canada before 30 weeks of pregnancy. In India, BPD was shown to be 11.2% prevalent (Bhunwal et al., 2018); however, Soliman et al. (2017) found that infants delivered to normotensive mothers had a 26% prevalence.

Over time, Korea has seen a decrease in BPD rates due to improved prenatal care (Kim et al., 2016). China's Xu (2016) claims that severe BPD is associated with early pulmonary hypertension and ongoing oxygen or ventilator use. Finally, a study by Lapcharoensap et al. (2015) discovered that BPD rates varied significantly throughout different NICU classifications in California, USA. These findings highlight the impact of healthcare quality and neonatal care practices on the outcomes of BPD and highlight the need for additional research in specific regions, such as Palestine, and to better understand and treat local prevalence.

2.3 Risk Factors of BPD

2.3.1 Gestational age and Birth weight

A retrospective cohort study conducted by Jensen et al (2021) in the USA, the first benchmark epidemiological data using this concept is presented in this study. Of the 24 896 babies, 8192 (36.9%) developed grade 1 or 2 BPD, 932 (3.7%) had grade 3 BPD, 12 198 (40.0%) did not develop BPD, and 2574 (10.3%) died before 36 weeks of postmenstrual age (PMA). Infants born at 22 weeks gestation had mortality rates of 52.7% and 9.9% before 36 weeks' PMA and grade 3 BPD, respectively; infants born at 29 weeks gestation had rates of 17.3% and 0.8%, respectively. The frequency of grade 1 or 2 BPD

peaked at 51.8% in children born at 25 weeks gestation. Among survivors with grade 3 BPD, the prevalence of severe intraventricular hemorrhage or cystic periventricular leukomalacia rose from 4.8% to 23.4%.

A study was conducted by Geetha et al (2021) in the USA, to assess the risk factors and prevalence of moderate-to-severe BPD/death in neonates with extremely low gestational ages (ELGANs). The study design is an investigation into 266 ELGANs born at 28 weeks (w) or less GA. The cohort's mean GA and BW were 25.3 ± 1.4w and 724 ± 14 g, respectively, with a moderate-to-severe BPD of 67% and an overall mortality of 19%. As GA increased, the prevalence of moderate-to-severe BPD/death dropped dramatically, from 86–93% at 23–24 weeks to less than 60% at 27–28 weeks. Other risk factors on univariate analysis included mechanical ventilation (MV) on Day 7, air leaks with a fraction of inspired oxygen (FiO2) need more than 25%, BW, sepsis, and PDA requiring therapy. The composite outcome was only independently predicted by the requirement for Day 7 MV. Initiatives to establish lung preventive measures and create future models for BPD prognosis and prognostication will be made possible by the identification of risk factors.

A multicenter study conducted by Valenzuela-Stutman et al (2019) in the USA aimed to create risk prediction models for VLBWI at delivery, 3, 7, and 14 postnatal days, as well as for BPD and/or mortality and moderate/severe BPD. There were 6121 (37.3%) BPD/death and 2580 (15.7%) BPD presentations overall. The BPD models' respective AUC values were 0.788, 0.818, 0.827, and 0.894. The AUC values for BPD/death were 0.860, 0.869, 0.867, and 0.906. The time of oxygen therapy and ventilation had the most influence at later ages, while BW and GA had the largest contribution at birth. When contrasted with a neutral value of 0.5, all AUC values were of statistical significance. At four postnatal ages, we created high-accuracy models for BPD/death and moderate/severe BPD.

A study was conducted by Kim et al (2016) in Korea, the purpose of this study was to look at the connection between BPD incidence and survival in very preterm newborns. Compared to period I, the overall survival rate was considerably higher in period II (80.3% vs. 70.0%, respectively), particularly for infants born between weeks 23 and 24 (73.9% vs.

47.4%, respectively). Survivors' BPD incidence was considerably lower during period II (55.0%) than during period I (67.7%), particularly at 25–26 weeks of pregnancy (41.7% vs. 62.3%). Higher prenatal steroid use and an increased 5-minute Apgar score were linked to significantly better survival at 23–24 weeks gestation. Early extubation, extended use of less invasive continuous positive airway pressure, and decreased supplementary oxygen were linked to a significant decrease in the risk of BPD at 25–26 weeks gestation.

2.3.2 Small for gestational age (SGA) and gestational hypertension disorder

Using information from the Taiwan Neonatal Network, a study by Huang et al (2023) sought to determine risk variables for BPD and BPD/mortality in Taiwan. The National Institute of Child Health and Human Development's guidelines served as the foundation for the BPD criteria. 23.7% of GAs were categorized as small for GA (SGA), with an average GA of 27.5 weeks. Poor BW, poor GA, and other prenatal characteristics were identified by multivariate analysis as important risk factors for BPD. Male gender and SGA, endotracheal intubation (ETT), or cardiopulmonary cerebral resuscitation (CPCR) during initial resuscitation were additional risk factors for moderate-to-severe BPD. The only other risk factors in the moderate-to-severe BPD/death group were SGA and ETT or CPCR after initial resuscitation.

A study conducted by Rocha et al (2019) in Portugal, aim was to evaluate the relationship between preterm infants' BPD and low birth weight. There were 40 (8.0%) preterm newborns with SGA criteria out of the 614 total preterm infants delivered by 410 women who were included in the study. In addition to having higher rates of antenatal corticosteroid use, gestational hypertensive disorders, C-section, rupture of membranes before 18 hours, intubation rates in the labor room, use of surfactant therapy, oxygen administration, mechanical ventilation need, BPD, cystic periventricular leukomalacia, nosocomial sepsis, and pneumonia, SGA were more frequently linked to a single pregnancy and had lower rates of chorioamnionitis and Apgar scores. After adjusting for BPD risk variables, the multivariate analysis using logistic regression showed a substantial correlation between SGA and BPD.

2.3.3 Mechanical ventilation and neonatal pneumonia

A study conducted by Ramos-Navarro et al (2022), analyzing the traits and effects of perinatal risk factors on the severity of BPD was the aim of this observational study. The median BW was 890 g (740–1,090 g), while the median GA was 27.1 weeks (25.8–28.5). Type 1 BPD was classified as mild in 52.3% of cases, type 2 BPD in 25.1%, and type 3 BPD in 22.6% of cases. The duration of exposure to MV was linked to the majority of prenatal and postnatal risk variables for type 2/3 BPD. Intrauterine growth restriction, oligohydramnios, and male gender were independent prenatal risk factors. Postnatal risk variables were the duration of MV exposure, nosocomial pneumonia, two or more doses of surfactant administration, and the requirement for FiO2 of > 0.30 in the delivery room.

A cohort study by Reiterer et al (2019) in Austria, the most common chronic lung disease in infancy is BPD, which is linked to neonatal comorbidity and poor long-term pulmonary and neurodevelopmental (ND) outcomes. A very preterm children GA, 24+0–28+6 weeks) with BPD (n = 44) and a cohort of GA-matched preterm infants without BPD (n = 44) were compared in this retrospective, single-center cohort analysis. With relation to lower respiratory tract infection (LRTI) incidence and newborn morbidity Higher rates of neonatal pneumonia (26% vs. 7%), longer mean days of mechanical ventilation (21 vs. 13), pulmonary hypertension (20.5% vs. 0%), and severe retinopathy of prematurity (13.6% vs. 0%) were all linked to bronchopulmonary dysplasia (incidence: 11.3%).

2.3.4 Pulmonary Hypertension

The purpose of the study by Choi et al (2019) in Korea was to determine how pulmonary hypertension (PH) affected the growth and neurodevelopment of children aged 18 to 24 months of corrected age (CA). Examined the medical data of 394 babies (born before 28 weeks of pregnancy) in the past. At 18 to 24 months of CA, the PH group's cognitive, language, and motor Bayley-III scores were noticeably lower than those of the non-PH group. Of PH infants, 45.0% (9/20) had cognitive delay. Furthermore, the BPD with the PH group had significantly lower z-scores for both weight and HC. Weight growth after discharge was found in infants with PH and severe BPD, and the cognitive score was consistently lower and worse in infants with severe BPD exclusively, according to the subgroup analysis.

A prospective study conducted by Vayalthrikkovil et al (2019) in Canada, to assess the frequency, risk factors, and best time to do an echocardiography for PH in babies with BPD. 48 (38%) of the 126 babies (mean birth weight 858 ± 221 g; mean GA 26.1 ± 1.6 weeks) experienced PH at some point while they were in the hospital. The median age for the first study echocardiography was 31 weeks postpartum. At enrollment, the prevalence of PH was 28.5%; at 32, 36, and 40 weeks, it was 20%, 21.6%, and 17%, respectively. At 40 weeks, no new PH cases were found. While 20% of infants with moderate BPD and 32% of infants with severe BPD had PH at 36 weeks, none of the infants with mild BPD had it.

A retrospectively reviewed study conducted by Xu (2016) in China, We examined the variables and echocardiographic indicators of early PH linked to moderate or severe BPD. The study included forty-two preterm newborns. The average duration of oxygen treatment for all patients was 62.5 ± 28.0 days. The BPD grades were categorized as follows: mild, 23.8%; moderate, 40.5%; and severe, 35.7%. Infants that acquired PH need ventilators and oxygen supplements for a longer period of time. At 28 days, severe BPD was linked to PH. These results lend credence to the idea that preterm infants' heightened vulnerability to severe BPD is a result of both early pulmonary vascular dysfunction and chronic infection.

A systematic review study was conducted by Nagiub et al (2017) in Atlanta, to determine the risk variables for PH development in infants with BPD. Ten of the 20 risk factors that were found were reproduced in nine other trials. The results of the meta-analysis indicated that while BW and GA were negatively correlated, the duration of mechanical ventilation, length of stay, oligohydramnios, usage of high-frequency breathing, small for GA, sepsis, and severity of BPD were significant risk factors. PH development in babies with BPD is predicted by a number of clinical factors. To convert these risk indicators into a risk-based scoring system, prospective research is required.

2.3.5 Acute Kidney Injury (AKI)

A study by Starr et al (2020) in Washington, aim to assess the relationship between BPD and AKI in infants born before 32 weeks of GA. The Assessment of Worldwide AKI Epidemiology in Neonatal (AWAKEN) retrospective cohort (n = 546) includes the current study as a secondary analysis of premature infants born at less than 32 weeks of gestation. The main outcome and adjusted AKI for infants born at 29 weeks gestation were 1.15. After adjusting for a number of variables, infants born with AKI between weeks 29 and 32 had a four-fold increased risk of moderate or severe BPD or mortality.

2.3.6 Sepsis

A retrospective analysis of preterm children born before 32 weeks of pregnancy conducted by Alonso et al (2021) in Spain to outline the risk factors for bronchopulmonary dysplasia in the initial weeks of life in extremely preterm newborns. The study involved 202 babies with a mean GA of 29.5 ± 2.1 weeks, of whom 61.4% never had invasive mechanical ventilation. 10.4% of patients had moderate-to-severe BPD, while the incidence of BPD was 28.7%. Nosocomial infections, FiO2 on day 14, GA, and the requirement for mechanical ventilation on the first day of life were all independently linked to BPD. Nosocomial sepsis and receiving mechanical ventilation on the first and third days of life were both independent risk factors for moderate-to-severe BPD.

A study by Sharma et al. (2020) to finding risk factors for moderate-to-severe BPD in an era when NIV is widely available in the DR is the aim of this study. 59% of the 263 eligible newborns had BPD that was moderate to severe. Compared to No/Mild BPD, there was a substantial correlation between Moderate/Severe BPD and surfactant, DR intubation, gender, and birth weight. Forty percent of children with No/Mild BPD and eighty percent with Moderate/Severe BPD who were not intubated in the delivery room were intubated within 48 hours ($p < 0.05$). Infants with moderate to severe BPD require more oxygen and MV for longer periods. Moderate/Severe BPD was predicted by birth weight, gender, oxygen concentration, cumulative oxygen and MV time, surfactant, and blood transfusions using logistic regression. The most significant predictors for Moderate/Severe BPD, according to both CART analysis and logistic regression, were oxygen duration and MV.

A study by Kardum et al (2019) in Croatia sought to investigate the prevalence and risk factors for moderate and severe BPD in a group of infants born to VLBW mothers.

The BPD rate was 59.6% (106/178), which is much greater than what was previously stated. 65.1% (69/106) of babies had mild BPD, and 34.9% (37/106) had moderate/severe BPD. 40.5% (30/74) of newborns before 28 weeks of gestation had moderate to severe BPD. Higher initial neonatal risk as indicated by the Critical Risk Index for Babies (CRIB) score and late-onset sepsis were the ultimate risk aspects of the onset of moderate/severe BPD. The majority of afflicted infants are under 29 weeks of gestation, and the frequency of moderate and severe BPD in our study group is higher than previously described.

2.3.7 Male gender and prolonged mechanical ventilator

A study conducted by Nakashima et al (2021) in Japan, for insights into current BPD trends and risk factors in babies born very early. By 36 weeks postmenstrual age, 2,244 (11.6%) of the 19,370 infants had passed away. In 2003, the mortality rate was 19.0%; by 2016, it had dropped to 8.0% (6.2%–10.3%). BPD developed in 7,792 (45.5%) of the 17,126 survivors, and its percentage rose dramatically from 41.4% (36.5%–46.4%) in 2003 to 52.0% (48.2%–55.9%) in 2016. The survivors' multivariable analysis revealed a positive correlation between BPD and chorioamnionitis, small-for-gestational-age, >4 weeks of non-invasive positive pressure ventilation, >4 weeks of supplemental oxygen or intrusive ventilation, birth weight <750 g, <26 weeks of gestational age, <20 center-patient volume cases annually, or treated patent ductus arteriosus.

In a study conducted by Rutkowska et al (2019) in Poland, to determine the prevalence and predictors of severe BPD in infants with RDS who are born very preterm. 45.2% of people had BPD overall. With morbidity primarily affecting newborns under 29 weeks GA (incidence 10%), severe BPD accounted for 6%. Male gender, intubation in the delivery room, and invasive ventilation for longer than seven days were risk factors for severe BPD. Early CPAP in the univariate study and surfactant administration <15 minutes postpartum in the multivariate model were the protective factors. The most common risk factor for severe BPD is mechanical breathing for longer than seven days. Two important preventive interventions are early surfactant and CPAP started in the delivery room.

2.3.8 Maternal smoking and preexisting hypertension

A study reviewed in retrospective by Cokyaman & Kavuncuoglu (2020) to assess the association between perinatal risk factors, additional preterm comorbidities, and the frequency of BPD in infants with very low BW. 20.9% was the total mortality rate. The frequency of complete BPD was 20.1% following the initial 28-day mortality decrease. The factors influencing the development of BPD were determined to be male gender, RDS, PDA, apnea, late sepsis, and early membrane rupture, respectively. On the other hand, BPD was unaffected by chorioamnionitis, prenatal steroids, small for GA, early sepsis, and birth type.

A prospective, longitudinal study conducted by Morrow et al (2017), to determine prenatal risk factors linked to a higher chance of respiratory illness and BPD in early infancy following preterm birth. Mother smoking before preterm birth doubled the likelihood of having a baby with BPD after controlling for variables. The risks for BPD increased threefold among those whom with pre-existing hypertension. BPD was linked to lower birth weight and gestational age z-scores. In early childhood, 34% of preterm children without BPD and 22% of infants with BPD did not exhibit any clinical symptoms of late respiratory disease.

In a prospective cohort study conducted by Soliman et al (2017) in the USA, to study's goal was to investigate the possibility that preeclampsia, an antiangiogenic condition, increases the likelihood of developing BPD. BPD developed in 23% of the 102 infants in the preeclampsia group and 26% of the 217 newborns in the normotensive group. Preeclampsia was not shown to be a risk factor for the development of BPD on multivariable binary regression modeling. Significant risk factors for BPD were the use of surfactants, the Score for Neonatal Acute Physiology Perinatal Extension-II score, sepsis, blood transfusions, and intrauterine growth restriction (IUGR). Preeclampsia did not significantly increase the incidence of BPD in our population. IUGR babies of normotensive and preeclamptic moms were more likely to develop BPD.

2.3.9 Patent Ductus Arteriosus (PDA), Chorioamnionitis

A retrospective study conducted by Yang et al (2022) in China, Included 250 preterm infants diagnosed with BPD and GA <32 weeks. There were 15.6%, 74.0%, and

10.4% of instances of mild, moderate, and severe BPD, respectively. The rates of SGA, intrauterine asphyxia, pulmonary hemorrhage, neonatal RDS, circulatory failure, pulmonary hypertension, PDA, pulmonary surfactant (PS), aminophylline, caffeine, glucocorticoids, tracheal intubation, diuretics, and parenteral nutrition length varied significantly between the three groups. When compared to moderate BPD, the duration of parenteral feeding and PDA were independent risk factors for severe BPD. While caffeine was a protective factor for severe BPD in comparison to mild BPD, PDA and aminophylline were independent risk factors for severe BPD.

A descriptive cohort study was conducted by Bhunwal et al (2018) in India, to determine the prevalence of BPD in premature infants and its correlations. Of the 250 neonates that were enrolled, 170 (68%) lived to day 28, and 19 (11.2%) of them developed BPD. Infants with BPD had considerably lower mean gestation and BW. Infants with BPD had significantly higher rates of chorioamnionitis (clinical 5.3% vs 1.9%, P=0.375; and histological 37.5% vs 16.7%), PDA (52.6% vs 8.9%), median sepsis episodes [2 vs 1], invasive ventilation (84.2% vs 11.3%), and ventilation duration [56 vs 4]. The two groups' serum Malondialdehyde (MDA), Superoxide dismutase (SOD), and catalase levels were similar.

2.3.10 Restrictions on Fetal Growth and Birth Problems

A retrospective review study conducted by Chen et al (2021) in China, this study sought to identify the risk factors for Metabolic bone disease (MBD) development in infants with BPD. A total of 156 infants with BPD were included, including 104 controls and 52 MBD cases. The following were identified as statistically significant risk factors for MBD in BPD infants: cholestasis, late onset sepsis, prolonged (> 2 weeks) use of diuretics, fetal growth restriction, VLBW, feeding volume < 80 mL/kg/d at the end of the fourth week after birth, and cholestasis. Fetal growth restriction, VLBW, feeding volume < 80 mL/kg/d at the end of the fourth week after birth, cholestasis, and late onset sepsis are important risk factors for MBD in BPD children of homogenous GA.

A retrospective cohort study was conducted by Kim et al (2020) in Korea, to find a strategy to lower the prevalence of moderate-to-severe BPD and look into the risk variables for BPD severity by GA. 3,717 newborns (24 weeks, 25 weeks, 26 weeks, 27 weeks, and

28 weeks) out of 3,976 were included. In the 24-, 25-, 26-, 27-, and 28-GA groups, the corresponding death rates were 43%, 29%, 11%, and 6%, whereas the overall mortality rate was 18%. The multivariate analyses revealed that hypotension, corrected PDA, late-onset sepsis, and SGA were significant indicators of risk of developing moderate/severe BPD in the 25–28-week GA groups. Other than the first resuscitation, there were no noteworthy risk factors for infants born at 24 weeks GA.

2.3.11 The Use of Surfactants in Neonatal Support

Long-term prospective study conducted by Ding et al (2020) in China, to determine postnatal risk factors for the development of BPD in premature infants born before 32 weeks of pregnancy. The pathophysiology of BPD was discovered to be linked to electrolyte imbalances, hemodynamically significant patent ductus arteriosus (hs-PDA), and the age at which infants reached 120 kcal/kg/d via enteral feeding ≥40 days after birth. The BPD group had considerably greater levels of serum sB7-H3, IL-18, and NCIS than the non-BPD group. At 1, 7, 14, and 28 days after birth, the BPD group's enteral fluid and calorie intake was noticeably lower than that of the non-BPD group.

Study of a retrospective cohort conducted by Lapcharoensap et al (2015) in California, to determine hospital diversity in BPD rates across all levels of NICUs under the California Perinatal Quality Care Collaborative, as well as individual risk factors for BPD development. Of the 15,779 infants in the study group, 1534 passed away before they were 36 weeks postmenstrual. 7081 babies, or 44.8% of the total, died before 36 weeks or had the major outcome of BPD. The interquartile range for the combined BPD or mortality rates in 116 NICUs was 38.7%–54.1%, ranging from 17.7% to 73.4%. The risk of developing BPD was higher in level II NICUs and comparable in level III NICUs when compared to level IV NICUs.

2. 4 Summary

Numerous risk variables, such as male gender, SGA, mechanical ventilation, and sepsis, have been linked to BPD in studies conducted in different nations. The prevalence of BPD varies greatly between nations; in very low birth weight newborns, the USA reports rates as high as 37.3%, while Portugal has lower rates, about 8%. Global studies have

consistently linked higher BPD severity to key risk factors such as low birth weight, gestational age, mechanical ventilation, and diseases like pulmonary hypertension.

Chapter Three: Methodology

3.1 Introduction

To answer our research questions, the researcher chooses an appropriate research design that will contribute to the following process of data collection and analysis. To check if what we claimed is right or wrong, the following parts will clarify the design that was used and all other methodology-related questions.

A retrospective design was used in this research; the researcher chose a hospital in the north of the West Bank as a research setting, as it contains a NICU and the hospitals have a fully computerized database for all procedures containing all data about patients, and the period from the beginning of Jan 2024 until the end of Dec 2024 was chosen as a period for data collection.

3.2 Study design

A quantitative methodology was used in this research; a retrospective design was utilized to study the risk factors for BPD among premature infants less than 32 weeks at Palestinian private hospitals in the North West Bank.

3.3 Study site and setting

The current study was conducted at a tertiary care private hospital in the north of the West Bank, which contains a NICU and has a fully computerized health information system containing all the information related to their case and the treatment or any procedure that was made in full detail with the name and note of each healthcare provider contacted with him.

3.4 Study Duration

The study was conducted from the beginning of Jan 2024 until the end of Dec 2024.

3.5 Study population

The population was all premature infants less than 32 weeks.

3.6 Sample and Sampling

A sample was taken from a tertiary care hospital in the North-West Bank, which will include data from last year's database. A total population sample method was used to select data.

Choosing the period from the beginning of Jan 2024 until the end of DEC 2024.

3.7 Inclusion criteria

1. Weighing < 1,500 g
2. GA < 32 weeks
3. The availability of a complete medical file.

3.8 Exclusion criteria

1. Infants with intrauterine growth retardation (IUGR),
2. GA > 32 weeks
3. Major congenital malformations
4. Preterm delivery < 23 weeks
5. Premature infant receiving palliative care

3.9 Sample size

The total population sample method, which includes all available premature infants with GA < 32 weeks and meets the pre-determined inclusion criteria, was used. A total of 119 premature infants were included in the study.

3.10 Study instrument

The data collection tool was self-developed according to the reviewed literature related to the risk factors of BPD, and then a pediatric specialist and the supervisor of this research with a PhD reviewed it; all their comments were considered and adjusted accordingly. The survey contains five sections. Section one represents demographic data with 5 questions. Section Two: Maternal History with 7 questions, Section Three: Birth and Neonatal History with 4 questions, Section Four: Respiratory Support and Intervention with 8 questions, and the last section: Infection and Complication with 3 questions.

3.11 Validity and reliability

The study's internal validity, methodology, and data collection methods accurately measure the relationship between the dependent and independent variables. Any potential sources of bias or confounding factors were carefully controlled to establish a significant relationship.

External Validity: this research's findings can be generalized to the broader population of BPD patients. Considerations should be given to the representativeness of the sample and the relevance of the BPD studied. An acceptable Cronbach's alpha value of 0.72 indicates acceptable reliability of the study's instrument.

3.12 Data Collection

Data collection begins immediately after obtaining the approval to conduct the study from the Arab American University-Palestine IRB code number (R-2024/A/123/N), private hospital administrations as attached in **appendix II**. After obtaining approval from each hospital administration mentioned previously by the medical director, as he is directly responsible for patient files and protecting their data, the premature infants who had GA less than 32 weeks and were admitted to the NICU for treatment were counted. The total number was 854 newborns. The medical files were used. The necessary information was based on the prepared instrument tool, so 119 samples were collected.

The samples were distributed to the mentioned hospitals based on the total number of admissions as the premature infant had GA less than 32 weeks to be treated during the last years, so the distribution was as follows, (Table 2.1):

Table 2. 1: Hospital Distribution

Hospital Name	Admission From 1-2024 to 12-2024	Sample	Sampling
Private Hospital- Nablus	434	100	65
Private Hospital- Jenin	420	95	54
Total	854	195	119

3.13 Ethical considerations

Ethical approval was obtained from Arab American University, Institutional Review Board (IRB), and registered under the number (R-2024/A/123/N), and permission for conducting the study in hospitals was taken from their administrative department; all data was confidential and only for the use of research purposes; no names of any patient will be mentioned or used; no patient information used in any context apart from this research; and all data will be kept confidential. Confidentiality is ensured by guiding against unauthorized access to the data.

3.14 Administrative Design

An official letter was taken from the Arab American University, Institutional Review Board (IRB), to the Health Education Center in Private hospitals included in the study, asking for permission to access the involved hospitals and collect data.

An official permission was approved by the nursing directors of the mentioned private hospitals, who are involved in the study; explained to them about the objectives and aims of the study, and the importance of conducting this study to improve work competencies of nurses.

3.15 Analysis plan

The collected data was organized, revised, scored, tabulated and analyzed using the number & percentage distribution. Statistical analysis was done by computer using Statistical Package for Social Science (SPSS) version 27, and different tests were run to test the significance of changes in each independent variable on the dependent variable, including measures of central tendency and inferential statistics. The Chi-square test was used to test the significance between categorical variables, and the Analysis of Variance (ANOVA) test was employed in testing the significance between the groups of different level measurements and other variables.

Chapter Four: Results

4.1 Introduction

The statistical analysis of the data gathered from a retrospective study examining the risk factors for BPD in premature infants under 32 weeks in Palestinian private hospitals in the North West Bank is presented in the current chapter. The study used a sample of 119 preterm newborns and ran for a year, from January 2024 to December 2024. The 31 items that made up the collected data had an appropriate Cronbach's alpha value of 0.72, which suggests that the study's instrument is reliable enough. (Table 4.2).

Table 4.2: Reliability Statistics

Cronbach's Alpha	N of Items
.720	31

The analysis in this chapter is designed to address the study's core research questions, which aim to identify maternal, neonatal, perinatal, and postnatal risk factors contributing to the development of BPD in the target population. Since the collected data is for infants with BPD, this will be a descriptive analysis. The analysis seeks to answer the following questions:

1. What are the maternal risk factors associated with BPD among premature infants less than 32 weeks at Palestinian private hospitals in the North West Bank?
2. What are the neonatal risk factors associated with BPD in the same population and setting?
3. What are the perinatal risk factors influencing the development of BPD?
4. What are the post-natal risk factors contributing to BPD among premature infants in the studied context?
5. What is the correlation between maternal and neonatal variables that are associated with BPD?

4.2 Demographic characteristics of the sample

The following (Table 4.3) below provides a summary of the demographic characteristics of premature infants diagnosed with BPD. Among the 119 premature infants, the majority (88.2%) were born between 28 and 32 weeks of gestation, while only 11.8% were born before 28 weeks. Regarding gender, 65.5% of the infants were male, and 34.5% were female. The maternal age distribution shows that most mothers (63.9%) were between 20 and 29 years old, followed by 27.7% aged 30 to 39 years. A smaller proportion of mothers were less than 19 years old (7.6%), and only 0.8% were older than 40 years.

Table 4.3: Demographic Characteristics of the Studied Premature Infants

		Count	**N %**
GA (Gestational Age) at birth	Less than 28 weeks	14	11.8%
	28-32 weeks	105	88.2%
Gender	Female	41	34.5%
	male	78	65.5%
Mother Age	-less than 19 years old.	9	7.6%
	-20-29 years old.	76	63.9%
	-30-39 years old.	33	27.7%
	More than 40 years old.	1	0.8%

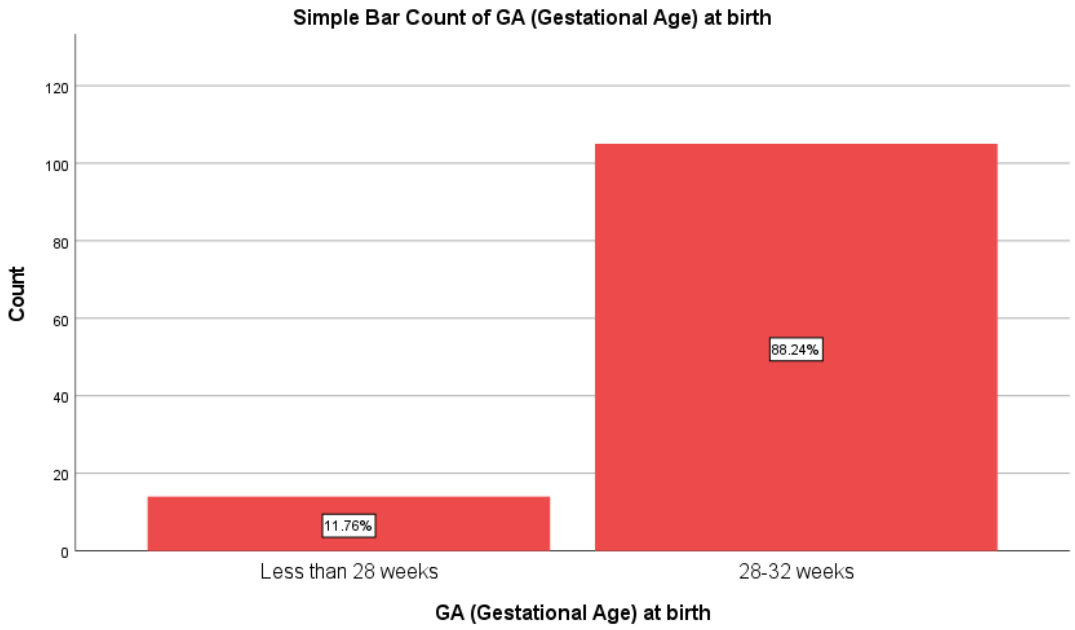

Figure 4.2. Number and percentage of premature infants according to GA at birth

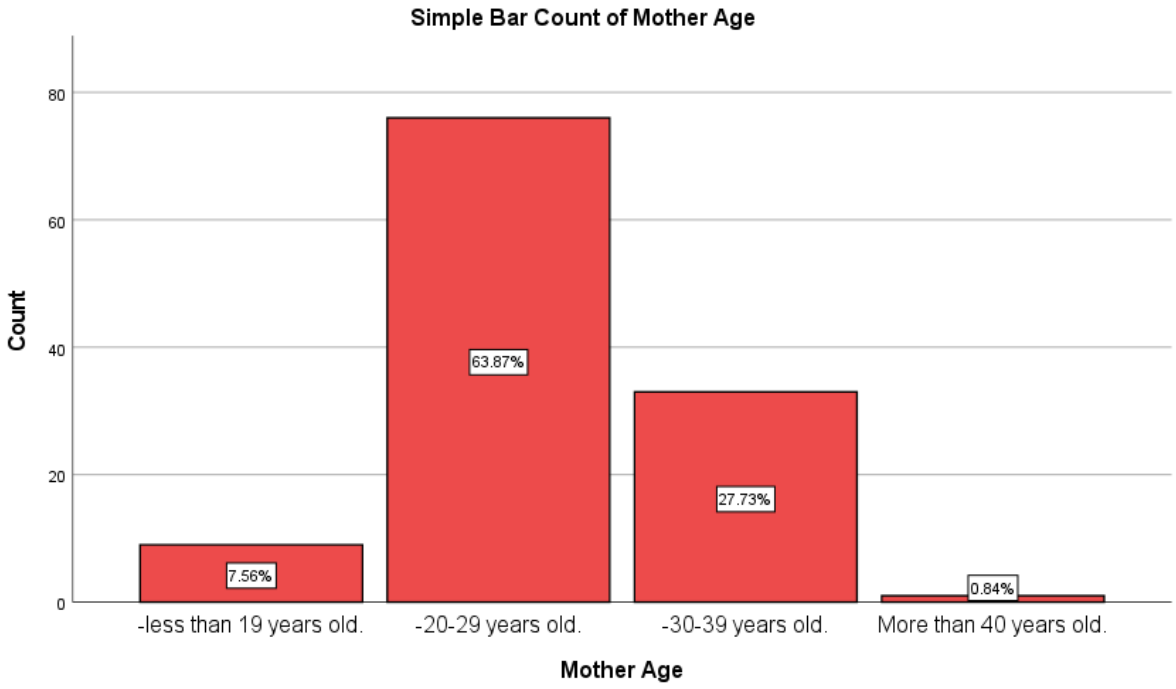

Figure 4.3. Mothers' age distribution

The following (Table 4.4) provides descriptive statistics on the weights of the infants included in the study. The mean admission weight was 1265.11 grams, with a

standard deviation of 184.21 grams, ranging from a minimum of 750 grams to a maximum of 1500 grams. Similarly, the mean birth weight was 1257.45 grams, with a standard deviation of 196.57 grams, ranging from 500 grams to 1500 grams.

4.2.1 Maternal History

The following (Table 4.5) outlines key aspects of the maternal history for the study population. The majority of mothers (73.9%) received prenatal care, while 26.1% did not. Most mothers (79.8%) did not experience infections such as chorioamnionitis or urinary tract infections, though 20.2% did. Preeclampsia was reported in 44.5% of the mothers, and eclampsia was slightly more common, occurring in 47.9%. Gestational diabetes mellitus (GDM) was less frequent, with 16.8% of mothers affected. However, 64.7% of mothers experienced premature rupture of membranes (PROM). Slightly more than half (51.3%) of the mothers received corticosteroids before delivery, while 48.7% did not. Regarding delivery mode, cesarean section (CS) was the predominant method (82.4%), while 17.6% delivered normally. Lastly, the majority of pregnancies (71.4%) were multiple births, with 28.6% being with single births.

4.2.2 Birth and Neonatal History

The following (Table 4.6) summarizes the birth and neonatal history of the study population. Evidence of fetal distress was observed in the majority of cases (88.2%), with only 11.8% showing no signs of distress. At birth, 60.5% of the infants required resuscitation, while 39.5% did not. Additionally, 75.6% of the infants needed immediate intubation after birth, whereas 24.4% did not require intubation.

The following (Table 4.7) provides descriptive statistics for the Apgar scores of the study population. The mean Apgar score at one minute was 5.87, with a standard deviation of 1.34, ranging from a minimum of 4 to a maximum of 8. At five minutes, the mean Apgar score increased to 8.18, with a smaller standard deviation of 0.72 and a range of 7 to 9.

4.2.3 Respiratory support and intervention

The following (Table 4.8) presents data on respiratory support and interventions among the study population. All infants (100%) required oxygen therapy, highlighting the significant respiratory challenges faced by premature neonates. All of the chosen sample

require the use of MV, the majority (84%) were on mechanical ventilation for less than four weeks, while 16% required it for a longer duration. Extubation and weaning trials were attempted in 78.2% of cases, whereas 21.8% remained dependent on respiratory support. Additionally, early caffeine administration was not recorded in any case. Regarding steroid use, 57.1% of infants received dexamethasone, while 42.9% did not.

4.2.4 Infections and complications

The following (Table 4.9) summarizes the infections and complications observed among the study population. Notably, sepsis was a high concern, with 60.5% of infants diagnosed with the condition. Pneumonia affected 12.6% of the infants, while NEC was observed in 14.3% of cases. Early-onset sepsis was present in 48.7% of infants, while late-onset sepsis was less common, occurring in 26.1% of cases. PDA was diagnosed in 58.5% of infants, highlighting its prevalence in premature neonates. Retinopathy of prematurity (ROP) was reported in approximately 31% of cases, with a slight discrepancy in counts due to repeated entries.

4.3 Maternal history and neonatal complication

A chi square test was done between all the maternal variables with all neonatal variables to test for significance any p value less than 0.05 will be considered significant, the below tables are for all variables that we found a significant effect between them.

The following (Table 4.10) shows the relationship between maternal preeclampsia and the occurrence of PDA in infants. Out of 119 infants in the study, among infants whose mothers did not have preeclampsia, 32 (49%) did not have PDA, and 33 (51%) had PDA. Among infants whose mothers had preeclampsia, 17 (32%) did not have PDA, and 36 (68%) had PDA.

The p-value of 0.045 in the chi-square test for the relationship between maternal preeclampsia and the occurrence of PDA indicates a statistically significant association. This means that the likelihood of infants developing PDA is influenced by whether their mothers had preeclampsia. Since the p-value is below the typical significance threshold of 0.05, we can conclude that maternal preeclampsia is a significant factor in the development of PDA among premature infants in this study.

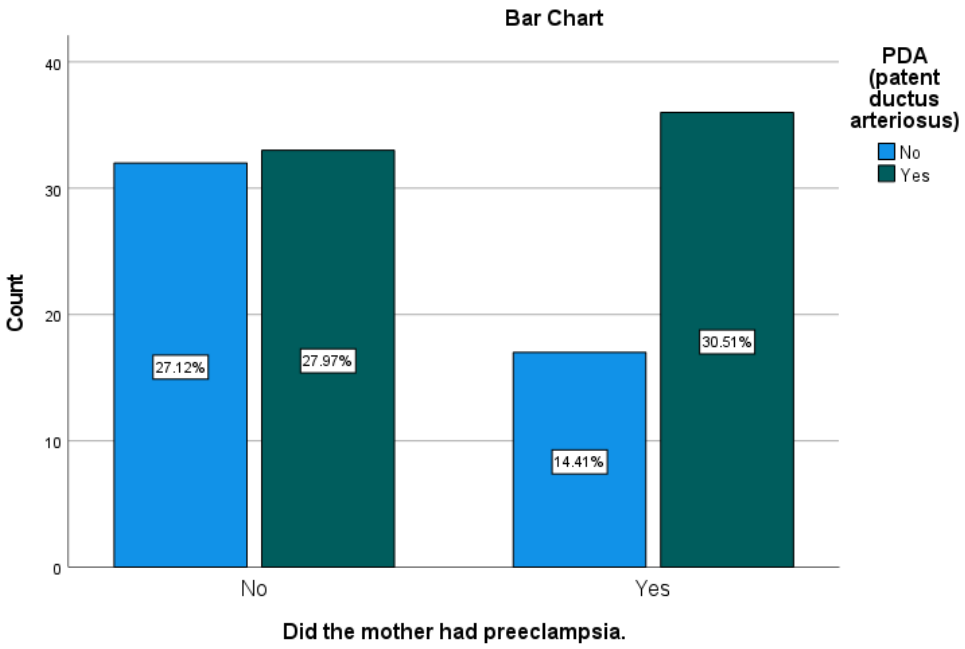

Figure 4.4: Maternal preeclampsia with PDA

The following (Table 4.11) shows the relationship between maternal eclampsia and the occurrence of sepsis in infants. Out of 119 infants in the study, among infants whose mothers did not have eclampsia, 29 (46.8%) did not have sepsis, and 33 (53.2%) had sepsis. Among infants whose mothers had eclampsia, 18 (31.6%) did not have sepsis, and 39 (68.4%) had sepsis.

The p-value of 0.046 in the chi-square test for the relationship between maternal eclampsia and the occurrence of sepsis in infants indicates a statistically significant association. This suggests that maternal eclampsia is likely a factor contributing to the development of sepsis in premature infants. Since the p-value is below the standard significance threshold of 0.05, we can conclude that infants born to mothers with eclampsia have a higher likelihood of developing sepsis compared to those born to mothers without eclampsia.

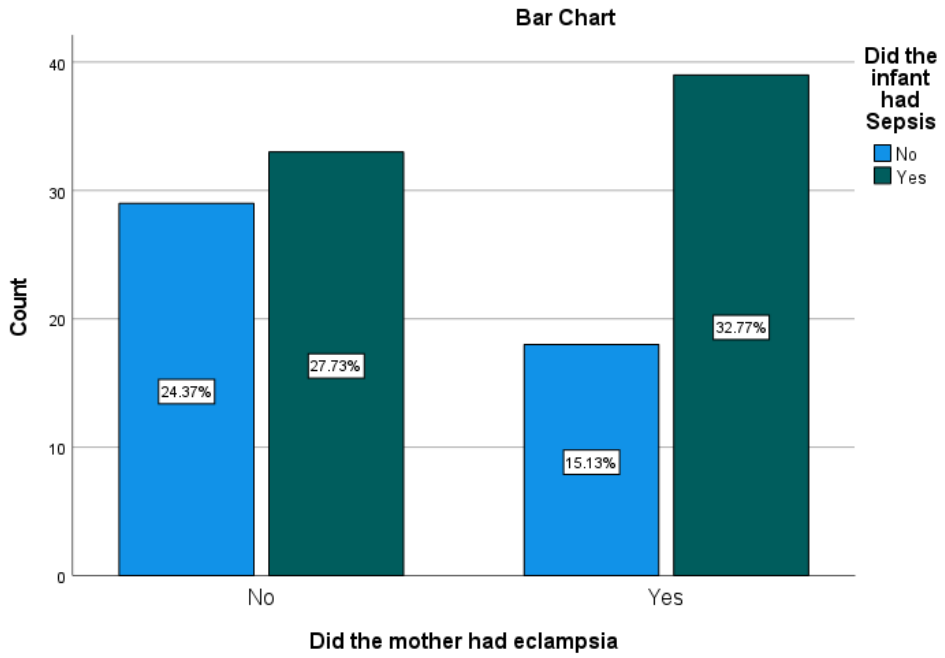

Figure 4.5. Distribution of mothers with Eclampsia & studied premature infants with sepsis

The following (Table 4.12) shows the relationship between maternal eclampsia and late-onset sepsis in infants. Out of 119 infants. Among infants whose mothers did not have eclampsia, 52 (83.9%) did not develop late-onset sepsis, and 10 (16.1%) developed it. Among infants whose mothers had eclampsia, 36 (63.2%) did not develop late-onset sepsis, and 21 (36.8%) developed it.

The p-value of 0.009 in the chi-square test for the relationship between maternal eclampsia and late-onset sepsis indicates a statistically significant association. This suggests that maternal eclampsia is a significant risk factor for the development of late-onset sepsis in premature infants. Since the p-value is well below the standard significance threshold of 0.05, we can confidently conclude that infants born to mothers with eclampsia have a higher likelihood of developing late-onset sepsis compared to those born to mothers without eclampsia.

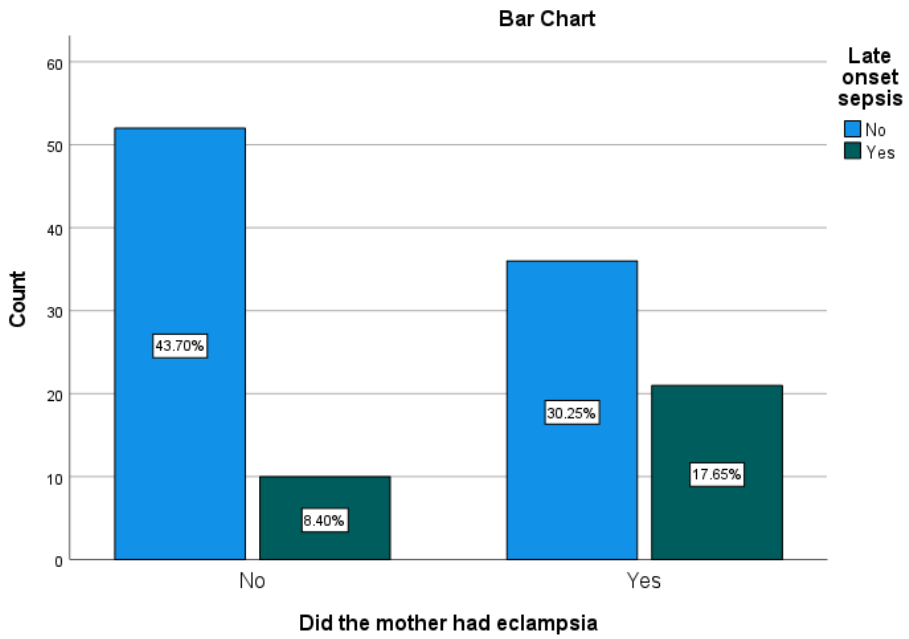

Figure 4.6. Mothers with Eclampsia with a premature infants with late onset of neonatal sepsis

The following (Table 4.13) displays the relationship between a mother's history of premature rupture of membranes (PROM) and the occurrence of ROP in infants. Out of 119 infants in the study. Among infants whose mothers did not have a history of PROM, 34 (81%) did not develop ROP, and 8 (19%) developed ROP. Among infants whose mothers had a history of PROM, 47 (61%) did not develop ROP, and 30 (39%) developed ROP.

The p-value of 0.020 from the chi-square test for the relationship between a mother's history of PROM and the occurrence of ROP indicates a statistically significant association. Since the p-value is below the common significance threshold of 0.05, we can conclude that there is a significant relationship between maternal PROM history and the development of ROP in premature infants.

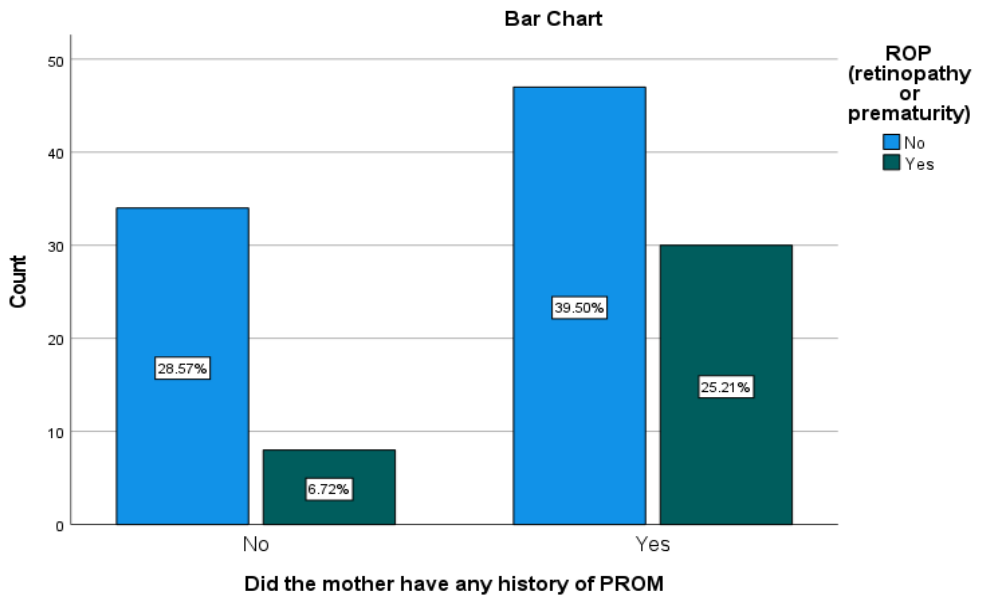

Figure 4.7: Mother PROM with infant premature infants with ROP

The following (Table 4.14) presents the relationship between multiple births and late-onset sepsis in infants. Out of 119 infants in the study. Among infants from single births (not multiple), 29 (85.3%) did not develop late-onset sepsis, and 5 (14.7%) developed late-onset sepsis. Among premature infants from multiple births, 59 (69.4%) did not develop late-onset sepsis, and 26 (30.6%) developed it.

The p-value of 0.042 from the chi-square test for the relationship between multiple births and late-onset sepsis indicates a statistically significant association. Since the p-value is below the commonly used significance threshold of 0.05, we can conclude that multiple births are significantly associated with an increased risk of late-onset sepsis in premature infants.

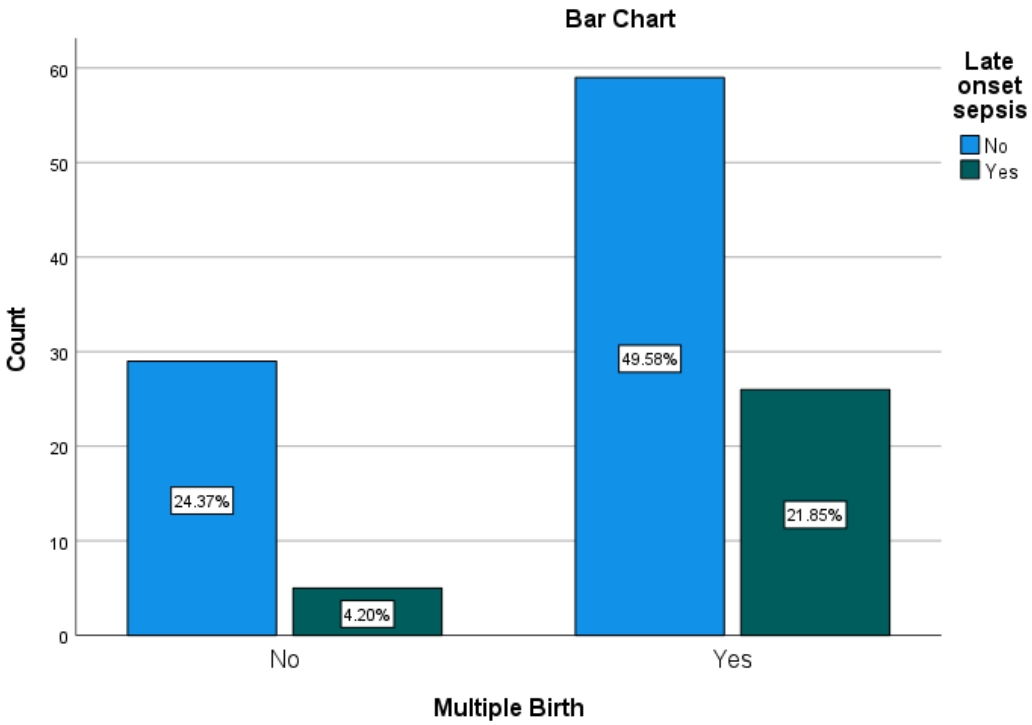

Figure 4.8. Multiple births with late-onset sepsis

The following (Table 4.15) shows the relationship between multiple births and the occurrence of ROP in infants. Out of 119 infants in the study. Among infants from single births (not multiple), 29 (85.3%) did not develop ROP, and 5 (14.7%) developed ROP. Among infants from multiple births, 52 (61.2%) did not develop ROP, and 33 (38.8%) developed ROP.

The p-value of 0.008 from the chi-square test for the relationship between multiple births and ROP indicates a statistically significant association. Since the p-value is below the standard significance threshold of 0.05, we can conclude that multiple births are significantly associated with an increased risk of ROP in premature infants. This suggests that infants born from multiple pregnancies are more likely to develop ROP compared to those born from single pregnancies.

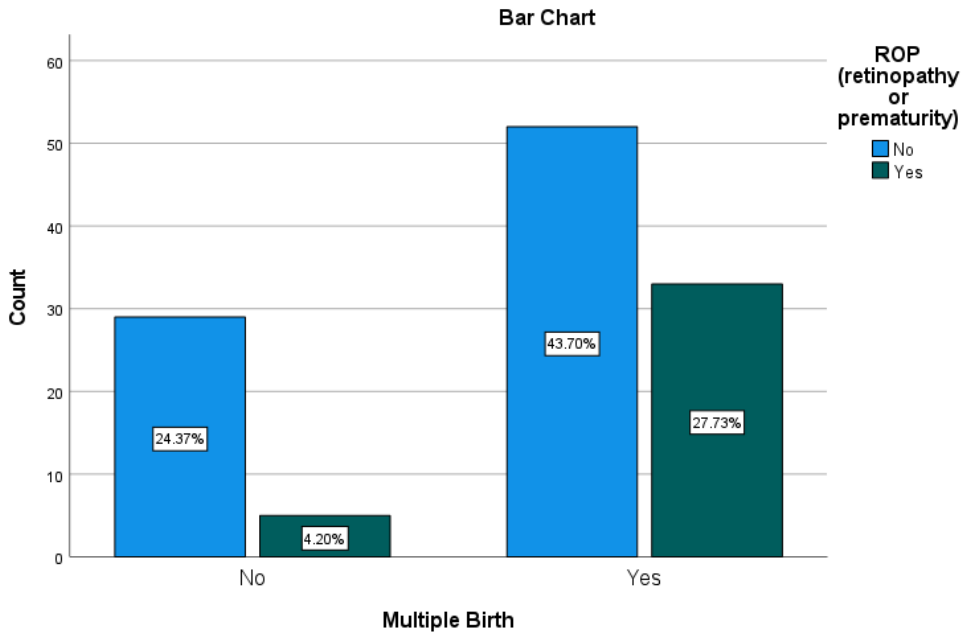

Figure 4.9. Multiple births with premature infants with ROP

Chapter Five: Discussion

5.1 Introduction

This chapter identifies an essential correlation between maternal, perinatal, and neonatal variables and the development of BPD, comparing the results with those of other research to determine whether the results are consistent or different. By considering the impact of these findings, this conversation aims to offer a theoretical justification for patterns that have been noticed, backed by research with reliable information.

5.2 Discussion

5.2.1 Demographic Characteristics

Only 11.8% of infants were born before 28 weeks of gestation, whereas the majority (88.2%) were born between 28 and 32 weeks. This finding is consistent with research by Huang et al. (2023) and Valenzuela-Stutman et al. (2019), which supports global epidemiology evidence that infants born earlier in pregnancy are more likely to have BPD.

Moreover, the percentage of male (65.5%) similar to the findings of Cokyaman and Kavuncuoglu (2020), Alonso et al. (2022), and Kardum et al. (2019), which suggest that male preterm neonates are more susceptible to BPD due to genetic and hormonal factors that affect lung development.

This finding is consistent with a study by Choi et al. (2019) and Geetha et al. (2021) that indicates a reduced maternal age can be associated with a higher risk of preterm birth and complications for newborns. There were fewer mothers under the age of 19 (7.6%) or over 40 (0.8%), with the majority (63.9%) being between the ages of 20 and 29.

5.2.2 Maternal History

A study by Huang et al. (2023), Ding et al. (2020), and Bhunwal et al. (2017) found that 26.1% of mothers did not receive prenatal care and treatment, which is an important risk factor for neonatal complications like BPD. Inadequate prenatal care increases the risk of complications like intrauterine growth restriction, which predisposes infants to BPD. In this study, preeclampsia was found to have substantial connections with PDA in moms

with eclampsia (47.9%) and preeclampsia (44.5%) in premature infants. This is consistent with research by Ding et al. (2020) and Geetha et al. (2021), which discovered that complications from maternal hypertension increase the risk of BPD by resulting in extended prenatal hypoxia and placenta insufficiency, which can lead to lung impairment and increase the risk of BPD in newborns.

64.7% of patients had premature rupture of membranes (PROM), a known cause of preterm birth and neonatal problems. This agrees with a study by Geetha et al. (2021); Lapcharoensap et al. (2015) and Huang et al. (2023), that has emphasized the association between PROM and BPD, indicating prolonged rupture raises the risk of fetal infection, which causes systemic inflammation in the neonate and subsequent lung injury.

A high percentage of infants (82.4%) delivered by CS. This agrees with a study by Mahmoud et al. (2024) and Rutkowska, et al. (2018), which reported that increased rates of CS led to fetal distress or maternal complications that increase the risk of developing BPD.

5.2.3 Birth and Neonatal History

Fetal distress was found in 88.2% of cases, and 60.5% required resuscitation at birth. This is consistent with Nakashima et al. (2020); Kim et al. (2020), and Ding et al. (2020), which shows that infants who are born with hypoxia are more likely to need long-term oxygen treatment and mechanical breathing, which significantly cause the development of BPD.

5.2.4 Respiratory Support and Intervention

All of the study premature infants needed oxygen therapy, although only a small proportion (84% for < 4 weeks, 16% for > 4 weeks) had mechanical ventilation. According to a study by Jensen et al. (2021), the main causes of BPD include prolonged oxygen therapy and ventilator support.

5.2.5 Infection and Complication

60.5% of premature infants were diagnosed with neonatal sepsis, of which 48.7% had early onset sepsis and 26.1% had late-onset sepsis. This is consistent with Geetha et al. (2021) which shows that BPD is exacerbated by sepsis, which triggers a systemic inflammatory response that damages the lung and impairs alveolar formation.

According to Huang et al. (2023) and Yang et al. (2022), who identified a high correlation between PDA and BPD, 58.5% of newborns had PDA. By increased pulmonary blood flow and fluid overloaded, PDA irritability lung damage and inflammation and increases the risk of BPD.

5.2.6 PDA and Maternal Preeclampsia

Maternal preeclampsia and the frequency of PDA in newborns are statistically correlated ($p = 0.045$), according to the results of the chi-square test. Infants born to mothers with preeclampsia had a higher chance of developing PDA (68%) compared to those born to mothers without hypertension (51%). This finding is in line with Yang et al. (2022), who found that PDA was an independent risk factor for severe BPD.

5.2.7 Neonatal Sepsis and Eclampsia in Mothers

An association between maternal eclampsia and neonatal sepsis incidence was statistically significant ($p = 0.046$). Similar to the study by Alonso et al. (2021), the results showed that children whose mothers had eclampsia had a higher likelihood of having sepsis (68.4%) than babies whose mothers did not (53.2%).

5.2.8 Late-onset sepsis and Maternal Eclampsia

A strong correlation was seen between maternal eclampsia and late-onset sepsis in neonates ($p = 0.009$). newborns whose moms had eclampsia had a considerably higher incidence of late-onset sepsis (36.8%) than newborns whose parents did not have eclampsia (16.1%); this finding is consistent with research by Kardum et al. (2019) and Sharma et al. (2020).

5.2.9 ROP and Maternal PROM

There was a significant correlation ($p = 0.020$) between a mother's history of PROM and the development of ROP in neonates. In line with Geetha et al. (2021) and Lapcharoensap et al. (2015), babies born to mothers with PROM had a greater probability of having ROP (39%), compared to babies born to moms without PROM (19%).

5.2.10 Late-onset sepsis with Multiple Births

The chi-square test revealed a statistically significant correlation between multiple births and late-onset sepsis ($p = 0.042$). newborns from multiple births had a greater incidence of late-onset sepsis (30.6%) than newborns from singleton pregnancies (14.7%); this finding is consistent with Croatian research by Kardum et al. (2019).

5.3 Conclusion

The findings indicate that low birth weight, gestational age, prolonged MV, and exposure to supplementary oxygen are some of the most significant risk factors for the development of BPD. The findings support previous research, emphasizing the need for targeted preventive interventions in NICUs and early identification of infants at risk.

The study's findings highlight the significance of respiratory treatment in assessing the prevalence of BPD, with prolonged invasive MV emerging as a significant contributing factor. The connection between elevated levels of oxygen and lung damage provides additional evidence of the detrimental effects of oxidative damage on growing lungs.

Overall, the work adds to our understanding of BPD risk factors by providing a comprehensive analysis of prenatal and postnatal influences on diseases progression. Consistency with previous research enhances the validity of the findings and contributes to a wealth of knowledge in newborn care. By identifying key components of BPD, the work supports efforts to improve newborn care practices and improve the long-term wellness and lives of preterm infants.

5.4 Study Recommendation

1. Focusing on that in order to minimize lung damage, respiratory support procedures must be optimized.
2. Promoting the use of non-invasive MV whenever possible

3. Use evidence-based interventions such as prenatal corticosteroids and surfactant therapy.
4. Improving postnatal care practices, such as offering nutritional support and conducting infection prevention measures, may also be crucial in reducing the incidence and severity of BPD.
5. NICUs should emphasize infection prevention techniques. Reducing sepsis-related consequences in preterm newborns requires sterile hand hygiene, antibiotic management, and early infection detection.

5.5 Study Limitation

1. Limited access to a governmental hospital.
2. Lack of documentation in medical file.
3. Differences in clinical procedures between several NICUs.

References

Alonso, A. S., Diaz, S. P., Soto, R. S., & Avila-Alvarez, A. (2022). Epidemiology and risk factors for bronchopulmonary dysplasia in preterm infants born at or less than 32 weeks of gestation. *Anales de Pediatría (English Edition)*, *96*(3), 242–251. https://doi.org/10.1016/j.anpede.2021.06.002

Bhunwal, S., Mukhopadhyay, K., Bhattacharya, S., Dey, P., & Dhaliwal, L. K. (2018). Bronchopulmonary dysplasia in preterm neonates in a level III neonatal unit in India. *Indian Pediatrics*, *55*, 211–215.

Chen, W., Zhang, Z., Dai, S., & Xu, L. (2021). Risk factors for metabolic bone disease among preterm infants less than 32 weeks gestation with bronchopulmonary dysplasia. *BMC Pediatrics*, *21*(1), 235. https://doi.org/10.1186/s12887-021-02738-9

Choi, E. K., Shin, S. H., Kim, E. K., & Kim, H. S. (2019). Developmental outcomes of preterm infants with bronchopulmonary dysplasia-associated pulmonary hypertension at 18–24 months of corrected age. *BMC Pediatrics*, *19*, 1–8. https://doi.org/10.1186/s12887-019-1558-1

Cokyaman, T., & Kavuncuoglu, S. (2020). Bronchopulmonary dysplasia frequency and risk factors in very low birth weight infants: A 3-year retrospective study.

Northern Clinics of İstanbul, *7*(2), 176–182. https://doi.org/10.14744/nci.2020.00543

Ding, L., Wang, H., Geng, H., Cui, N., Huang, F., Zhu, X., & Zhu, X. (2020). Prediction of bronchopulmonary dysplasia in preterm infants using postnatal risk factors. *Frontiers in Pediatrics*, *8*, 349. https://doi.org/10.3389/fped.2020.00349

Geetha, O., Rajadurai, V. S., Anand, A. J., Dela Puerta, R., Huey Quek, B., Khoo, P. C., ... & Agarwal, P. (2021). New BPD-prevalence and risk factors for bronchopulmonary dysplasia/mortality in extremely low gestational age infants ≤ 28 weeks. *Journal of Perinatology*, *41*(8), 1943–1950. https://doi.org/10.1038/s41372-021-01031-1

Higgins, R. D., Jobe, A. H., Koso-Thomas, M., Bancalari, E., Viscardi, R. M., Hartert, T. V., ... & Raju, T. N. (2018). Bronchopulmonary dysplasia: Executive summary of a workshop. *The Journal of Pediatrics*, *197*, 300–308. https://doi.org/10.1016/j.jpeds.2018.01.043

Huang, L. Y., Lin, T. I., Lin, C. H., Yang, S. N., Chen, W. J., Wu, C. Y., ... & Yang, Y. N. (2023). Comprehensive analysis of risk factors for bronchopulmonary dysplasia in preterm infants in Taiwan: A four-year study. *Children*, *10*(11), 1822. https://doi.org/10.3390/children10111822

Jensen, E. A., Edwards, E. M., Greenberg, L. T., Soll, R. F., Ehret, D. E., & Horbar, J. D. (2021). Severity of bronchopulmonary dysplasia among very preterm infants in the United States. *Pediatrics*, *148*(1), e2020030007. https://doi.org/10.1542/peds.2020-030007

Jobe, A. H., & Bancalari, E. (2021). An all-inclusive perspective on bronchopulmonary dysplasia. *The Journal of Pediatrics*, *234*, 257–259. https://doi.org/10.1016/j.jpeds.2021.02.058

Kardum, D., Filipović Grčić, B., Müller, A., & Dessardo, S. (2019). Incidence and risk factors for moderate and severe bronchopulmonary dysplasia in very low birth weight infants in two Croatian perinatal regions—a retrospective cohort study. *Journal of Pediatric and Neonatal Individualized Medicine*, *8*(1), e080104. https://doi.org/10.7363/080104

Kim, J. K., Chang, Y. S., Sung, S., Ahn, S. Y., Yoo, H. S., & Park, W. S. (2016). Trends in survival and incidence of bronchopulmonary dysplasia in extremely preterm infants at 23–26 weeks gestation. *Journal of Korean Medical Science*, *31*(3), 423–429. https://doi.org/10.3346/jkms.2016.31.3.423

Kim, S. H., Han, Y. S., Chun, J., Lee, M. H., & Sung, T. J. (2020). Risk factors that affect the degree of bronchopulmonary dysplasia: Comparison by severity in the same gestational age. *PLOS ONE*, *15*(7), e0235901. https://doi.org/10.1371/journal.pone.0235901

Lapcharoensap, W., Gage, S. C., Kan, P., Profit, J., Shaw, G. M., Gould, J. B., ... & Lee, H. C. (2015). Hospital variation and risk factors for bronchopulmonary dysplasia in a population-based cohort. *JAMA Pediatrics*, *169*(2), e143676. https://doi.org/10.1001/jamapediatrics.2014.3676

Mahmoud, R. A., Abdelrahman, M., Gharib, A., Elagami, A. H., Abdelrahim, A., & Alfaleh, K. (2024). Frequency and risk factors of bronchopulmonary dysplasia in low-birth-weight infants in Saudi Arabia: A 5-year experience. *Journal of Pediatric and Neonatal Individualized Medicine*, *13*(1), e130106. https://doi.org/10.7363/130106

Morrow, L. A., Wagner, B. D., Ingram, D. A., Poindexter, B. B., Schibler, K., Cotten, C. M., ... & Abman, S. H. (2017). Antenatal determinants of bronchopulmonary dysplasia and late respiratory disease in preterm infants. *American Journal of Respiratory and Critical Care Medicine*, *196*(3), 364–374. https://doi.org/10.1164/rccm.201610-2000OC

Nagiub, M., Kanaan, U., Simon, D., & Guglani, L. (2017). Risk factors for development of pulmonary hypertension in infants with bronchopulmonary dysplasia: Systematic review and meta-analysis. *Paediatric Respiratory Reviews*, *23*, 27–32. https://doi.org/10.1016/j.prrv.2016.08.002

Nakashima, T., Inoue, H., Sakemi, Y., Ochiai, M., Yamashita, H., Ohga, S., & Neonatal Research Network of Japan. (2021). Trends in bronchopulmonary dysplasia among extremely preterm infants in Japan, 2003–2016. *The Journal of Pediatrics*, *230*, 119–125. https://doi.org/10.1016/j.jpeds.2020.11.051

Ramos-Navarro, C., Maderuelo-Rodriguez, E., Concheiro-Guisan, A., Perez-Tarazona, S., Rueda-Esteban, S., Sánchez-Torres, A., ... & Sánchez-Luna, M. (2022). Risk factors and bronchopulmonary dysplasia severity: Data from the Spanish Bronchopulmonary Dysplasia Research Network. *European Journal of Pediatrics*, *182*, 1107–1117. https://doi.org/10.1007/s00431-022-04550-9

Reiterer, F., Scheuchenegger, A., Resch, B., Maurer-Fellbaum, U., Avian, A., & Urlesberger, B. (2019). Bronchopulmonary dysplasia in very preterm infants: Outcome up to preschool age, in a single center of Austria. *Pediatrics International*, *61*(4), 381–387. https://doi.org/10.1111/ped.13836

Rocha, G., De Lima, F. F., Machado, A. P., Guimarães, H., Proença, E., Carvalho, C., ... & Quintas, C. (2019). Small for gestational age very preterm infants present a higher risk of developing bronchopulmonary dysplasia. *Journal of Neonatal-Perinatal Medicine*, *12*(4), 419–427. https://doi.org/10.3233/NPM-180200

Rutkowska, M., Hożejowski, R., Helwich, E., Borszewska-Kornacka, M. K., & Gadzinowski, J. (2019). Severe bronchopulmonary dysplasia–incidence and predictive factors in a prospective, multicenter study in very preterm infants with respiratory distress syndrome. *The Journal of Maternal-Fetal & Neonatal Medicine*, *32*(12), 1958–1964. https://doi.org/10.1080/14767058.2017.1410798

Sharma, A., Xin, Y., Chen, X., & Sood, B. G. (2020). Early prediction of moderate to severe bronchopulmonary dysplasia in extremely premature infants. *Pediatrics & Neonatology*, *61*(3), 290–299. https://doi.org/10.1016/j.pedneo.2019.08.001

Soliman, N., Chaput, K., Alshaikh, B., & Yusuf, K. (2017). Preeclampsia and the risk of bronchopulmonary dysplasia in preterm infants less than 32 weeks' gestation. *American Journal of Perinatology*, *34*(06), 585–592. https://doi.org/10.1055/s-0036-1597929

Starr, M. C., Boohaker, L., Eldredge, L. C., Menon, S., Griffin, R., Mayock, D. E., ... & Hingorani, S. (2020). Acute kidney injury and bronchopulmonary dysplasia in premature neonates born less than 32 weeks' gestation. *American Journal of Perinatology*, *37*(03), 341–348. https://doi.org/10.1055/s-0039-1694037

Valenzuela-Stutman, D., Marshall, G., Tapia, J. L., Mariani, G., Bancalari, A., Gonzalez, Á., & Neocosur Neonatal Network. (2019). Bronchopulmonary dysplasia: Risk prediction models for very-low-birth-weight infants. *Journal of Perinatology*, *39*(9), 1275–1281. https://doi.org/10.1038/s41372-019-0406-1

Vayalthrikkovil, S., Vorhies, E., Stritzke, A., Bashir, R. A., Mohammad, K., Kamaluddeen, M., ... & Soraisham, A. (2019). Prospective study of pulmonary hypertension in preterm infants with bronchopulmonary dysplasia. *Pediatric Pulmonology*, *54*(2), 171–178. https://doi.org/10.1002/ppul.24188

Xu, Y. P. (2016). Bronchopulmonary dysplasia in preterm infants born at less than 32 weeks gestation. *Global Pediatric Health*, *3*, 2333794X16668773. https://doi.org/10.1177/2333794X16668773

Yang, T., Shen, Q., Wang, S., Dong, T., Liang, L., Xu, F., ... & Yang, J. (2022). Risk factors that affect the degree of bronchopulmonary dysplasia in very preterm infants: A 5-year retrospective study. *BMC Pediatrics*, *22*(1), 200. https://doi.org/10.1186/s12887-022-03254-w

Appendices

Appendix 1: List of Tables

Table 4.2: infants' weights description

	Mean	St.d	Minimum	Maximum
Admission weight (G)	1265.11	184.21	750.00	1500.00
Birth weight (G)	1257.45	196.57	500.00	1500.00

Table 4.3: Maternal History Variables: Number and Percentage

Items		Count	N %
Did the mother received prenatal care	No	31	26.1%
	Yes	88	73.9%
Did the mother had infections (e.g. Chorioamnionitis, UTI)	No	95	79.8%
	Yes	24	20.2%
Did the mother had preeclampsia.	No	66	55.5%
	Yes	53	44.5%
Did the mother had eclampsia	No	62	52.1%
	Yes	57	47.9%
Did the mother had GDM gestational diabetes mellitus.	No	99	83.2%
	Yes	20	16.8%
Did the mother have any history of PROM	No	42	35.3%
	Yes	77	64.7%
Have the mother received corticosteroid before delivery?	No	58	48.7%
	Yes	61	51.3%
Mode of Delivery?	CS	98	82.4%
	Normal	21	17.6%
Multiple Birth	No	34	28.6%
	Yes	85	71.4%

Table 4.4: Birth and Neonatal History Variables of the studied premature infants: Number and Percentage

Items		Count	N %
Was there any evidence of fetal distress?	No	14	11.8%
	Yes	105	88.2%
Was resuscitation required at birth?	No	47	39.5%
	Yes	72	60.5%
Did the baby need intubation after birth immediately?	No	29	24.4%
	Yes	90	75.6%

Table 4.5: APGAR score of the studied premature infants

	Mean	**St.D**	**Minimum**	**Maximum**
Apgar Score at one minute:	5.87	1.34	4.00	8.00
Apgar Score at five minutes:	8.18	.72	7.00	9.00

Table 4.6: Respiratory support and intervention variables: Number and percentage

Items		Count	N %
Was the oxygen therapy required?	No	0	0.0%
	Yes	119	100.0%
Did the infants require mechanical ventilation?	No	0	0.0%
	Yes	100	100.0%
The duration of mechanical ventilation.	-Less than 4 weeks	100	84.0%
	-More than 4 weeks	19	16.0%
Did the infant receive surfactant therapy?	No	0	0.0%
	Yes	0	0.0%
Have been trial for extubation and weaning?	No	26	21.8%
	Yes	93	78.2%
Early caffeine administration?	No	0	0.0%
	Yes	0	0.0%
given dexamethasone?	No	51	42.9%
	Yes	68	57.1%

Table 4.7: infections and complications variables: Number and Percentage

Items		Count	N %
Did the infant had Sepsis	No	47	39.5%
	Yes	72	60.5%
Did the infant had Pneumonia	No	104	87.4%
	Yes	15	12.6%
Did the infant had NEC (necrotizing enterocolitis)	No	102	85.7%
	Yes	17	14.3%
Early onset sepsis	No	61	51.3%
	Yes	58	48.7%
Late onset sepsis	No	88	73.9%
	Yes	31	26.1%
PDA (patent ductus arteriosus)	No	49	41.5%
	Yes	69	58.5%
ROP (retinopathy of prematurity)	No	82	68.9%
	Yes	37	31.1%

Table 4.8: Correlation between maternal preeclampsia and PDA in the studied premature infants

					Chi square P-vale
Count					0.045
		PDA		Total	
		No	Yes		
Did the mother had preeclampsia.	No	32	30	62	
	Yes	15	42	57	
Total		47	72	119	

Table 4.9: Correlation between maternal eclampsia and Studied Premature with sepsis

					Chi square P-vale
Count					0.046
		Did the infant had Sepsis		Total	
		No	Yes		
Did the mother had eclampsia	No	29	33	62	
	Yes	18	39	57	
Total		47	72	119	

Table 4.10: Correlation between maternal eclampsia and late onset of neonatal sepsis

					Chi square P-vale
Count					0.009
		Late onset sepsis		Total	
		No	Yes		
Did the mother had eclampsia	No	52	10	62	
	Yes	36	21	57	
Total		88	31	119	

Table 4.11: Correlation between PROM & premature infants with ROP

					Chi square P-vale
Count					
		ROP (retinopathy or prematurity)		Total	
		No	Yes		
Did the mother have any history of PROM	No	34	8	42	0.020
	Yes	47	30	77	
Total		81	38	119	

Table 4.12: Correlation between multiple births and neonatal late onset sepsis

					Chi square P-vale
Count					0.042
		Late onset sepsis		Total	
		No	Yes		
Multiple Birth	No	29	5	34	
	Yes	59	26	85	
Total		88	31	119	

Table 4.13: Correlation between multiple births and premature infants with ROP

					Chi square P-vale
Count					0.008
		ROP (retinopathy of prematurity)		Total	
		No	Yes		
Multiple Birth	No	29	5	34	
	Yes	52	33	85	
Total		81	38	119	

Appendix 2: Study Tools

Demographic data

Infants Birth Date	
GA (Gestational Age) at birth	_ 28-32 weeks _ Less than 28 weeks
Admission weight	
Birth weight	
Gender	-Male -Female

Maternal History

Mother Age	-less than 20 years old. -20-30 years old. -30-40 years old. -Above than 40 years old.
Did the mother received prenatal care	-yes -No
Did the mother have any of the following conditions during pregnancy? -infections (e.g. Chorioamnionitis, UTI) -preeclampsia. -eclampsia. -GDM gestational diabetes mellitus.	 -yes -No -yes -No -yes -No -yes -No
Did the mother have any history of PROM (premature rupture of membrane)	-yes -No
Have the mother received corticosteroid before delivery?	-yes -No
Mode of Delivery?	-Normal -CS cesarian section
Multiple Birth	-yes -No

Birth and Neonatal History

Was there any evidence of fetal distress?	-yes -No
Was resuscitation required at birth?	-yes -No
Apgar Score at one minute: Apgar Score at five minutes:	--------- ---------

Did the baby need intubation after birth immediately?	-yes -No

Respiratory support and intervention

Was the oxygen therapy required?	-yes -No
The duration of oxygen therapy in weeks.	-Less than 4 weeks -More than 4 weeks
Did the infants require mechanical ventilation?	-yes -No
The duration of mechanical ventilation.	
Did the infant receive surfactant therapy?	-yes -No
Have been trial for extubation and weaning?	-yes -No
Early caffeine administration?	-yes -No
Given Dexamethasone?	yes -No

Infections and complications

Did the infant have any of the following infections?	
-Sepsis	-yes -No
-Pneumonia	-yes -No
-NEC (necrotizing enterocolitis)	-yes -No
Sepsis:	
Early onset sepsis	-yes -No
Late onset sepsis	-yes -No
Were there any other complications?	
PDA (patent ductus arteriosus)	-yes -No
IVH (intraventricular hemorrhage)	-yes -No
ROP (retinopathy or prematurity)	-yes -No

Appendix 3: IRB Approval

Arab American University
Institutional Review Board - Ramallah

الجامعة العربية الأمريكية
مجلس اخلاقيات البحث العلمي – رام الله

IRB Approval Letter

Study Title: "Risk Factors for Broncho Pulmonary Dysplasia among Premature Infants Less than 32 Weeks at Palestinian Hospitals, A Retrospective Study".

Submitted by: Maram Zahi Algharabeh

Date received: 24th July 2024

Date reviewed: 29th July 2024

Date approved: 29th July 2024

Your Study titled **"Risk Factors for Broncho Pulmonary Dysplasia among Premature Infants Less than 32 Weeks at Palestinian Hospitals, A Retrospective Study"** with the code number **"R-2024/A/123/N"** was reviewed by the Arab American University Institutional Review Board - Ramallah and it was approved on the 29th of July 2024.

Sajed Ghawadra, PhD
IRB-R Chairman
Arab American University of Palestine

IRB-R
ARAB AMERICAN UNIVERSITY-PALESTINE
INSTITUTIONAL REVIEW BOARD - RAMALLAH

General Conditions:

1. Valid for 6 months from the date of approval.
2. It is important to inform the IRB-R with any modification of the approved study protocol.
3. The Bord appreciates a copy of the research when accomplished.

رام الله – فلسطين

Tel: 02-294-1999 **E-Email:** IRB-R@aaup.edu **Website:** www.aaup.edu

Appendix 4: تسهيل المهمة

Arab American University
Faculty of Graduate Studies

الجامعة العربية الأمريكية
كلية الدراسات العليا

2024/8/10

إلى من يهمه الأمر

تسهيل مهمة بحثية

تحية طيبة وبعد،

تُهديكم كلية الدراسات العُليا في الجامعة العربية الأمريكية أطيب التحيات، وبالإشارة الى الموضوع أعلاه، تشهد كلية الدراسات العُليا في الجامعة أن الطالبة **مرام زاهي ذيب الغرايبة** والتي تحمل الرقم الجامعي 202216657هي طالبة ماجستير في برنامج تمريض حديثي الولادة وتعمل على رسالة الماجستير الخاصة بها بعنوان:

"Risk factors for Bronchopulmonary Dysplasia among Premature Infants Less than 32 weeks at Palestinian Hospitals, A retrospective study"

تحت إشراف الدكتور عمر المحمود. نأمل من حضرتكم الإيعاز لمن يلزم لمساعدتها للحصول على المعلومات اللازمة للدراسة، علماً أن المعلومات ستستخدم لغاية البحث فقط وسيتم التعامل معها بغاية السرية، وقد أعطيت هذه الرسالة بناءً على طلبها.

وتفضلوا بقبول فائق الاحترام

عميد كلية الدراسات العليا

د. نوار قطب

كلية الدراسات العليا
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State of Palestine
Ministry of Health
Education in Health and Scientific Research Unit

دولة فلسطين
وزارة الصحة
وحدة التعليم الصحي والبحث العلمي

Ref.: ....
Date:..................

الرقم: ٢٢١/١٩٤٢/٢٠٢٤
التاريخ: ١٨/٨/٢٠٢٤

الأخ مدير عام الادارة العامة للمستشفيات المحترم،،،

الاخت ق. أ. مدير عام الادارة العامة لتكنولوجيا المعلومات المحترمة،،،

تحية واحترام...

الموضـــوع: تسهيل مهمة بحث

يرجى تسهيل مهمة **الطالبة: مرام زاهي ذيب الغرابة – تمريض حديثي الولادة/ الجامعة العربية الامريكية**، وباشراف د. عمر المحمود، في عمل بحث بعنوان:

"Risk factors for Bronchopulmonary Dysplasia among Premature Infants Less than 32 weeks at Palestinian Hospitals, A retrospective study"

من خلال السماح للطالبة بجمع معلومات عن طريق الاطلاع على ملفات المرضى وباشراف المسؤول من قسم IT، وذلك في:

- مستشفيات شمال ووسط الضفة الغربية

على ان يتم الالتزام باساليب واخلاقيات البحث العلمي، وعد التعرض للمعلومات التعريفية للمشاركين .
على ان يتم تزويد الوزارة بنسخة PDF من نتائج البحث، التعهد بعدم النشر لحين الحصول على موافقة الوزارة على نتائج البحث.

مع الاحترام...

د. عبد الله القواسمي
رئيس وحدة التعليم الصحي والبحث العلمي

نسخة عميد الدراسات العليا المحترمة –الجامعة العربية الامريكية

Telfax.:09-2333901 scientificresearch.dep@gmail.com تلفاكس: 09-2333901

عوامل خطر الإصابة بخلل التنسج القصبي الرئوي لدى الأطفال الخدج الذين تقل أعمارهم عن 32 أسبوعًا في المستشفيات الفلسطينية الخاصة شمال غرب الضفة الغربية: دراسة استعادية

مرام زاهي ذيب الغرابة

د. عمر الحمود

د. معتز دريدي

د. نجوى صبح

ملخص

يُعد خلل التنسج القصبي الرئوي (BPD) أكثر أمراض الرئة شيوعًا لدى الأطفال الخدج، ويشكل تحديات صحية عالمية كبرى. يتميز هذا الاضطراب بنمو رئوي غير طبيعي، ويؤثر على وظائف الجهاز التنفسي، والنمو العصبي، والنمو العام على المدى الطويل، بالإضافة إلى التسبب في مشاكل تنفسية حادة.

الهدف الرئيسي من هذه الدراسة هو تحديد عوامل خطر الإصابة بخلل التنسج القصبي الرئوي لدى الأطفال الخدج الذين تقل أعمارهم عن 32 أسبوعًا في المستشفيات الفلسطينية الخاصة شمال غرب الضفة الغربية. أُجري تصميم كمي بأثر رجعي في مستشفيات خاصة للرعاية الثالثية في شمال غرب الضفة الغربية، والتي تضم وحدة عناية مركزة لحديثي الولادة. كان جميع الأطفال الخدج الذين تقل أعمارهم عن 32 أسبوعًا هم من السكان. استُخدمت طريقة العينة الكلية لاختيار البيانات. بلغ حجم العينة 119 طفلًا. طُوّرت أداة جمع البيانات ذاتيًا، ويتألف الاستبيان من خمسة أقسام. بمتوسط وزن عند الولادة بلغ 1257.45 غرامًا، وُلدت الغالبية (88.2%) بين الأسبوعين 28 و32 من الحمل، وكانوا ذكورًا (65.5%). ارتبطت مقدمات الارتعاج والقناة الشريانية السالكة (PDA) ارتباطًا وثيقًا (p=0.045)، وكانت المتغيرات الأمومية مثل مقدمات الارتعاج (44.5%) وتسمم الحمل (47.9%) شائعة. كان اعتلال الشريان الرئوي (PDA) (58.5%)، واعتلال الشبكية الخداجي (ROP) (31%)، وتسمم الدم (60.5%) من بين المشاكل الشائعة لدى حديثي الولادة. خضع جميع الرضع للتهوية الميكانيكية، ولكن لم يُعطَ أيٌّ منهم علاجًا بالسطح الفاعل. علاوة على ذلك، احتاج 75.6% من

المواليد الجدد إلى التنبيب فورًا، مما يدل على خطورة الضائقة التنفسية. لتحسين نتائج الأطفال الخدج، تُسلِّط البيانات الضوء على ضرورة تحسين رعاية ما قبل الولادة، والعلاجات المبكرة لحديثي الولادة، وتقنيات الإدارة المُركَّزة.

تُحدِّد هذه الدراسة انخفاض الوزن عند الولادة، وعمر الحمل، والتهوية الميكانيكية المُطوَّلة، والتعرض للأكسجين كعوامل خطر رئيسية لخلل التنسج القصبي الرئوي لدى حديثي الولادة الخدج. بالإضافة إلى تسليط الضوء على أهمية التحكم في التنفس، تُسمِّي الدراسة عوامل أخرى مثل تسمم الدم وتقييد النمو داخل الرحم. تُؤيِّد النتائج استراتيجيات الوقاية والكشف المُبكِّر في وحدات العناية المركزة لحديثي الولادة.

الكلمات المفتاحية: خلل التنسج القصبي الرئوي، الخدج، عوامل الخطر، وحدة العناية المركزة لحديثي الولادة.