Arab American University
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Prevalence and Risk Factors of Intraventricular Hemorrhage among Premature Infants in Southern West Bank Hospitals-Palestine

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Thesis Approval

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Declaration

I am, Hothyfa Alhorini, hereby declare that the dissertation titled Prevalence and Risk Factors of Intraventricular Hemorrhage Among Premature Infants in Southern West Bank Hospitals-Palestine, in this thesis, is my own, except for quotations and summaries which have been duly acknowledged and that it has not been submitted elsewhere for the award of any degree.

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Dedication

This thesis is dedicated to the martyrs of our homeland, who sacrificed their lives on the sacred grounds of duty, your bravery and dedication inspire us all, to my beloved father and dear mother, your unwavering support and endless love have been the cornerstone of my journey, to my wife, my steadfast companion, thank you for walking beside me through every step and every challenge, to my brothers and sisters, your encouragement and belief in me have been a constant source of strength. and to my esteemed teachers, whose guidance and wisdom have shaped my path, I am forever grateful.

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I also thank my university, the Arab American University, for its pioneering role in promoting practical research at all levels.

Abstract

Introduction: This study assesses the prevalence and risk factors of intraventricular hemorrhage (IVH) in premature (gestational age <32 weeks) in Southern West Bank hospitals. It aims to improve nursing practices in Neonatal intensive care units and develop effective preventive strategies for Intraventricular Hemorrhage.

Methodology: A total of 186 premature infants were included in this retrospective study from Palestinian hospitals, A designed checklist methodology was utilized to acquire and process patient data confidentially.

Results: This study found that 32.3% of premature (gestational age <32 weeks) developed intraventricular hemorrhage (IVH), with 53.3% of these cases being low-grade. Lower gestational age was associated with a higher incidence of IVH, especially in babies less than 28 weeks, This study found that Maternal steroid administration significantly reduced Intraventricular Hemorrhage risk. And found umbilical catheter insertion, surfactants, blood transfusions, nasal CPAP, pulmonary hemorrhage, and invasive respiratory assistance, were significant predictors of Intraventricular Hemorrhage.

Conclusion:. The study highlights risk factors for Intraventricular Hemorrhage such as nasal CPAP use, lower Gestational Age, surfactant administration, and blood transfusion, and the study highlights potential preventive measures for Intraventricular Hemorrhage in this region.

Keywords: Intraventricular hemorrhage, Premature, Gestational Age, Risk factor, Transfontanelle ultrasonography.

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List of abbreviation

Abbreviation	Explanation
AAUP	Arab American University Palestine
BW	Birth weight
DCC	Delayed Cord Clamping
ELBW	Extreme low birth weight
G.A.	Gestational age
gm	Gram
GDM	Gestational diabetes mellites
ICC	Immediate Cord Clamping
IVH	Intraventricular hemorrhage
LBW	Low birth weight
CPAP	continuous positive airway pressure
NICU	Neonatal intensive care unit
PDA	patent ductus arteriosus
PHVD	posthemorrhagic ventricular dilatation
PVL	Periventricular leukomalacia
PIH	Pregnancy-induced hypertension
PVHI	Periventricular hemorrhagic infarction
RDS	Respiratory distress syndrome
SPSS	Statistical package for social sciences
Std	Standard deviation
WHO	World Health Organization
VLBW	Very low birth weight
wk	Week

Chapter One

Introduction

1:1 Background:

World Health Organization (WHO) in 2024, defines Premature born alive before 37 weeks of pregnancy. According to gestational age, premature is classified as extremely premature for babies who are less than 28 weeks, very premature for babies between 28-32 weeks, and moderately too late for babies between 32-37 weeks.

Gestational age is the weeks between the start day of the mother's final regular menstrual cycle and the birthday. More precisely, the difference between the day of delivery and the 14 days before the day of conception is the gestational age. The fetus's gestational age is not the same as its embryologic age (MSD Manuals, 2023).

Intraventricular hemorrhage (IVH) in Premature refers to the occurrence of bleeding within the fluid-filled spaces, or ventricles, encircled by the baby's brain. Premature are most severely impacted by this disorder, with a higher susceptibility in those who are smaller and born at an earlier gestational age. The elevated risk in premature babies is attributed to the underdeveloped and fragile nature of their cerebral blood vessels IVH rarely occurs at birth mostly it is a complication in the first few days of life (Johns Hopkins Medicine, 2024).

This problem can be classified according to the severity of the IVH clinical spectrum into four grades: IVH grades one and two which contain mild bleeding and most often self-limiting, and IVH grades three and four which include moderate to severe bleeding (Siffel et al., 2021). Intra Ventricular Hemorrhage IVH is a condition where there is bleeding inside the ventricular system of the brain. This is a frequent neurological issue in premature infants. It can cause significant neurological and

developmental problems, which is why it is a top priority for healthcare providers, parents, and researchers.

Globally, IVH in premature infants, especially those whose gestational age is less than 32 weeks, is considered one of the most dangerous diseases and has high mortality and morbidity rates, a global incidence range of IVH grade 3-4, spanning from 5% to 52%. The regional breakdown indicated varying rates: Europe (5-52%), North America (8-22%), Asia (5-36%), and Oceania (8-13%) (Siffel et al., 2021)

Taking care of premature infants, especially those born before 32 weeks of gestation, is a significant challenge in obstetrics and neonatology. Intraventricular Hemorrhage (IVH) is a complicated condition that poses a severe threat to the health and well-being of these neonates. This research project aims to explore the occurrence and risk factors associated with IVH among premature infants with a gestational age of less than 32 weeks in Southern West Bank hospitals.

The Southern West Bank is a Region with a diverse population with varying healthcare access and socioeconomic factors that may influence the prevalence and risk factors associated with IVH in premature infants. By conducting this research, the researcher hopes to develop strategies that mitigate risk factors associated with IVH.

1.2 Problem Statement

Intra Ventricular Hemorrhage in premature infants is a significant global health issue. Moreover, it is a major cause of death and morbidity in very premature. Although survival rates are increasing to about 70% among premature infants, IVH is still a significant factor in mortality and morbidity (Özek & Kersin, 2020**)**. Premature infants (< 30 weeks of gestational age) are at high risk for IVH (Özek & Kersin, 2020**)**.

Furthermore, a literature review conducted in 2019 revealed that IVH increased with low gestational age (Leijser, & de Vries, 2019). This problem occurs in about 35–45% of Premature with a birth weight below 750 grams (Özek & Kersin, 2020**)**. This is due to multiple risk factors such as sepsis, transportation, extremely low birth weight, sodium bicarb administration, health-care workers' care and procedures, and others. Therefore, our goal is to study the prevalence and risk factors of intraventricular hemorrhage among premature infants less than 32 weeks gestational age in Southern West Bank.

1.3 Study Aim

To assess the prevalence and risk factors of intraventricular hemorrhage among premature less than 32 weeks of gestational age in Southern West Bank hospitals.

1.4 Study objectives:

This research encompasses three primary objectives aimed at enhancing our understanding of intraventricular hemorrhage (IVH) among premature in the Southern West Bank region:

1. To assess the prevalence of IVH in premature infants in the Southern West Bank.

2. To assess the correlation between gestational age and IVH among premature infants.

3. To assess risk factors for IVH among premature infants in Southern West Bank.

1.5 Significance of Study

This research stands as a pioneering effort in our region, aiming to uncover the determinants that contribute to the occurrence of IVH.

Hence, the significance of this study lies in addressing the severe lack of information available about this disease in the Southern West Bank. Through this research, the researcher aims to fill this gap.

Importantly, there is a dearth of statistics or quantifiable information regarding the incidence or prevalence of IVH in Palestine. Our research endeavors to fill this void, shedding light on the extent of this critical issue and its implications for neonatal care, so this research is considered the first research on this concept in Palestine.

Upon the completion of the final analysis, the findings of this study may have the potential to significantly enhance nursing knowledge and healthcare professionals working in NICUs. By expanding our understanding of the factors influencing IVH, nurses will be better equipped to provide specialized and tailored care to premature infants, ultimately improving their overall health outcomes.

Furthermore, the results of this study may serve as a valuable resource for decision-makers within Palestinian hospitals. The insights gained from this research can inform more effective care planning and strategies aimed at preventing complications related to IVH. In doing so, this study contributes to the advancement of neonatal healthcare practices and, ultimately, the well-being of premature infants in the South West Bank region.

1.6 Research Questions

Main question:

What are the prevalence and risk factors of IVH among premature infants <32 weeks gestational age in Southern West Bank hospitals?

Sub-questions:

What are the primary risk factors associated with intraventricular hemorrhage (IVH) among premature infants <32 weeks gestational age in Southern West Bank hospitals?

Are there differences between gestational age and intraventricular hemorrhage (IVH) in premature infants in Southern West Bank hospitals?

What are the maternal predictors of intraventricular hemorrhage (IVH) among premature infants <32 weeks gestational age in Southern West Bank hospitals?

What are the therapeutic intervention predictors of intraventricular hemorrhage (IVH) among premature infants <32 weeks gestational age in Southern West Bank hospitals?

What are the comorbidities predictors of intraventricular hemorrhage (IVH) among premature infants <32 weeks gestational age in Southern West Bank hospitals?

1.7 Study Variables

Dependent Variables:

- Intraventricular hemorrhage IVH.

Independent Variables:

- IVH Risk factors:

- Neonatal characteristics and demographic data of the infants: gender, transportation, gestational age, birth weight, intubation at delivery.
- Maternal factor: antenatal steroid, chorioamnionitis, PPROM.

- Neonatal comorbidities: patent ductus Invasive respiratory support, Hypothermia, nasal CPAP, pulmonary hemorrhage, hypercapnia, Pneumothorax.
- Therapeutic interventions: Hypotension therapy, acidosis therapy, hydrocortisone, blood transfusion, surfactant, Umbilical catheter insertion.

1.8 Theoretical definition:

Gestational Age: age is the weeks between the start day of the mother's final regular menstrual cycle and the birthday. More precisely, the difference between the day of delivery and the 14 days before the day of conception is the gestational age. The fetus's gestational age is not the same as its embryologic age (MSD Manuals, 2023)

Premature: It is defined as neonates born alive before 37 weeks of gestation, according to gestational age premature is classified as extremely premature for babies who are less than 28 weeks, very premature for babies between 28-32 weeks, and moderate to late for babies between 32-37 weeks (World Health Organization, 2024).

Low birth weight: According to the American Academy of Pediatrics, low birth weight (LBW) is defined as infants weighing 2500 grams or less. This category of LBW can be further divided into very low birth weight (VLBW), which refers to infants weighing less than 1500 grams, and extremely low birth weight (ELBW), which refers to infants weighing less than 1000 grams (Cutland et al., 2017).

Prolonged labor: also referred to as failure to progress occurs when the duration of labor extends to approximately 20 hours or more for first-time mothers or 14 hours or more for women who have previously given birth. This extended duration is primarily experienced during the initial phase of labor. While it can be physically exhausting and

emotionally draining, it seldom results in complications. (American Pregnancy Association, 2024).

1.8 Operational Definition

After a comprehensive review of the literature on IVH and its risk factors, the data collected to achieve the goals of the study were conducted through a checklist form developed by the researcher and evaluated by various experts, containing factors that may help reduce or increase the impact of Intraventricular hemorrhage.

The data record or checklist model included the data of all premature with G.A. ≤ 32 wk to investigate factors that could help in the development of IVH for them. Data records contain demographic data, neonatal characteristics, neonatal co-morbidities, neonatal therapeutic interventions, and maternal factors.

1.9 Summary:

This study addresses the critical issue of intraventricular hemorrhage (IVH) among premature infants born with a gestational age of less than 32 weeks in Southern West Bank hospitals. It commences with a comprehensive introduction outlining the significance of the study, highlighting the lack of data and assessment tools for IVH risk factors in this region.

This study aims to assess the prevalence of IVH and to identify primary risk factors associated with IVH. It seeks to fill crucial knowledge gaps in neonatal care, enhance nursing knowledge in NICUs, and provide valuable insights for decision-makers in Palestinian hospitals to develop better preventive care strategies. The assessment is poised to contribute significantly to neonatal healthcare practices and the well-being of premature in Southern West Bank hospitals.

Chapter Two

Literature Review

2.1 Introduction

Premature birth continues to pose a significant global health challenge, particularly for infants born before 32 weeks of gestational age who face a range of complications. Among these, (IVH) emerges as a pivotal neurological concern. This chapter consolidates insights drawn from both regional and global scientific literature, thoroughly exploring the prevalence and risk factors associated with IVH in premature infants. A comprehensive understanding of the complexities surrounding IVH, including diagnostic hurdles and potential complications, is imperative for healthcare providers. By situating these findings within the context of the local healthcare landscape, this research strives to bridge the divide between theoretical knowledge and practical application. Ultimately, the goal is to elevate the standard of care and improve outcomes for these vulnerable infants.

2.2 Prevalence and Risk Factors of Intraventricular hemorrhage

Globally, 15 million neonates are born prematurely every year, over half in low-income countries. Prematurity and low birth weight neonates have a greater risk of IVH (MacLeod et al., 2021).

After extensive research and inquiry, it is evident that there is a noticeable gap in the existing literature within our country concerning the prevalence and risk factors of intraventricular hemorrhage (IVH) in premature infants. Therefore, through this research, the researcher seeks to find the prevalence of this disease among premature infants in the south of the West Bank, as this is considered the first research in this context in Palestine.

2.2.1 Prevalence of Intraventricular hemorrhage (Regional studies)

A retrospective case-control study was conducted at the neonatal intensive care of King Saud Medical City in (2021) to assess risk factors for IVH in premature infants. Study findings revealed that the following risk factors were associated with severe IVH: decreased administration of antenatal steroid ($P < .001$), pulmonary hemorrhage ($P = .023$), inotrope medication use ($P = .032$), administration of hydrocortisone ($P = .001$), and patent ductus arteriosus (PDA) ($P = .005$). Researchers conclude that failure to give antenatal dexamethasone, PDA, and low hematocrit in the first three days of life and hydrocortisone administration for neonatal hypotension was associated with severe IVH in VLBW neonates (Al-Mouqdad et al., 2021). Another retrospective cross-sectional study was conducted in Iran, on 178 neonates with a gestational age of ≤ 32 weeks admitted to Fatemieh Hospital in 2016. This study revealed that the prevalence of IVH in premature infants admitted to NICU was approximately 20%, and 61.2% of the neonates were male. In addition, results showed that the problem of IVH is provoked in premature infants by some factors such as low birth weight, 5-minute Apgar score, gestational age, and the need for mechanical ventilation (Basiri et al., 2021).

Research is scarce about intraventricular hemorrhage in premature infants in our region, Therefore, this research will support studies in this area regarding the extent of prevalence and risk factors.

2.2.2 Prevalence of Intraventricular hemorrhage (Global studies)

Regarding the extent of the prevalence of intraventricular hemorrhage, international studies have been added to clarify the high prevalence, and these studies are:

To assess the prevalence of intraventricular hemorrhage, a systematic review of observational studies was conducted between May 2006 and October 2017 focused on intraventricular hemorrhage (IVH) in infants born at ≤28 weeks gestational age. This review included 98 relevant studies, with 39 articles from Europe, 31 from North America, 25 from Asia, and five from Oceania. Unfortunately, no studies from Africa or South America were identified, and both Europe and North America were represented in two publications. The findings revealed a global incidence range of IVH grade three to four, spanning from 5% to 52%. The regional breakdown indicated varying rates: Europe (5-52%), North America (8-22%), Asia (5-36%), and Oceania (8-13%). When restricting the analysis to population-based studies, the incidence range for IVH grades three – four narrowed to 6-22%. However, documentation for IVH grade 2 was less common and ranged from 5% to 19%, including population-based studies. Notably, a general trend emerged, indicating an inverse relationship between IVH incidence and gestational age. In summary, this systematic review highlights that intraventricular hemorrhage is a frequent complication among extremely premature births, with varying incidence rates observed across different regions (Siffel et al., 2021)

Intraventricular hemorrhage is a serious complication in premature infants. It happens in about 20% of very low-birth-weight premature infants. Intraventricular hemorrhage is less common in females, the black race, and with antenatal steroid use, but is more common in the presence of mechanical ventilation, respiratory distress, pulmonary bleeding, pneumothorax, chorioamnionitis, asphyxia, and sepsis. Intraventricular hemorrhage and its complications are best diagnosed by Ultrasonography. Around 25–50% of germinal intraventricular hemorrhage cases are asymptomatic and diagnosed during routine screening (Özek & Kersin, 2020**)**.

Another prospective cohort study of neonates with birth weights of ≤2000 g admitted to a neonatal unit in a regional referral hospital in eastern Uganda showed that out of 120 neonates recruited, intraventricular hemorrhage (IVH) was reported in 34.2% of neonates; 19.2% had a low grade, while 15% had a high grade. On the other hand, nearly all IVH (90.2%) occurred by day 7, including 88.9% of high-grade IVH. In addition, researchers found that vaginal delivery, gestational age (GA) < 32 weeks, and resuscitation in the neonatal unit increased the odds of IVH. Of the six neonates who received 2 doses of antenatal steroids, none had IVH (MacLeod et al., 2021).

2.3 Risk Factors of Intraventricular hemorrhage.

Many risk factors for intraventricular hemorrhage were explored by searching through the literature. A quantitative retrospective analysis of risk the factors of IVH was conducted by Szpecht and his colleagues (2016). The analysis included 267 premature babies (24 to 32 weeks of gestation) hospitalized in 2011–2013 at the Department of Neonatology, Poznan University of Medical Sciences. The investigators found that uncompleted antenatal steroid therapy increased the probability of the development of severe intraventricular hemorrhage (IVH). Antenatal steroid therapy (LIKE DEXAMETHASONE) should be promoted among women at risk of premature delivery. Hypotension therapy with catecholamine and acidosis with sodium hydrogen carbonate should be carefully considered. The use of appropriate prophylaxis of perinatal (antenatal steroids therapy women at risk of premature birth, limiting the indications for the use of catecholamines for hypotension treatment and sodium hydrogen carbonate (NAHCO3) for acidosis therapy, limitation of premature deliveries outside tertiary referral centers) significantly reduces the incidence of intraventricular hemorrhage stage three and four (Szpecht et al., 2016). Infants transferred between

centers within the first 72 hours of life faced a higher risk of severe intraventricular hemorrhage as revealed by a retrospective cohort study conducted in United Condom neonatal centers that assessed the risk of severe intraventricular hemorrhage in premature infants born at less than 32 weeks gestation. The researchers found, that premature infants especially if born at less than 28 weeks gestation, transported infants in this gestational age group remained at significantly higher risk even with full antenatal steroid courses. In addition, this study emphasizes the need to improve the transport pathway to reduce this additional risk, especially when in-utero transfer is not feasible (Shipley et al., 2019).

To identify factors associated with intraventricular hemorrhage (IVH) in premature babies a prospective cross-sectional study was conducted on 99 premature babies in Aminu Kano Teaching Hospital, Nigeria. The study revealed that lower gestational age (under 32 weeks) and the use of respiratory support (CPAP) were significant independent predictors of IVH. Early interventions for preventing premature births and improving neonatal care, particularly CPAP usage, are crucial to mitigate the risk of IVH, especially among very premature neonates (Egwu et al., 2019).

Additionally, another retrospective study was conducted to assess intraventricular hemorrhage (IVH) in premature infants, with particular attention to its prevalence, associated risk factors, and effect on mortality. Ninety-six premature infants between the ages of 23 and 36 weeks gestational age (GA) who were sequentially admitted to Parma University Hospital's NICU between 1995 and 2004 were included in the study. Using cranial ultrasonography, the IVH was identified and categorized using Papile's classification. Variables including GA, sex, delivery style, twins, resuscitation techniques, newborn weight, Apgar scores, IVH degree, and discharge mortality were

all included in the data analysis. The findings indicated that IVH remains a significant concern in premature infants, with increasing severity of IVH correlating with higher mortality rates, Low birth weight and extremely low gestational ages (<= 26 weeks) have been found to be independent risk factors for severe IVH, further increasing the risk of mortality. The study emphasized the need for effective solutions to address this critical clinical condition and reduce its impact on healthcare costs and the affected families (Piccolo et al., 2022). Therefore, there is a need to confirm such studies through extensive and comprehensive research.

This observational study aimed to assess the associations between delivery room intubation and severe intraventricular hemorrhage (IVH) among extremely premature infants in Japan, excluding those with low Apgar scores. Data from 16,081 infants born at 24–27 gestational weeks between 2003 and 2019 were analyzed using robust Poisson regression. The primary outcome was severe IVH, with secondary outcomes including other neonatal morbidities and mortality. Over time, delivery room intubation rates increased while severe IVH rates decreased. However, infants who underwent delivery room intubation had a higher risk of severe IVH compared to those who did not (6.8% vs. 2.3%), with an adjusted risk ratio of 1.86. This association remained consistent across different gestational ages (Tamai et al.,2023).

To identify risk factors associated with early intraventricular hemorrhage (IVH) to enhance early interventions and improve outcomes for these infants in China , this study conducted a retrospective evaluation of 421 very-low-birth-weight (VLBW) premature infants admitted to Tianjin Central Hospital of Gynecology Obstetrics from July 2017 to July 2019. It aimed. The analysis revealed significant correlations between early IVH and factors such as early gestational age, spontaneous labor, low birth

weight, low Apgar scores, invasive mechanical ventilation, and early onset sepsis. Conversely, gestational hypertension was associated with lower IVH incidence. Severe IVH was linked to early gestational age, low birth weight, low Apgar scores, and neonatal sepsis. Logistic regression indicated that antenatal glucocorticoid use significantly reduced severe IVH incidence. These findings underscore the importance of optimizing delivery methods and antenatal care strategies to mitigate IVH risks in VLBW premature infants in China (Zhao et al., 2022).

In a two-centered prospective double-blind randomized controlled trial, to assess the impact of Delayed Cord Clamping (DCC) versus Immediate Cord Clamping (ICC) on the prevention of intraventricular hemorrhage (IVH) in premature infants (26-34 weeks gestational age). The results showed that DCC significantly reduced the incidence of significant IVH (grades II, III, and IV) compared to ICC (1.4% vs. 10.1%). Delayed Cord Clamping also led to increased birth weight, higher hemoglobin levels, and shorter hospital stays without an elevated risk of hyperbilirubinemia, low Apgar scores, or neonatal mortality. Although there was no reduction in the overall incidence of any grade of IVH, these findings suggest that DCC can offer substantial benefits for premature infants (Hemmati et al., 2022). In light of my personal experience in the field, I have identified a documentation deficiency in patient records, particularly concerning the recording of delayed umbilical cord clamping in newborns. This observation prompted my exception of this factor as a potential risk factor in the study, emphasizing the critical need for improved documentation practices in addressing this specific issue.

Regarding the link between antenatal infection and intraventricular hemorrhage (IVH) in premature infants, the analysis of 23 cohort studies involving 13,605

premature infants demonstrated a significant association between antenatal infection and IVH, with increased risks for all grades of IVH, including mild and severe cases. Subtypes of antenatal infection, such as chorioamnionitis and Ureaplasma, also displayed elevated risks. However, it's important to note that the overall quality of evidence is relatively low, emphasizing the necessity for well-designed studies further to assess this relationship (Huang et al., 2019). To better understand the issue and to confirm this relationship, well-designed studies are needed. Based on the above studies, all risk factors must be considered, and their relationship to the occurrence of intraventricular hemorrhage in premature infants must be investigated.

2.4 Pathogenesis of Intraventricular Hemorrhage

Intraventricular hemorrhage (IVH) in premature infants is a complex condition with multifactorial causes. It involves altered cerebral blood flow due to impaired autoregulation, increasing vulnerability to changes in blood pressure. Hemodynamically significant patent ductus arteriosus and fluctuations in arterial carbon dioxide levels also contribute to the risk. Impaired cerebral venous drainage, often exacerbated by high intrathoracic pressure, is another factor. Prolonged labor and certain delivery modes can damage the cerebral venous system, potentially leading to IVH. Understanding these factors is essential for effective IVH prevention and management in premature infants (Tsao, 2023).

2.5 grades and screening for diagnosis of intraventricular hemorrhage

The screening for intraventricular hemorrhage (IVH) in premature infants, involves the use of medical imaging techniques, either through computed tomography (CT) or cranial ultrasonography. However, in the case of extremely premature infants, cranial ultrasonography is the preferred method for several reasons. This option is

preferred since it is a realistic option for newborn care units due to its cost and ease of transportation. Cranial ultrasonography is conducted for each premature infant with a gestational age of less than 32 weeks, and the examination is performed for infants older than 32 weeks based on specific clinical criteria. The protocol for cranial ultrasonography may vary between hospitals, but for the study, the examination is typically conducted on the first, third, and seventh days after birth, with an additional examination around 15 to 30 days postnatally, One drawback of cranial ultrasonography, however, is that it can be challenging to distinguish between the first and second grades of IVH. Nonetheless, this non-invasive and cost-effective approach remains a valuable tool in the early diagnosis and management of intraventricular hemorrhage in premature infants, helping to improve neonatal care and outcomes (Özek & Kersin, 2020**)**.

2.6 Intraventricular Hemorrhage Classification in Premature Infants Using Transfontanel Ultrasound

In 1978, Papile introduced a classification system for grading intraventricular hemorrhage (IVH) in premature infants using trans-fontanel ultrasound images. This classification system categorizes IVH into the following grades:

1. Grade I - Germinal matrix hemorrhage, characterized by either minimal or no hemorrhage in the ventricle.
2. Grade II - IVH that fills 10-50% of the ventricle in the parasagittal section.
3. Grade III - IVH that fills more than 50% of the ventricle, leading to ventricular enlargement.
4. Grade IV - Periventricular echodensity (formerly known as Grade IV).

Papile's IVH classification is a valuable tool for assessing the severity of hemorrhage in premature infants and guiding clinical care in neonatal medicine (Özek & Kersin, 2020**)**. This international classification is accredited in most children's hospitals internationally and locally. They are also accredited in my workplace, the Palestinian Red Crescent Hospital.

2.7 Management for Intraventricular Hemorrhage (IVH)

The management of IVH involves addressing various aspects, including adjusting hemodynamics, ensuring proper oxygenation and ventilation, providing fluid and nutritional support, controlling seizures, and addressing complications. There is no specific treatment for IVH (Özek & Kersin, 2020**)**.

2.8 Complications and Outcomes

Intraventricular hemorrhage may result in complications such as Periventricular hemorrhagic infarction (PVHI), posthemorrhagic ventricular dilatation (PHVD), periventricular leukomalacia, and cerebellar hemorrhage (Özek & Kersin, 2020**)**.

In a cohort study spanning from 1998 to 2004, the focus was on extremely premature infants born between 23 and 28 weeks of gestation and admitted to a neonatal intensive care unit (NICU). The primary aim of this study was to evaluate the impact of lower-grade intraventricular hemorrhages (IVH) on these infants' neurodevelopmental outcomes. The study assessed 1472 surviving infants and found that grade III-IV IVH (93 infants) was associated with higher rates of developmental delay (17.5%), cerebral palsy (30%), deafness (8.6%), and blindness (2.2%). Even grade I-II IVH (336 infants) showed increased rates of neurosensory impairment, including developmental delay (7.8%), cerebral palsy (10.4%), and deafness (6.0%), compared to infants with no IVH

(1043 infants). Notably, isolated grade I-II IVH (296 infants) was independently linked to a higher risk of neurosensory impairment (adjusted odds ratio 1.73, 95% confidence interval 1.22–2.46), even in the absence of white matter injury or late ultrasound abnormalities like periventricular leukomalacia, porencephaly, and ventricular enlargement. In summary, this study underscores that grade I-II IVH can have adverse neurodevelopmental consequences in extremely premature infants, emphasizing the importance of early recognition and intervention in neonatal care (Bolisetty et al., 2014).

2.9 Prevention

Preventing intraventricular hemorrhage (IVH) in premature infants involves a multifaceted approach. Administering antenatal corticosteroids 24 hours to seven days before delivery reduces IVH risk and indirectly improves respiratory distress syndrome (RDS) outcomes. Tocolytics' effectiveness remains debated, with magnesium sulfate showing promise but requiring proper patient selection. Perinatal management options include delayed cord clamping for improved cerebral oxygenation, although umbilical cord milking offers advantages but may increase severe IVH risk. Elective cesarean sections in extremely premature infants with antenatal steroid treatment can help. Postnatally, pharmacological agents like indomethacin vary in efficacy, making patient selection essential. Precise circulatory management, early patent ductus arteriosus (PDA) treatment, cardiac function optimization, and neuroprotective care bundles aim to reduce IVH, requiring further research to refine practices (Tsao, 2023).

2.10 summary

This literature review explores The prevalence, risk factors, pathophysiology, categorization, diagnosis, treatment, and complication of intraventricular hemorrhage

(IVH) in premature. With an emphasis on understudied regions like Palestine, This is considered a big gap, as there is no research related to this disease in our region, it draws attention to regional and worldwide differences in the occurrence of IVH. Low gestational age, absence of prenatal steroids, and respiratory assistance are important risk factors. The Papile classification system, management techniques, and possible neurodevelopmental complications are all covered in detail. The chapter highlights the significance of prevention with optimal prenatal and postnatal care as well as antenatal corticosteroids.

This introductory section outlines the primary objectives of the research, provides context for the study, and highlights the importance of addressing IVH in premature infants within the unique healthcare landscape of the Southern West Bank. In the subsequent sections, the researcher delves deeper into the methodology, findings, and implications of our study, with the ultimate goal of improving the care and outcomes for this vulnerable population.

Chapter Three

methodology

3.1 Introduction

The goal of this study is to assess the prevalence of intraventricular hemorrhage and the risk factors among Palestinian premature infants in the southern West Bank. This chapter explains the concepts of methodology in this study. It includes a description of the research design, sampling and sample size, settings, and statistical analysis.

3.2 Study Design

A quantitative, retrospective research design was chosen to meet the goal of this study. This design allows us to gather data efficiently and provide insights into the prevalence and risk factors of intraventricular hemorrhage among premature infants in the Southern West Bank.

3.3 Study Population and Setting

The study population included all premature infants born before 32 weeks of gestation who receive care in hospitals located in the Southern West Bank, specifically in the cities of Bethlehem and Hebron. The selected hospitals for this study are the Palestinian Red Crescent Hospital in Hebron and the Holy Family Hospital in Bethlehem.

These hospitals were carefully chosen for several reasons. Firstly, they have neonatal intensive care units (NICUs) that are classified as level three in terms of healthcare provision according to the Ministry of Health, ensuring the availability of advanced medical facilities and specialized care for premature infants. Secondly, each

of these departments has more than 20 incubators, facilitating the care and monitoring of premature infants. Additionally, these hospitals adhere to a consistent policy for conducting brain ultrasounds for all newborns with a gestational age of less than 32 weeks. These are performed in the initial 72 hours following birth, then again after seven days, and once more after one month of age. This standardized approach aids in accurately documenting and monitoring any cases of intraventricular hemorrhage, which is essential for researchers to obtain precise data for analysis, ultimately contributing to the success of the study's objectives.

3.4 Study Tool Construction.

The construction of the study tool, in this case, refers to the development and design of the data collection checklist used to gather information from patient medical records. The checklist used in this study for the purpose of data collection was created by the researcher based on a literature review, This checklist has relevant data for the study on the prevalence of intraventricular hemorrhage (IVH) and its associated risk factors among premature infants in the southern West Bank Hospitals.

This checklist comprises various sections, including demographic information and neonatal characteristics such as (gender, transportation, gestational age, birth weight, and intubation at delivery.IVH exam, neonatal comorbidities such as (patent ductus Invasive respiratory support, Hypothermia, nasal CPAP, pulmonary hemorrhage, hypercapnia, Pneumothorax) therapeutic interventions (Hypotension therapy, Acidosis therapy, Hydrocortisone, Blood Transfusion, Surfactant. Umbilical catheter insertion) maternal factors (antenatal steroid, chorioamnionitis, PPROM), and other factors related to some conditions that the child may be exposed to, such as transportation and hypothermia.

3.5 Sample of the Study.

The sampling method employed in this study is census sampling, with the inclusion criteria guiding the selection of infants for inclusion in the sample, 186 samples were taken from the hospitals, 97 babies from Holy Family Hospital and 89 babies from Alhilal Hospital, These were all cases that were admitted during the specified period and their gestational age was less than 32 weeks.

3.6 Inclusion Criteria

All Premature infants less than 32 weeks GA. That's admitted to NICU, from Jan. 2020 to Dec. 2023.

3.7 Exclusion Criteria

Premature infants have a G.A. of more than 32 weeks.

3.8 Data Collection and Procedure / Data Record

The data collection involves using a checklist format specifically designed by the investigator after a thorough review of the existing literature. The checklist was reviewed by a group of academics of nursing faculty at Arab American University and evaluated by experts in neonatology and statistics, all of whom were provided with a comprehensive understanding of the study's goals and purposes.

3.9 Validity and Reliability

Validity: In this study, the researcher carefully consented to the concepts of validity and reliability to ensure the robustness of our research findings. Validity, which pertains to the accuracy and authenticity of our measurements, has been addressed through a meticulously designed data collection instrument. The checklist used in this study was developed after a comprehensive review of existing literature and was rigorously

reviewed by three doctors at Arab American University and evaluated by tow experts in neonatology and statistics. This rigorous process ensures that the checklist accurately measures the factors related to intraventricular hemorrhage and risk factors among premature infants.

Reliability of the Study Scales: Cronbach's Alpha of all scales was above 0.70, indicating acceptable internal consistency or homogeneity for the questionnaire, as seen in 3.1

Table 3.1. Cronbach's Alpha of the scales.

Scale	Item	Cronbach's Alpha
Neonatal co-morbidities	seven questions	0.74
Neonatal Therapeutic Interventions	six questions	0.82
Maternal Factor	six questions	0.78

3.10 Ethical Consideration

Ethical approval was obtained from the Arab American University and the respective hospital administrations before commencing data collection. The consent form provided information about the study's purpose, briefly explained the study's objectives, and outlined the procedures for maintaining the confidentiality of their data, It was not possible to obtain parental consent because the patients participating in the study had been in a previous period and were not hospitalized. To ensure complete privacy and confidentiality, the names of the patients were not mentioned.

3.11 Pilot Study

A pilot study was conducted by using 18 samples, selected randomly. During the pilot study, certain concepts were refined, some questions were clarified, and others were eliminated after consulting with experts to align with the study's objectives.

3.12 Data Analysis

All the provided information was treated as confidential, and the researcher committed to not disclosing any data from the records. After completing the data collection, statistical analysis was carried out to meet the study's objectives. The data was collected by using the checklist model and was processed using IBM-Statistical Package for the Social Sciences (SPSS) version 23, and the results were subsequently presented.

Descriptive statistics: to calculate the prevalence of IVH as a percentage of the total premature infants in the Southern West Bank.

Chi-square test: to compare the prevalence of IVH across different hospitals to identify if there are significant differences.

Binary Logistic Regression with the enter method to identify predictors of IVH among neonatal co-morbidities in premature infants

Using Binary Logistic Regression with the enter method to identify the therapeutic intervention predictors of IVH in premature infants.

Chapter Four

Results

4.1 Introduction

This chapter deals with the data collected for analysis. The statistical method allowed the investigator to deduce, analyze, coordinate, measure, evaluate, and convey the numerical information. Data analysis aims to provide answers to questions about the study. The data analysis strategy comes directly from the questions, the design the data collection process, and the level of measurement of the data. This chapter edits, tabulates, analyzes, and interprets the data collected.

4.2 Demographic and medical characteristics of the neonate

One hundred and eighty-six newborns have participated in the current study in selected hospitals as part of the study. The analysis indicated that the mean age of the mothers was 27.3 ± 5.8 years old. More than half of the newborns 103 (55.4%) are males. Only, 34(18.3%) of them are transported from other hospitals. Moreover, more than half of the newborns 97 (52.2%) are from Bethlehem governorate, as outlined in Table 4-1.

Table 4.1 Demographic characteristics of the newborns (N=186).

Variable		N (%)	M(SD)
Mother's age			27.3(5.8)
Gender	Male	103(55.4)	
	Female	83(44.6)	
Transportation	Yes	34(18.3)	
	No	152(81.7)	
Governorate	Hebron	89(47.8)	
	Bethlehem	97(52.2)	

Based on the admission rate by year, the analysis showed that 71 (38.2%) of the newborns were admitted in the year 2023, followed by 58 (31.2%) in the year 2022, as depicted in Figure 4.1.

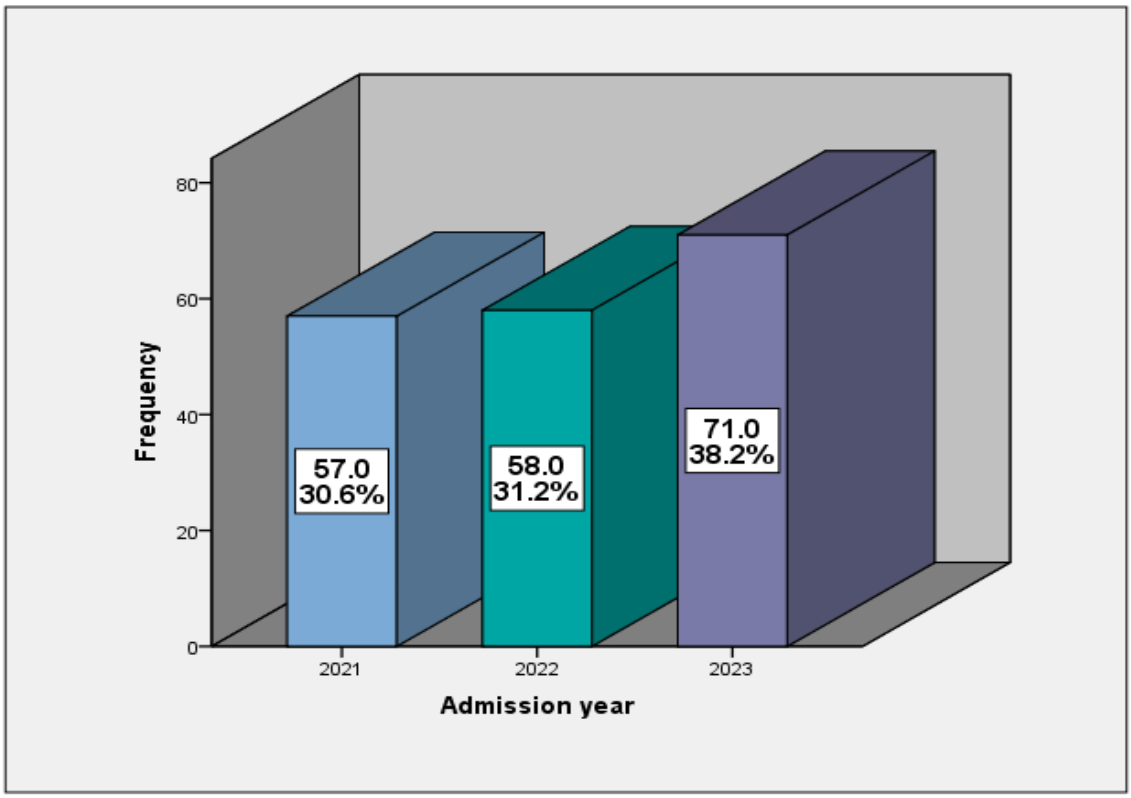

Figure 4.1 Distribution of the participants according to admission year (N=186).

The analysis indicated that the majority of newborns, 128 (68.8%),weighed less than 1500 grams at birth, with 90 (48.4%) of them weighing between 1000 and 1499 grams at birth. Additionally, 139 (74.7%) of the newborns were born at 28-31 weeks of gestational age. Out of the total, 124 (66.7%) were delivered via cesarean section, and 118 (63.4%) were singleton births. Moreover, 139 (74.7%) of the newborns had a high Apgar score at one minute, which increased to 175 (94.1%) at five minutes. Furthermore, 14 (7.5%) of them were diagnosed with early-onset sepsis, and 54 (29.0%) were intubated in the delivery room, as detailed in Table 4-2.

Table 4.2 Distribution of neonatal characteristics (N=186).

Variable		N (%)	M(SD)
Birth weight	less than 1000 gm.	38(20.4)	
	1000-1499 gm.	90(48.4)	
	1500 - 2000 gm.	58(31.2)	
Gestational age	Less than 28 weeks.	47(25.3)	
	28-31 wks.	139(74.7)	
Type of delivery	NSVD	59(31.7)	
	CS	124(66.7)	
	Assisted delivery	3(1.6)	
Type of Pregnancy	Singleton	118(63.4)	
	Multiple gestations	68(36.6)	
Early-onset sepsis (first three days)	yes	14(7.5)	
	No	172(92.5)	
APGAR score at one minute	Low score	9(4.8)	
	Moderate score	38(20.4)	
	High score	139(74.7)	
APGAR score at five minute	Moderate score	11(5.9)	
	High score	175(94.1)	
Early-onset sepsis (first three days)	yes	14(7.5)	
	No	172(92.5)	
Intubation in the delivery room?	yes	54(29.0)	
	No	132(71.0)	

The analysis indicated that 60 (32.3%) of the newborns had intraventricular hemorrhage (IVH), with more than half of them, 32 (53.3%), being in the low-grade stage, as illustrated in Table 4.3.

Table 4.3 Distribution of IVH exam of newborns (N=186).

Variable		n(%)
Diagnosis of IVH	Yes	60(32.3)
	No	126(67.7)
What was the stage of IVH?	Low grade	32(53.3)
	High grade	28(46.7)

According to neonatal comorbidities, the analysis showed that 133 (71.5%) of the newborns experienced "Use of nasal CPAP in the first week", followed by 101 (54.3%) who required "Invasive respiratory support in the first week", and 85 (45.7%) who had "hypothermia on admission", as detailed in Table 4.4.

Table 4.4. Distribution of neonatal co-morbidities (N=186).

Question	Yes	No
	n (%)	n (%)
Did the baby have Resuscitation in the first week?	35(18.8)	151(81.2)
Did the baby have Pneumothorax in the first week?	14(7.5)	172(92.5)
Did the baby have Invasive respiratory support in the first week?	101(54.3)	85(45.7)
Did the baby have a PDA in the first week?	43(23.1)	143(76.9)
Hypothermia on admission	85(45.7)	101(54.3)
Use of nasal CPAP in the first week?	133(71.5)	53(28.5)
Did the baby have a pulmonary hemorrhage in the first week?	15(8.1)	171(91.9)

According to neonatal therapeutic intervention, the analysis demonstrated that 133 (71.5%) of the newborns underwent "Umbilical catheter insertion", followed by

113 (60.8%) who received "surfactant", and 39 (21.0%) who required "Blood Transfusion in the first week", as presented in Table 4-5.

Table 4.5 Distribution of neonatal Therapeutic Interventions (N=186).

Question	Yes	No
	n (%)	n (%)
Hypotension therapy(Inotropes) in the first week	25(13.4)	161(86.6)
Acidosis therapy (sodium bicarbonate) in the first week	8(4.3)	178(95.7)
Hydrocortisone in the first week?	4(2.2)	182(97.8)
Blood Transfusion in the first week?	39(21.0)	147(79.0)
Surfactant?	113(60.8)	73(39.2)
Umbilical catheter insertion?	133(71.5)	53(28.5)

According to maternal factors, the analysis indicated that 142 (76.3%) of the newborns' mothers received "prenatal steroids", followed by 44 (23.7%) whose mothers experienced " preterm premature rupture of membranes (PPROM)", and 19 (10.2%) whose mothers had "chorioamnionitis", as depicted in Table 4-6.

Table 4.6 Distribution of Maternal Factor (N=186).

Question	Yes	No
	n (%)	n (%)
Did the mother receive prenatal steroids?	One dose,104(55.9) Two doses, 38(20.4)	44(23.7)
Did the mother have an Intrauterine infection?	6(3.2)	180(96.8)
Did the mother have GDM?	8(4.3)	178(95.7)
Pregnancy-induced hypertension PIH?	12(6.5)	174(93.5)
Did the mother have chorioamnionitis?	19(10.2)	167(89.8)
Did the mother have PPROM?	44(23.7)	142(76.3)

4.3. Testing the research questions

Research question one: What is the Prevalence of intraventricular hemorrhage among premature infants with a gestational age of less than 32 weeks in Southern West Bank hospitals?

The analysis revealed that among premature infants with a gestational age of less than 32 weeks, 60 (32.3%) had intraventricular hemorrhage (IVH), with more than half of them, 32 (53.3%), being in the low-grade stage, as illustrated in Table 4-7.

Table 4.7 Prevalence of intraventricular hemorrhage among premature infants with a gestational age of less than 32 weeks.

Variable		N (%)
Diagnosis of IVH	yes	60(32.3)
	No	126(67.7)
What was the stage of IVH?	Low grade	32(53.3)
	High grade	28(46.7)

Research question two: What are the primary risk factors associated with intraventricular hemorrhage (IVH) in premature infants born with a gestational age of less than 32 weeks in Southern West Bank hospitals?

According to premature infants born with a gestational age of less than 32 weeks who were transported from other hospitals, the analysis showed that eight (13.3%) of them had intraventricular hemorrhage (IVH), as detailed in Table 4.8

Table 4.8 Distribution of IVH of premature infants regarding demographic characteristics (N=60).

Variable	Yes	No
Transport from other Hospital	8(13.3)	52(86.7)

The analysis of premature infants' characteristics born with a gestational age of less than 32 weeks who have IVH revealed that 27 (45.0%) of them weighed less than 1000 grams at birth, and 24 (40.0%) had a birth weight between 1000 and 1499 grams. Additionally, 30 (50.0%) of them had a gestational age of less than 28 weeks. Among them, 39 (65.0%) were delivered by cesarean section, and 41 (68.3%) were singleton births. Moreover, 34 (56.7%) of these infants had a high Apgar score at one minute, which increased to 54 (90.0%) at five minutes after birth. Furthermore, seven (11.7%) of them experienced early-onset sepsis within the first three days, and 29 (48.3%) required intubation in the delivery room, as seen in Table 4.9

Table 4.9 Distribution of IVH of premature infants regarding neonatal characteristics (N=60).

Variable		N	(%)
Birth weight	less than 1000 gm.	27	45.0
	1000-1499 gm.	24	40.0
	1500 - 2000 gm.	9	15.0
Gestational age	Less than 28 weeks.	30	50.0
	28-31 wks.	30	50.0
Type of delivery	NSVD	21	35.0
	CS	39	65.0
Type of Pregnancy	Singleton	41	68.3
	Multiple gestations	19	31.7
APGAR score at one minute	Low score	5	8.3
	Moderate score	21	35.0
	High score	34	56.7
APGAR score at five-minute	Moderate score	6	10.0
	High score	54	90.0
Early-onset sepsis (first three days)	yes	7	11.7
	No	53	88.3
Intubation in the delivery room?	yes	29	48.3
	No	31	51.7

According to comorbidities, the analysis showed that 50 (83.3%) of the premature infants with IVH had "Invasive respiratory support in the first week", followed by 33 (55.0%) who required "Use of nasal CPAP in the first week", and 30 (50.0%) who experienced "hypothermia on admission", as detailed in Table 4.10

Table 4.10 Distribution of IVH of premature infants' co-morbidities (N=60).

co-morbidities	Yes	No
	n (%)	n (%)
Did the baby have Resuscitation in the first week?	19(31.7)	41(68.3)
Did the baby have Pneumothorax in the first week?	7(11.7)	53(88.3)
Did the baby have Invasive respiratory support in the first week?	50(83.3)	10(16.7)
Did the baby have a PDA in the first week?	24(40.0)	36(60.0)
Hypothermia on admission	30(50.0)	30(50.0)
Use of nasal CPAP in the first week?	33(55.0)	27(45.0)
Did the baby have a pulmonary hemorrhage in the first week?	12(20.0)	48(80.0)

According to therapeutic intervention, the analysis indicated that 54 (90.0%) of the premature infants with IVH underwent "Umbilical catheter insertion", followed by 50 (83.3%) who received "surfactant", and 28 (46.7%) who required "Blood Transfusion in the first week", as seen in Table 4.11

Table 4.11 Distribution of IVH of premature infants regarding therapeutic intervention (N=60).

Question	Yes	No
	n (%)	n (%)
Hypotension therapy(Inotropes) in the first week	19(31.7)	41(68.3)
Acidosis therapy (sodium bicarbonate) in the first week	6(10.0)	54(90.0)
Hydrocortisone in the first week?	3(5.0)	57(95.0)
Blood Transfusion in the first week?	28(46.7)	32(53.3)
Surfactant?	50(83.3)	10(16.7)
Umbilical catheter's insertion?	54(90.0)	6(10.0)

According to maternal factors, the analysis revealed that 39 (65.0%) of the premature infants with IVH had mothers who received "prenatal steroids", followed by

12 (20.0%) whose mothers experienced "PPROM (preterm premature rupture of membranes)", as shown in Table 4.12

Table 4.12 Distribution of IVH of premature infants regarding maternal factors (N=60).

maternal factors	Yes	No
	n (%)	n (%)
Did the mother receive prenatal steroids?	One dose 32(53.3) Two doses 7(11.7) Total 39 (65.0)	21 (35.0)
Did the mother have an Intrauterine infection?	1(1.7)	59(98.3)
Did the mother have GDM?	2(3.3)	58(96.7)
Pregnancy-induced hypertension PIH?	5(8.3)	55(91.7)
Did the mother have chorioamnionitis?	5(8.3)	55(91.7)
Did the mother have PPROM?	12(20.0)	48(80.0)

Research question three: Are there differences between gestational age and intraventricular hemorrhage (IVH) in premature infants in Southern West Bank hospitals?

There was a significant difference between the gestational age categories in the presence of intraventricular hemorrhage $\chi^2 = 28.7$, ($p < 0.001$), as seen in (Table 4.13)

Table 4.13 Differences between gestational age and intraventricular hemorrhage (IVH) in premature infants (N=186).

Gestational age	Intraventricular hemorrhage		X^2	p. value
	Yes	No		
	n (%)	n (%)		
Less than 28 weeks.	30 (16.1%)	17(9.1%)	28.7	0.000
28-31 weeks.	30(16.1%)	109(58.7%)		

Research question four: what are the maternal predictors of intraventricular hemorrhage (IVH) in premature infants in Southern West Bank hospitals?

Binary logistic regression with the enter step showed that maternal factors (Did the mother receive prenatal steroids? Yes: Two doses) appear to be significant predictors of IVH in premature infants in this study ($p< 0.05$), as seen in (Table 4.14)

Table 4.14 Maternal Predictors of intraventricular hemorrhage in premature infants (N=186).

Independent variable	OR	[95% CI]	p. value
Did the mother receive prenatal steroids? Yes: One dose	2.057	.992-4.266	.053
Did the mother receive prenatal steroids? Yes: Two doses	4.145	1.477-11.632	.007
Did the mother have an Intrauterine infection? yes	2.151	.192-24.128	.535
Did the mother have GDM? yes	1.584	.283-8.876	.601
Pregnancy-induced hypertension PIH? yes	.521	.147-1.840	.311
Did the mother have chorioamnionitis? yes	1.041	.298-3.631	.950
Did the mother have PPROM? yes	1.142	.507-2.573	.749

Dependent variable IVH

Research question five: what are the therapeutic intervention predictors of intraventricular hemorrhage (IVH) in premature infants in Southern West Bank hospitals?

Binary logistic regression with the enter step showed that therapeutic intervention factors (Blood Transfusion in the first week, Surfactant, Umbilical catheter insertion) appear to be significant predictors of IVH in premature infants in this study ($p< 0.05$), as seen in (Table 4.15)

Table 4.15 Therapeutic intervention predictors of intraventricular hemorrhage in premature infants (N=186).

Independent variable	OR	[95% CI]	p. value
Hypotension therapy (Inotropes) in the first week. yes	.296	0.087 -1.007	.051
Acidosis therapy (sodium bicarbonate) in the first week? yes	.180	0.021-1.564	.120
Hydrocortisone in the first week? yes	1.815	0.132-24.988	.656
Blood Transfusion in the first week? yes	.264	0.102-.678	.006
Surfactant? Yes	.310	0.125- 0.771	.012
Umbilical catheter insertion? yes	2.980	1.023- 8.680	.045

Dependent variable IVH

Research question six: what are the Neonatal co-morbidities predictors of intraventricular hemorrhage (IVH) in premature infants in Southern West Bank hospitals?

Binary logistic regression with the enter step showed that Neonatal co-morbidities factors (Did the baby have Invasive respiratory support in the first week, Use of nasal CPAP in the first week, did the baby have a pulmonary hemorrhage in the first week) appear to be significant predictors of IVH in premature infants in this study ($p< 0.05$), as seen in (Table 4.16).

Table 4.16 Neonatal co-morbidities predictors of intraventricular hemorrhage in premature infants (N=186).

Independent variable	OR	[95% CI]	p. value
Did the baby have Resuscitation in the first week? Yes	1.357	.552- 3.337	.506
Did the baby have Pneumothorax in the first week ? Yes	1.545	.462- 5.168	.480
Did the baby have Invasive respiratory support in the first week? yes	4.554	1.944- 10.666	.000
Did the baby have a PDA in the first week? yes	1.660	.737- 3.743	.221
Hypothermia on admission. yes	1.466	.702- 3.062	.309
Use of nasal CPAP in the first week? Yes	.418	.197- .889	.023
Did the baby have a pulmonary hemorrhage in the first week? Yes	4.815	1.134- 20.442	.033

Dependent variable IVH

Chapter Five

Discussion

5.1 Introduction

The aim of this study is to assess the prevalence and risk factors of intraventricular among premature infants born before 32 weeks of pregnancy in Southern West Bank hospitals. This chapter discusses the results of this study in comparison with other previous studies.

Intraventricular hemorrhage (IVH) is a common and serious disease in premature infants born before 32 weeks of pregnancy. In this study data related to prevalence and its risk factors were collected from two hospitals in the Southern West Bank. Given the several predictors associated with this disease, isolating the main risk factors may help prevent or minimize IVH among these infants. There are different risk factors for IVH like resuscitation, ventilation, blood transfusion, etc. In this study, the researcher have identified the IVH and correlated risk factors in Palestinian premature infants less than 32 weeks.

5.2 Prevalence of Intraventricular hemorrhage

In Palestine, no research was done about premature intraventricular hemorrhage, Through this study the analysis revealed that among premature infants with a gestational age of less than 32 weeks, 60 (32.3%) had intraventricular hemorrhage (IVH), with more than half of them, 32 (53.3%), being in the low-grade stage. the researcher found that, when comparing our national statistics to Worldwide research, the incidence of high-grade IVH (grades 3–4) among premature infants in our nation is within the range reported elsewhere, however, it tends to be greater. In particular,

grades three – four IVH have incidence rates ranging from 5% to 52% worldwide (Siffel et al., 2021), Different incidence rates were found throughout more specific regions, including Europe (5-52%), North America (8-22%), Asia (5-36%), and Oceania (8-13%). The aforementioned variety highlights the impact of local healthcare methods, socioeconomic variables, and maybe genetic predispositions.

5.3 Investigating the correlation between gestational age and IVH among premature infants

The study found by chi-squire test a significant difference between gestational age categories and the presence of intraventricular hemorrhage (IVH) in premature infants ($\chi 2 = 28.7$, $p < 0.001$), less than 28 weeks showed a markedly elevated incidence of IVH (16.1% with IVH vs 9.1% without IVH) compared to those born between 28-31 weeks (16.1% with IVH vs. 58.7% without IVH). These results highlight the increased susceptibility of extremely premature infants to IVH, which means that extremely premature infants are at higher risk for IVH than other premature, and if GA increases dramatically the risk decreases.

5.4 Correlation between the maternal factor and intraventricular hemorrhage

In analyzing the results of this study, there is no significant between maternal factors and intraventricular hemorrhage, except for giving the mother two doses of steroids. Binary logistic regression with the enter step showed that maternal factors (Did the mother receive prenatal steroids? Yes: Two doses) appear to be significant predictors of IVH in premature infants in this study ($p< 0.05$), Many previous research studies conducted by Özek, have proven this result by giving the mother steroids, intraventricular hemorrhage is less common with antenatal steroid use (Özek & Kersin, 2020**)**. However there is no significance with other factors like chorioamnionitis

gestational diabetes and prolonged rupture of membrane, This contradicts what was found in the article (Özek & Kersin, 2020**)**.intraventricular hemorrhage common in the presence of Chorioamnionitis.

Inconstant the results of this study about prenatal received steroids are compatible with a previous study included in a literature review conducted in 2016; the use of appropriate prophylaxis of perinatal (antenatal steroids therapy women at risk of premature birth, limiting the indications for the use of catecholamines for hypotension treatment and sodium hydrogen carbonate (NAHCO3) for acidosis therapy, limitation of premature deliveries outside tertiary referral centers) significantly reduces the incidence of intraventricular hemorrhage stage three and four, (Szpecht et al., 2016).

5.4 Correlation between therapeutic intervention and intraventricular hemorrhage

By using Binary logistic regression with the enter step, the results of this study showed that therapeutic intervention factors (Blood Transfusion in the first week, Surfactant, Umbilical catheter insertion) appear to be significant predictors of IVH in premature infants ($p< 0.05$). While the result found that other factors (Hypotension therapy (Inotropes), acidosis therapy (sodium bicarbonate), and hydrocortisone treatment) have no significant predictors of IVH in premature infants. The results of this study are incompatible with a previous study included in a literature review conducted in 2021 which aimed to assess risk factors for IVH in premature infants, and revealed that the following risk factors were associated with severe IVH: decreased administration of antenatal steroid ($P < .001$), pulmonary hemorrhage ($P = .023$), inotrope medication use ($P = .032$), administration of hydrocortisone ($P = .001$) (Al-Mouqdad et al., 2021),

This incompatibility with our result is due to decreased use of hydrocortisone, acidosis treatment, and hypotension therapy, which are avoided as much as possible at the selected units.

5.4 Correlation between Neonatal co-morbidities and intraventricular hemorrhage

Binary logistic regression with the enter-step analysis showed that neonatal co-morbidities factors (Did the baby have Invasive respiratory support in the first week, Use of nasal CPAP in the first week, did the baby have a pulmonary hemorrhage in the first week) appear to be significant predictors of IVH in premature infants in this study ($p< 0.05$), inconstant the results of this significant predictor are compatible with previous studies included in a literature review conducted in 2019. The study revealed that the use of respiratory support (CPAP) was a significant independent predictor of IVH. (Egwu et al 2019). And compatible with a study by AL-Mouqdad which revealed that pulmonary hemorrhage ($P = .023$) is a risk factor associated with severe IVH (Al-Mouqdad et al., 2021), and Ozik study, conducted in 2020, that revealed the use of a mechanical ventilator is considered a risk factor that could potentially lead IVH in premature infants(Özek et.al., 2020).

Some of the findings of this study are incompatible with earlier studies included in a literature review conducted in 2021, while the other factors of neonatal comorbidities (Did the baby have Pneumothorax, Did the baby have a PDA, and Did the baby have Resuscitation) have no significant predictor with IVH(p-value> 0.05) are incompatible with a study by (MacLeod, et.al 2021)**,** which revealed that the resuscitation and Pneumothorax in the neonatal unit increased the odds of IVH. Furthermore, a study conducted in 2021 to assess risk factors for IVH in premature

infants revealed the patent ductus arteriosus (PDA) (P = .005) associated with severe IVH in VLBW neonates (Al-Mouqdad et al., 2021).

5.5 Limitations of Study

The prevalence and risk factors of IVH in premature infants in the Southern West Bank are well understood from this study. It does, however, have a few limitations. Two hospitals refused access to patient records, which decreased the sample size and might have introduced selection bias. Additionally, the study's focus on a small geographic region may limit its generalizability to other areas with different healthcare practices and socioeconomic conditions. Unmeasured variables including genetic predispositions or environmental exposures may also have an impact on IVH risk. Despite these limitations, the study represents a major advancement in our knowledge of IVH in premature Palestinian infants. To validate these results and create focused therapies, further extensive prospective studies involving several centers will be required in the future.

5.6 Recommendation

1. The prevalence of IVH can be decreased by putting in place protocols for the delivery of prenatal steroids to all eligible moms who are at risk of premature birth along with enhanced prenatal care.

2. Considering that inotropes and hydrocortisone may increase the risk of IVH, establish criteria for minimizing their usage only when essential.

3. Ensure that nasal CPAP administration and invasive respiratory assistance are utilized sparingly and only when necessary to improve neonatal care practices.

4. Providing good training for healthcare providers on the updated IVH prevention and management strategies.

5. To decrease the prevalence of IVH, promote health policies that encourage best practices in the care of premature infants.

5.7 Conclusion

In two hospitals in the Southern West Bank, this study searched into the prevalence and risk factors of IVH in premature infants (less than 32 weeks gestational age). IVH was found in 32.3% of newborns, with low-grade IVH accounting for 53.3% of these cases, according to this study. The prevalence of high-grade IVH (grades 3–4) is between 5% and 52% worldwide. Infants born before 28 weeks are at higher risk of IVH, with a substantial association observed between lower gestational age and higher incidence of the condition. In line with previous research, giving mothers two doses of steroids dramatically decreased their chance of developing IVH.

IVH was significantly predicted by therapeutic interventions such as the insertion of an umbilical catheter, the use of surfactants, and blood transfusions. IVH risk was significantly elevated by neonatal comorbidities such as nasal CPAP, pulmonary hemorrhage, and invasive respiratory assistance; however, no significant link was seen with pneumothorax, PDA, or resuscitation. The important risk factors and possible preventative steps for IVH in this area are highlighted in this study.

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Appendices

Appendix (1)Data record

(checklist for IVH and related variable)

Demographic features section			
NO	Question	Answer	
1	Mother's age at delivery (in years)	…….. yrs	
2	Gender	1 - Male	2 - Female
3	Admission date	…./…../…… dd/mm/yyyy	
4	Region	Hebron Bethlehem	
5	Transport from other Hospital	1 - Yes	2 - No

Neonatal Characteristics section			
NO	Question	Answer	
6	Birth weight "grams"	< 1000gm 1000–1499gm 1500–2000gm	
7	Gestational Age	< 28 28–31	
8	Type of delivery	1- NSVD 2- C/S 3- Assisted delivery	
9	Type of Pregnancy	1- Singleton 2- Multiple gestations	
10	APGAR score at 1 min		
11	APGAR score at five-minute		
12	First PH		
13	Intubation in the delivery room?	1 – Yes	2 – No
14	Early-onset sepsis (first three days)	1 – Yes	2 – No

IVH exam section			
NO	Question	Answer	
15	Was the baby diagnosed with IVH?	1 - Yes	2 - No
16	What was the stage of IVH?	1 - Low Grade (I + II)	2- High Grade (III + IV)

Neonatal co-morbidities section			
NO	Question	Answer	
17	Did the baby have Resuscitation in the first week?	1 - Yes	2 - No
18	Did the baby have Pneumothorax in the first week?	1 - Yes	2 - No
19	Did the baby have Invasive respiratory support in the first week?	1 - Yes	2 - No
20	Did the baby have a PDA in the first week ?	1 - Yes	2 - No
21	Hypothermia on admission	1 - Yes	2 - No
22	Use of nasal CPAP in the first week ?	1 - Yes	2 - No
23	Did the baby have pulmonary hemorrhage in the first week	1 - Yes	2 - No
24	Did the baby have hypercapnia in the first week ?		

Neonatal Therapeutic Interventions section			
NO	Question	Answer	
25	Hypotension therapy(Inotropes) in the first week	1 - Yes	2 - No
26	Acidosis therapy (sodium bicarbonate) in the first week	1 - Yes	2 - No
27	Hydrocortisone in the first week?	1 - Yes	2 - No
28	Blood Transfusion in the first week?	1 - Yes	2 - No
29	Surfactant?	1 - yes	2 - No
30	Umbilical catheter's insertion?	1 - Yes	2 - No

Maternal Factor section			
NO	Question	Answer	
31	Did the mother receive prenatal steroids?	1 - One Dose 2- Tow Dose	2 - No
32	Did the mother have an Intrauterine infection?	1 - Yes	2 - No
33	Did the mother have GDM?	1 - Yes	2 - No
34	Pregnancy-induced hypertension PIH?	1 - Yes	2 - No
35	Did the mother have chorioamnionitis?	1 - Yes	2 - No
36	Did the mother have PPROM?	1 - Yes	2 - No

Appendix (2) IRB/ Approval Letter

Arab American University
Institutional Review Board - Ramallah

الجامعـــة العربيـــة الأمريكيـــة
مجلس اخلاقيات البحث العلمي – رام الله

IRB Approval Letter

Study Title: "Prevalence and Risk Factors of Intraventricular Hemorrhage among Premature Infants less than 32 weeks Gestational Age in Southern West Bank Hospitals"

Submitted by: Hothayfa Mohammad Hasan Horinat

Date received: 15th December 2023

Date reviewed: 6th January 2024

Date approved: 6th January 2024

Your Study titled **"Prevalence and Risk Factors of Intraventricular Hemorrhage among Premature Infants less than 32 weeks Gestational Age in Southern West Bank Hospitals"** with code number **"R-2024/A/13/N"** was reviewed by the Arab American University IRB committee and was approved on the 6th January 2024.

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

الجامعة العربية الأمريكية - فلسطين
مجلس اخلاقيات البحث العلمي - رام الله
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 (3) / Ethical Approval

Arab American University
Faculty of Graduate Studies

الجامعة العربية الأمريكية
كلية الدراسات العليا

2022/8/17

الى من يهمه الأمر

تسهيل مهمة بحثية

تحية طيبة وبعد،

تهديكم كلية الدراسات العليا في الجامعة العربية الأمريكية أطيب التحيات، وبالإشارة الى الموضوع أعلاه، تشهد كلية الدراسات العليا في الجامعة أن الطالب **نضال محمود خليل دار ذويب** والذي يحمل الرقم الجامعي202020373 هو طالب ماجستير في برنامج تمريض حديثي الولادة ويعمل على رسالة الماجستير الخاصة به بعنوان:

Prevalence and associated factor of retinopathy of prematurity among Palestinian premature infants" تحت اشراف الدكتور عماد فشافشة"، نأمل من حضرتكم الإيعاز لمن يلزم لمساعدته للحصول على المعلومات اللازمة للدراسة، علماً أن المعلومات ستستخدم لغاية البحث فقط وسيتم التعامل معها بغاية السرية، وقد أعطيت هذه الرسالة بناءً على طلبه.

وتفضلوا بقبول فائق الاحترام

عميد كلية الدراسات العليا

د. نوار قطب

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الملخص

المقدمة : تبحث هذه الدراسة في مدى انتشار وعوامل خطر النزيف داخل حجرات الدماغ لدى الاطفال الخدج ذوو العمر الحملي الاقل من 32 اسبوع في مستشفيات جنوب الضفة الغربية , وتهدف الى تحسين ممارسات التمريض وتطوير استراتيجيات للوقاية من المرض في وحدات العناية المركزة لحديثي الولادة .

المنهجية : شملت هذه الدراسة الاستعادية 186 رضيعا خديجاً من مستشفيات فلسطينية , تم استخدام منهجية قائمة تدقيق صممت خصيصا للحصول على المعلومات من بيانات المرضى وتحليلها بسرية تامة .

النتائج : وجدت هذه الدراسة ان 32.3% من الاطفال الخدج الذين عمرهم الحملي اقل من 32 اسبوع قد اصيبوا بالنزيف داخل حجرات الدماغ حيث كانت نسبة 53.3% من هذه الحالات من درجة النزيف المنخفضة , وكان هناك ارتباط بين النزيف داخل حجرات الدماغ والعمر الحملي حيث زادت نسبة حدوث النزيف كلما قل العمر الحملي, و ان اعطاء الام الستيرويدات قبل الولادة قلل بشل ملحوظ حدوث النزيف داخل حجرات الدماغ , ووجدت ان تركيب القسطرة السُريّة, واستعمال دواء اكتمال الرئة, وعمليات نقل الدم للمريض كانت عوامل تنبؤ هامة لحدوث النزيف داخل حجرات الدماغ , وان النزيف الرئوي والعلاج بواسطة التنفس الصناعي سواء أكان عن طريق الانف او استخدام انبوب الحنجرة الداخلي زادت من احتمالية حدوث هذا النزيف.

الملخص: تسلط هذه الدراسة الضوء على عوامل الخطر والتدابير الوقائية المحتملة لهذا المرض في هذه المنطقة , مثل استخدام التنفس عن طريق الانف , زيادة نسبة الحدوث للنزيف كلما قل العمل الحملي , واعطاء دواء اكتمال الرئة , ونقل الدم , وتسلط هذه الدراسة على العوامل المحتلمة لمنع حدوث النزيف داخل حجرات الدماغ في الخدج الذي عمرهم الحملي اقل من 32 اسبوع في هذه المنطقة .

الكلمات المفتاحية : نزف حجرات الدماغ , الخدج , العمر الحملي , عوامل الخطل , صورة الدماغ بالموجات الصوتية .