



**St. Paul's Hospital
Millennium Medical College**
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SCHOOL OF NURSING

**Magnitude and Associated Factors of Intraventricular
Hemorrhage among Preterm Neonates Admitted in St.
Paul's Hospital millennium Medical college, Adisabeba,
Ethiopia 2024**

***Principal Investigator (PI): Bereket Molla (Bsc, Msc NN
Candidate)***

**A Research Paper to be Submitted Department of Neonatal Nursing,
School of Nursing, St. Paul's Hospital Millenium Medical Collage, in
Partial Fulfillment of the Requirements in Degree of Masters of
Neonatal Nursing**

March 2024

Addis Abeba, Ethiopia

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Academic research paper submission guide

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Abstract

Introduction: Intraventricular hemorrhage denotes the presence of blood within the cerebral ventricular system. It is caused by a rupture of the ependymal lining into the lateral ventricles caused by germinal matrix hemorrhage. Intraventricular hemorrhage (IVH) is the most common and serious neurologic consequence of preterm birth, affecting 20% to 40% of all infants born weighing less than 1500 gm globally.

Objective: The aims of this study was to assess the magnitude and associated factors of Intraventricular hemorrhage among preterm neonates admitted in St. Paul's Hospital Millenium Medical Collage, Addis Ababa, Ethiopia 2024.

Methods: An institutional based retrospective cross-sectional study design was conducted from January 1/2020 to December 30/2022 with the study period of April 1 to April 30/2024. Simple random sampling technique was used. Data was entered, cleaned and coded and then analyzed using SPSS version 27 software. Bivariable and multivariable logistic regression models was used to the association between dependent and independent variables the adequacy of the model to predict the outcome variables was checked by Hosmer-Lemeshow goodness-of-fit and P-value < 0.05 was considered as statistically significant in the multivariable logistic regression model.

Result: A total of 481 participate 150 (31.2%) developed intraventricular hemorrhage majority of them were grade II intraventricular hemorrhage 57 (11.9%), followed by grade I 55(11.4%), grade III 31 (6.4%), and grade IV 7 (1.5%). Factors associated with increased odds of IVH were Hypothermia (AOR=2.04(1.28-3.25)) Preclamsia (AOR=1.97(1.22-3.18)) Gestational age (AOR=.78 (.70-.87)), Maternal age (AOR=1.08(1.02-1.13)) and Duration of labor (AOR=1.07(1.02-1.11)) was statistically significant with Intraventricular hemorrhage at a p-value of <0.05 with 95% confidence interval.

Conclusion: The magnitude of IVH was found to be high in preterm neonates. The magnitude was greater in newborns that were born in infants who had very low birth weight, showing having a smaller birth weight increased the risk of IVH. Majority of the neonates with intraventricular hemorrhage presented with grades II of the condition. Lower gestational age and maternal age was strongly associated with intraventricular hemorrhage.

Key word : neonates, preterm, intraventricular hemorrhage

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List of Acronym and Abbreviation

AAU- Addis Ababa University
APH- Antepartum Hemorrhage
CI- Confidence Interval
CPAP-Continuous Positive Airway Pressure
CPR- Cardiopulmonary Resuscitation
CS- Cesarean Section
CSF- Cerebrospinal Fluid
ELBW- Extremely Low Birth Weight
GA- Gestational Age
HUS- Head Ultra-Sonography
IVH-Intraventricular Hemorrhage
LBW- Low Birth Weight
LICs- Low Income Countries
MTRH-Moi Teaching Referral Hospital
NICU-Neonatal Intensive Care Unit
OR-Odds Ratio
PROM- Premature Rapture of Membrane
PVH- Peri-Ventricular Hemorrhage
RDS -Respiratory Distress Syndrome
SVD-Spontaneous Vaginal Delivery
TGSH-Tibebe Ghion Specialized Hospital
VLBW-Very Low Birth Weight

1. Introduction

1.1 background

The World Health Organization defines preterm birth as any birth that occurs before 37 weeks of gestation (or 259 days after the mother's last menstrual cycle). It is further defined according to birth weight: low birth weight (LBW; 1500–2500 g), very low birth weight (VLBW; 1000–1499 g), and extremely low birth weight (ELBW; less than 1000 g) (1). Several issues emerge as a result of prematurity, one of which is cerebral hemorrhage (2). Intraventricular hemorrhage refers to the presence of blood within the cerebral ventricular system. The ependymal lining ruptures into the lateral ventricles as a result of germinal matrix hemorrhage (3).

The bleeding starts in the periventricular areas and proceeds to periventricular hemorrhage. If the bleeding continues, an increasing volume of blood enters the adjacent lateral ventricles, resulting in intraventricular hemorrhage (IVH). By 28 weeks, the germinal matrix has started to involute and is no longer present in term newborns. As a result, this form of bleeding exclusively occurs in premature infants (4).

Intraventricular hemorrhage (IVH) is still a severe issue in premature newborns born before 35 weeks of gestation. The global incidence of IVH in VLBW and ELBW newborns is reported to be 50% (5). The incidence varies according to birth weight and gestational age, with the risk increasing with lower gestational age (GA) and in those born smaller. The vast majority of children with severe IVH die, and those who escape the acute problems are most often victims of long-term neurologic damage (6).

The germinal matrix has a dense network of microvessels but no basement membrane deposition or tight connections. When exposed to an insult such as hypotension or hypoxemia, cerebral blood flow increases. Hemorrhage occurs within the germinal matrix, allowing blood to reach the ventricular system (7).

PIVH severity is described using modified Papile classification: grade 1 IVH is confined to the germinal matrix; grade 2 IVH occupies 50% of the lateral ventricle volume; grade 3 IVH occupies 50% of the lateral ventricle volume, causing ventricle dilation; and grade IV IVH is diagnosed when there is an infarction and/or hemorrhage in the periventricular white matter ipsilateral to a large IVH(8). A study done in Ethiopia showed that the prevalence of intraventricular hemorrhage among preterm infants was 27.04% (9).

1.2 Statement of the problem

Globally, every year, about 15 million neonates are born prematurely, of which more than half are in low-income countries (LICs). In high-income countries, with improved neonatal care, the number of surviving preterm births is increasing. However, in low and middle-income countries (LMIC), preterm birth-associated complications are the leading cause of neonatal mortality (10). Under-five mortality has dropped dramatically worldwide in recent years, including in Ethiopia. Unlike under-five mortality, newborn mortality in Ethiopia has remained constant and has even been reported to be increasing in recent years, with 29 per thousand live births in 2016, 30 per thousand live births in 2019 and 26.2 per thousand live birth in 2021 (11).

Intraventricular hemorrhage (IVH) is the most common and deadly neurologic consequence of preterm birth, affecting 20% to 40% of all infants born weighing less than 1500 gm globally (12). Prematurity is the most widely recognized and established risk factor for IVH, accounting for more than half of all premature births in low-income countries (13). Despite greater survival, mortality rates range from 30% to 60%, and survivors are more likely to develop cerebral palsy, hydrocephalus, seizures, and intellectual disabilities (14). IVH has a significant financial and quality-of-life impact on both patients and caretakers. The global incidence of intraventricular hemorrhage among extremely preterm neonates in grades 3–4 was 5–52 percent (15).

In the United States, IVH causes 3600 new cases of intellectual disability each year, with total lifetime care expenses for these children exceeding \$3.6 billion (16). According to studies in Canada, babies with intraventricular hemorrhage had a higher rate of childhood hospitalization than those without (23.8 vs. 5.7 per 100 person-years) (17).

Approximately 90% of IVH happens within the first 5 days of life, with the majority occurring within the first few hours and increasing in severity over the next few days. As a result, head ultrasonography (HUS) is commonly used in clinical practice between days 5 and 7, when it achieves maximum severity based on IVH grading. Some high-risk preterm newborns may need HUS within the first 24 hours of life. (18, 19).

Newborn morbidity and death would be reduced if newborn disorders were diagnosed and treated early. Preterm newborns who are fewer than 35 weeks gestational age are more likely to develop IVH, which contributes considerably to both mortality and cognitive neurological

impairment in preterm and LBW neonates (6). Antenatal dexamethasone administered to the mother or indomethacin administered to the neonates has been found to reduce the incidence of IVH. The prognosis is determined by the size of the hemorrhage and the existence of hydrocephalus (20).

Most of the literature available is reported from high-income countries, and there is limited data in Ethiopia, where the setting and the care given to preterm infants differ from those in high-income countries, making it difficult to generate local data. In a study at Tibebe Ghion specialized hospital, the prevalence of IVH among preterm neonates was 27.04% (9). In Ethiopia, there are limited studies on the magnitude and associated factors of intraventricular hemorrhage in preterm neonates. Therefore, this study aims to assess the magnitude and associated factors of intraventricular hemorrhage in preterm neonates in St. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia.

1.3 significance of the study

Intraventricular hemorrhage (IVH) is a significant predictor of poor neurodevelopmental outcomes. Preterm neonates who develop IVH are at a higher risk of death, and survivors are more likely to have lasting disabilities. This study will reveal the magnitude and risk factors of IVH in preterm neonates admitted to St. Paul's Hospital Millennium Medical College, Addis Ababa.

IVH magnitude and risk factor identification may improve the quality of care in neonatal intensive care units. Also, the research will help clinicians to know the magnitude and factors of IVH and those neonates at risk, and these risk groups will get extra attention in their health care. The associated factors that will be identified can be used to guide prevention strategies and promote the need for routine screening of high-risk neonates. Additionally, the findings of this study will be used as base-line data for further investigation by the institution to improve the diagnosis and management of IVH.

2. Literature review

2.1. Over view of intraventricular hemorrhage in preterm neonates

Intraventricular hemorrhage (IVH) is common in preterm neonates, and its consequences are neurodevelopmental delays, hydrocephalus, seizures, and death. A study showed neonates with severe IVH had a 23-fold higher risk of death than neonates with no IVH (21). Intraventricular hemorrhage (IVH) is prevalent in premature babies and is associated with substantial morbidity and lifelong disability (22).

2.2. Magnitude of intraventricular hemorrhage in preterm neonate

A study done in the United Kingdom with 618 children born fewer than 30 weeks gestational age found risk factors related to intraventricular hemorrhage in extremely preterm neonates. Of the neonates with birth weights less than 1000 g, 36.5% developed IVH(23) Research conducted in Canada discovered that IVH occurred in 24.4% of 495 preterm neonates born before 29 weeks, with 9.7% having severe IVH (24). A prospective study conducted in the neonatal critical care unit of a Lahore hospital revealed that IVH occurred in 45% of 100 preterm neonates (25).

A cross-sectional study was undertaken in Iran on 178 infants with a gestational age of ≤ 32 weeks. The prevalence of IVH was 20% (26). Studies were undertaken at Zambia University Teaching Hospital to determine the prevalence of intraventricular haemorrhage and associated risk factors in preterm neonates in the Neonatal Intensive Care Unit. In the first seven days after birth, 34.2% of preterm newborns weighing 1.5kg or less experienced intraventricular hemorrhage(27).

A study in Ghana on cord blood Vitamin A levels and intraventricular haemorrhage outcomes in preterm neonates discovered that the incidence of IVH was 8.88%(28). In investigations conducted at Moi Teaching Hospital (MTRH) in Western Kenya, the prevalence of IVH was 33.8% (29). A cross-sectional study of 201 preterm neonates was carried out at Tibebe Ghion Specialized Hospital in Ethiopia. The prevalence of IVH among preterm neonates was 27.04% (9).

2.3 Factors associated with the prevalence of IVH in preterm neonates

2.3.1. Neonatal related factors of IVH in preterm neonate

A study done in the United Kingdom with 618 children born fewer than 30 weeks gestational age found risk factors related to intraventricular hemorrhage in extremely preterm neonates. IVH was linked to thrombocytopenia, cardiopulmonary resuscitation (CPR), and intubation during birth (23). Studies in Atlanta showed that premature infants with very low birth weight, lower gestational age, perinatal asphyxia, and Apgar scores < 6 at minutes 1 and 5 were more likely to develop IVH(30).

A study conducted at Germen University Hospital found that RDS, pneumothorax, and early-onset sepsis, as well as patent ductus arteriosus, were related to a greater prevalence of intraventricular hemorrhage in 765 very preterm newborns (31). Studies conducted in England showed that neonates who are exposed to second stage of labor were risk for IVH as compared to neonates who are not exposed (32). In studies conducted in Korea, gestational age less than 34 weeks and the presence of PDA were significantly associated with IVH(33).

Another investigation conducted in Turkey found that in 230 premature children born at a gestational age less than 34 weeks, cardiopulmonary resuscitation in the delivery room (15.2%) and sepsis (4.78%) were substantially linked with intraventricular hemorrhage(34). A study was undertaken in Poland on 267 premature infants delivered before 32 weeks of gestation who had hypoxia and hypotension, which were related to the incidence of IVH (35). In a study of 95 very low-birth-weight infants (including 37 preoperative neonates and 58 postoperative neonates) conducted at the National Taiwan University Hospital. The occurrence of hypothermia was greatly reduced (45.9% - 8.5%), while recording (59.5% to 15.5%). The short-term efficacy in very preterm newborns was significantly improved, especially the incidence of new intraventricular hemorrhage cases (21.6% to 5.2%, $P = 0.015$). This is clearly associated with a higher incidence IVH (36).

Premature Newborns with Gestational Age Less than 34 Weeks: Prevalence, Risk Factors, and In-Hospital Outcomes was investigated in Brazil. Premature babies with gestational age < 28 weeks (37%), birth weight < 1500 g (71.7%), and Apgar < 7 in the 5th minute of life (46.1%) were substantially linked with IVH (37). Studies conducted in china, maternal age was associated with the occurrence of IVH(38).

A study conducted in Pakistan found that babies who received surfactant had a substantially higher risk of IVH(39). Another study was conducted in Nigeria. In 99 preterm infants, lower gestational age and respiratory assistance (continuous positive airway pressure (CPAP)) were significant predictors of IVH(40). The study was done at the University Teaching Hospital in Lusaka, Zambia. 298 preterm neonates with birth weights less than or equal to 1.5kg and gestational ages less than 30 weeks had a significant association with IVH(27).

A Study were undertaken on preterm newborns in western Kenya. Low gestational age and extremely low birth weight, neonates with thrombocytopenia, and neonates on mechanical breathing were all related to IVH (41).

Another study conducted in Tibebe Ghion Specialized Hospital (TGSH) found that birth weights between 1500 and 2000 g and neonates with gestational age between 28 and 32 weeks were positively associated with the occurrence of IVH (9).

2.3.2. Maternal related factor of IVH among preterm neonates

In studies conducted in New York, prolonged rupture of membrane was independently associated with the occurrence of IVH(42). Another study conducted in France found that the risk factor of IVH among very preterm neonates receiving antenatal magnesium sulfate therapy, antenatal corticosteroids, infants born after placental abruption, and preterm labor was associated with a risk of intraventricular hemorrhage(43).

In other studies conducted in North Carolina and China, preeclampsia, complete prenatal steroid exposure, and cesarean delivery were negatively linked with IVH, but maternal Chorioamnionitis was positively associated with the occurrence of IVH (44, 45). Studies conducted in Nigeria found that the place of delivery of preterm neonates was significantly associated with the occurrence of IVH (40).

2.4. Conceptual frame work

By reviewing different literatures about the magnitude and associated factor of intraventricular hemorrhage among preterm neonates.

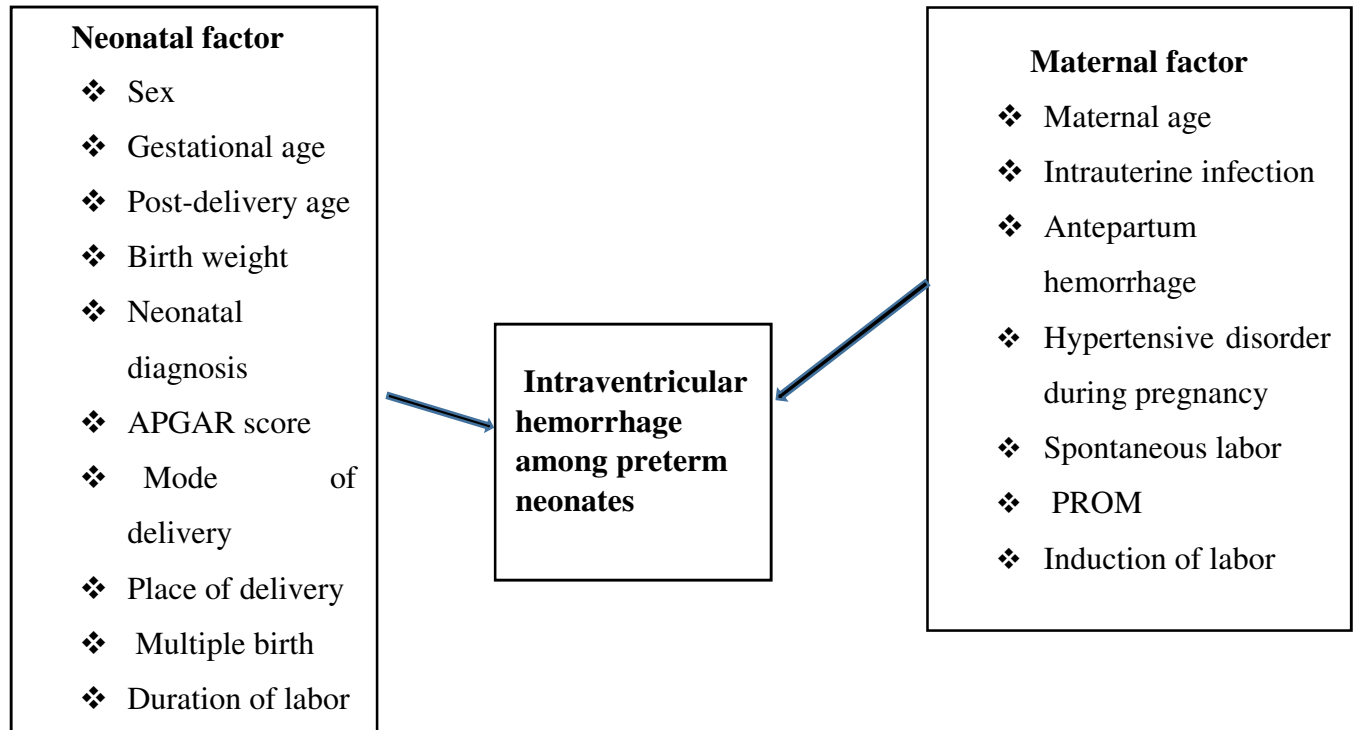


Figure 1. Conceptual frame work for IVH and associated factors among preterm neonates in Addis Ababa, Ethiopia, 2024(9, 31, 37, 46).

3. Objective

3.1 General objective

1. To assess the magnitude and associated factors of intraventricular hemorrhage among preterm neonates admitted in St. Paul's Hospital Millennium Medical Collage, Addis Ababa, Ethiopia, in 2024.

3.2 Specific objectives

1. To determine the magnitude of intraventricular hemorrhage among preterm neonates admitted in St. Paul's Hospital Millennium Medical Collage, Addis Ababa, Ethiopia, in 2024.
2. To identify factors associated with intraventricular hemorrhage among preterm neonates admitted in St. Paul's Hospital Millennium Medical Collage, Addis Ababa, Ethiopia, in 2024.

4. Methods and Materials

4.1 Study area

The study was conducted in St. Paul's Hospital Millennium Medical Collage, Addis Abeba, Ethiopia. There are twelve governmental hospitals in the city. Five operate under the Addis Abeba health authority, four operate under the federal ministry of health, one under the ministry of education (AAU), and two under the Ethiopian defense force. Eleven of them have a neonatal unit. The study was conducted at St. Paul's Hospital Millennium Medical College in Addis Ababa, Ethiopia, selected purposely due to availability and applicability of neonatal Transfontanel ultrasound screening. St. Paul's Hospital Millennium Medical College has a total of two neonatologists and 50 nurses working in the unit, and there are 60 beds in the unit. The annual number of neonatal admissions in NICU was 3556 and the average annual admission of preterm was 1193.

4.2 Study period

The study period was from April 1 to April 30 / 2024.

4.3. Study design

An institutional-based retrospective cross-sectional study design was used from January 1, 2020, up to December 30, 2022.

4.4. Population

4.4.1. Source Population

The source population was all medical records of preterm neonates admitted in St. Paul's Hospital Millennium Medical Collage, Addis Ababa.

4.4.2 Study population

The study population was all medical records of preterm neonates admitted in St. Paul's Hospital Millennium Medical Collage, Addis Ababa from January 1, 2020, up to December 30, 2022.

4.3.3 Sampling unit

Selected medical charts of preterm neonates in St. Paul's Hospital Millennium Medical Collage, Addis Ababa.

4.4.4. Inclusion and exclusion criteria

Inclusion criteria

- ❖ All medical records of preterm neonates who were admitted in NICU at St. Paul's Hospital Millennium Medical College, Addis Ababa during the study period.

Exclusion criteria

- ❖ Incomplete Medical records of preterm neonates with no cranial ultrasonography screening.
- ❖ Medical records of preterm neonates diagnosed with anencephaly.

4.4. Sample size determination and sampling technique

4.4.1. Sample size determination

The sample size is determined by using single population proportion formula. By taking prevalence of IVH 27.04% from a study in Tibebe Ghion Specialized Hospital (9) and 5% marginal error,

95% confidence interval and 10% non-response rate was added.

$$n = (Z\alpha/2)^2 P(1-p)/d^2$$

n= the minimum required sample size

$Z\alpha/2$ = normal standard distribution value corresponding to 95% confidence interval

p= single population proportion =27.04 %

d= the margin of error (precision) =0.05

$$n = \frac{(1.96)^2 0.2704(1-0.2704)}{(0.05)^2} = 303$$

By adding 10% non-response rate, the final sample size required for first objective was 333

Sample size calculation for the second objective by taking significant factor from the previous study (9).

Table 1: Sample size calculation by factors of intraventricular hemorrhage obtained from previous study using Epi info Version 7, Addis Ababa, Ethiopia, 2024.

Variables	95 % CI	Powe r	Rati o	Proportio n among unexpose d	Proportio n among exposed	Odds ratio	Non-respons e rate	Sampl e size
Birth weight	95	80	1:1	0.162	0.107	0.38	10%	444
Gestationa l age	95	80	1:1	0.112	0.158	2.14	10%	506

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After calculating sample size using associated factors the final sample size required for second objective was 506.

Therefore, the final sample size for this study was 506.

4.4.2. Sampling procedure and technique

Considering the admission rate of preterm neonates at NICU for the past three consecutive years in St Paul's Hospital Millenium Medical College. Proportion to size allocation was implemented to determine the number of preterm neonates from each year. Consideration preterm neonates was selected using simple random sampling technique.

The number of preterm neonates included from each hospital is calculated as;

(Number of preterm neonate in each year × sample size) / total population from all hospitals.

Table 2. Proportional allocation of total sample based on three years admission data

Name of hospital	Year one (2020)	Year two (2021)	Year three (2022)	admission in three years	Total sample size
	number of admission	number of admission	number of admission		
SPHMMC	1029	1210	1340	3579	506
Proportional allocation	145 (29%)	171 (34%)	190 (37%)	506 (100%)	

4.5. Variables

4.5.1 Dependent variables

- ❖ Intraventricular hemorrhage

4.5.2 Independent variables

- ❖ Gender
- ❖ Gestational age
- ❖ Birth weight

- ❖ APGAR score
- ❖ Mode of delivery
- ❖ Place of delivery
- ❖ Duration of labor
- ❖ Maternal obstetric diagnosis
- ❖ Neonatal diagnosis

4.6. Operational definition

- ❖ **Intraventricular hemorrhage:** those preterm neonates with a cranial sonographic study showing intraventricular hemorrhage on their medical chart.
- ❖ **Preterm:** babies born before 37 weeks of gestation.
- ❖ **Neonates are** babies born after 28 weeks of gestation and less than 28 days old (3, 46).
- ❖ **Incomplete medical record:** The main variables (birth weight, gestational age) are absent in the medical charts of the preterm neonates.

4.7. Data Collection Instrument and Procedure

A structured checklist adapted from reviews of different literatures was used for data collection (9, 47, 48). The registration book was used to get the card numbers of preterm neonates and computer generation random sampling technique was used. After getting the card numbers, patient charts was retrieved from the record and documentation office. The checklist consists of four parts. Part I: socio-demographic factor; Part II: investigation-related; Part III: obstetric-related; Part IV: neonatal-related. To collect the data. Those data collectors was assigned to a selected hospital, and the entire data collection period was supervised by a trained supervisor and principal investigator.

4.8. Data Quality Control and management

To assure the quality of the data, the following measures was undertaken: A pre-test was done of the checklists in 5% of the patient's chart other than the selected years of the study in St Paul's Hospital Millenium Medical College to correct or manage ambiguous questionnaires. Two BSc nurses and one supervisor was trained for two days by the principal investigator about how to collect the data from the chart, inclusion and exclusion criteria, and ethical issues. The appropriately designed data collection instrument was used. Every day, the collected data was reviewed and checked for completeness and consistency of response by the principal

investigator and supervisor. Then the necessary feedback was given on how to proceed the next day. A non-overlapping unique code was given for each individually answered checklist.

4.9. Data Analysis and Interpretation

All data was checked visually, coded, and then exported into the SPSS version 27 software package for final analysis. After categorizing and determining variables, descriptive analysis was carried out for each of the independent variables using frequencies, cross-tabulation, and percentages. The continuous variable was determined by median with IQR. The outcome of interest was computed using text, tables, graphs, and charts. To determine the independently associated variables, associations was investigated using bivariable logistic regression analysis. All independent variables with a p value < 0.2 in the unadjusted model was selected as candidates for multivariable analysis to control the effect of confounding variables. In the multivariable analysis, variables with a p-value < 0.05 was considered statistically significant. Model fitting at the hosmer and lemeshow test was done to check model fitness at a non-significant level in multivariable analysis. Then the degree of associations was expressed by using the odds ratio (ORs) with a 95% CI in the multivariable logistic regression.

4.10. Ethical and legal consideration

A formal letter seeking ethical clearance and approval was obtained from the St. Paul's Hospital Millennium Medical College Ethical Review Committee, School of Nursing. This official document was submitted to the respective hospitals. Following this, a letter of permission was secured from administrative bodies in the area to communicate with relevant bodies at the hospital. Before commencing data collection, permission was obtained from the in-patient directorate of St. Paul's Hospital Millennium Medical College. To ensure confidentiality, the names of patients was replaced with codes to avoid individual identifiers.

4.11. Dissemination of results

Initially, the findings of this research will be submitted to the Department of Neonatal Nursing, the School of Nursing, and St. Paul's Hospital Millennium Medical College. Additionally, the study findings will be disseminated to the study hospitals and the Addis Ababa Health Bureau. Moreover, efforts will be made to present it in various seminars and workshops, and finally, it will be submitted for publication in a peer-reviewed and reputable journal.

5. Result

This study was to assess the magnitude and associated factors of intraventricular hemorrhage among preterm neonates. Intraventricular hemorrhage is one of the most common neurological complications in premature infants, particularly those born before 34 weeks of gestation.

5.1. Sociodemographic characteristics of preterm neonates

A total of 506 medical records of preterm neonates admitted to SPHMMC, of which 481 were fulfil the inclusion criteria and the response rate was 95%. From those are 226(47%) male and 255 (53%) are female. The median postnatal age of neonates in hour were 8hr (IQR of 46hr). The median maternal age was Median 26 year with an IQR (7). Among neonates enrolled in the study, 331 (68.8%) of them are singletons. Most of the neonates in the study have birth weights between 1500 and 2499 g (55.9%).majority of neonates were delivered at hospital 394 (81.9%) and most of them were SVD 240 (49.9%) table (3).

Table 3 Sociodemographic characteristics of preterm neonates

Variables		Frequency	Percent (%)
sex	Male	226	47
	Female	255	53
Birth weight	1500-2499	269	55.9
	1000-1499	187	38.9
	< 1000	25	5.2
Place of delivery	Hospital	394	81.9
	Health center	66	13.7
	Home	21	4.4
Mode of delivery	SVD	240	49.9
	Cesarean section	225	46.8
	Instrumental	16	3.3
Pregnancy	Single	331	68.8
	Twin	133	27.7
	Triple	17	3.5
	No	219	45.5
	No	235	48.9
	No	247	51.4
	No	367	76.3
	No	464	96.5

SVD; Spontaneous Vaginal Delivery

5.2 clinical characteristics of preterm neonates

According to this study, there were a variety of neonatal problems, and of these, 54.5 % of the babies admitted to this hospital have RDS followed by hypothermia 51.1%, sepsis 48.6%, hypoglycemia 23.7% and asphyxia 3.5% (see table 4).

Table 4. Clinical characteristics of preterm neonates

Variables		Frequency	Percent (%)
RDS	Yes	262	54.5
	No	219	45.5
Hypothermia	Yes	246	51.1
	No	235	48.9
Sepsis	Yes	234	48.6
	No	247	51.4
Hypoglycemia	Yes	114	23.7
	No	367	76.3
Asphyxia	Yes	17	3.5
	No	464	96.5

RDS: Respiratory Distress Syndrome

5.2. Obstetric characteristics of mothers

Several obstetric problems occurred during pregnancy of these premature infants. Of those 37 % of mothers were hypertension disorders of pregnancy, majority of them were pre-eclampsia 31%, chronic hypertension 7.3% and eclampsia 3.7%, followed by PROM 16.4% and antenatal hemorrhage 8.5%. From those mothers who gave preterm births, 22.9% of them were given antenatal corticosteroid injections (table 5).

Table 5. Obstetric characteristics of mothers

Variables		Frequency	Percent (%)
Preeclamsia	Yes	149	31
	No	332	69
Eclamsia	Yes	18	3.7
	No	463	96.3
Chronic hypertension	Yes	35	7.3
	No	446	92.7
PROM	Yes	79	16.4
	No	402	83.6
APH	Yes	41	8.5

	No	440	91.5
Spontaneous labor	Yes	334	69.4
	No	147	30.6
Antenatal steroid used	Yes	110	22.9
	No	371	77.1
Induction of labor	Yes	8	1.7
	No	473	98.3

PROM; Premature Rupture of Membrane, APH; Antepartum Hemorrhage

Magnitude of IVH among preterm neonates

Out of 481 participate 150 (31.2%) developed intraventricular hemorrhage majority of them were grade II intraventricular hemorrhage 57 (11.9%), followed by grade I 55(11.4%), grade III 31 (6.4%), and grade IV 7 (1.5%).

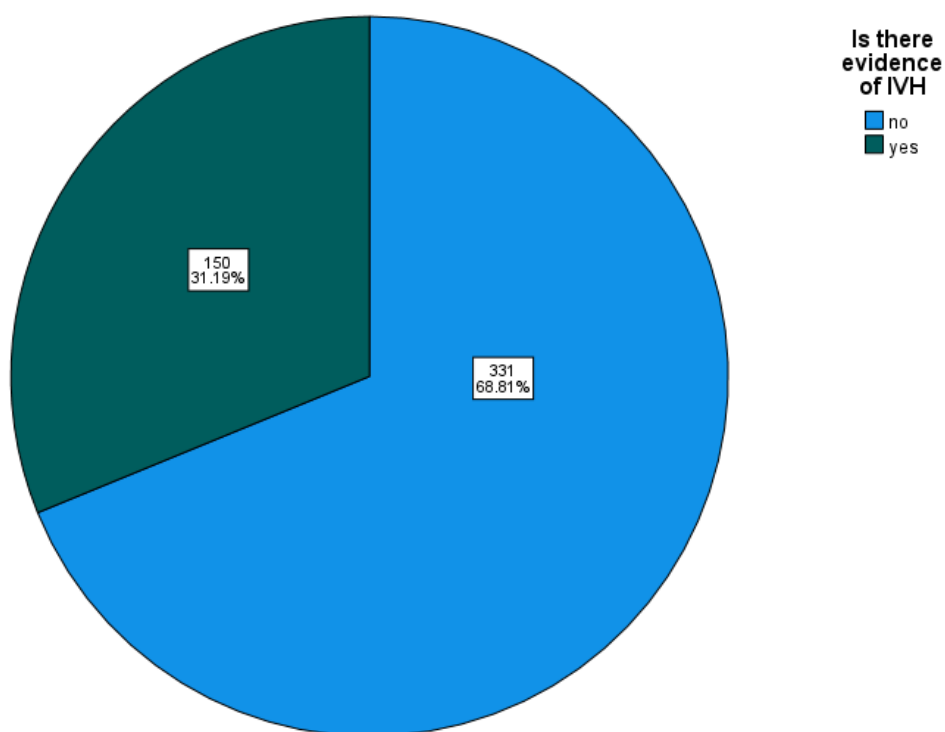


Figure 2: Magnitude of Intraventricular hemorrhage among preterm neonates admitted to NICU at SPHMMC, Addis Ababa, Ethiopia, 2024.

5.3 factor associated with intraventricular hemorrhage among preterm neonates

Bivariate logistic regression was used to examine the relationship between dependent variable and independent factors. Independent variables with p values less than 0.2 were entered into multivariate logistic regression analysis. Variables which are candidate for multivariate analysis after bivariate analysis with a p-value of <0.2 were RDS (COR = 1.44(0.97-2.16)), Hypothermia (COR= 2.43(1.62-2.63)), Pregnancy (COR= 2.38(1.68-3.38)), place of delivery (COR= 2.47(1.47-4.17)), Sex (COR= 0.56(0.38-0.83)), Preclamsia (COR= 2.79(1.85-4.19)), Eclamsia (COR= 2.28(0.88-.5.87)), birth weight (COR= 0.99(0.99-0.99)), Gestational age (COR= 0.72(0.66-0.80)), postnatal age (COR=0.98(0.98-0.99)), maternal age (COR=1.11(1.06-1.16)), Duration of labor (COR=1.03(0.99-1.07)). The model has also good fit since Hosmer and Lemeshow test could not reject the hypothesis of model appropriateness as chi-square value is 8.095 and p =0 .424(table 6).

Table 6. Bivariate analysis for the association of IVH among preterm neonates which are candidate for multivariate analysis p- value < 0.2.

Variables		Intraventricular hemorrhage		COR (95% CI)	P – value
		No	Yes		
RDS	No	160(73.1%)	59(26.9%)	1.44 (0.97-2.16)	0.067
	Yes	171(65.3%)	91(34.7%)		
Hypothermia	No	184(78.3%)	51(21.7%)	2.43 (1.62-2.63)	< 0.001
	Yes	147(59.8%)	99(40.2%)		
Pregnancy	Single	249(75.2%)	82(24.8%)	1	<0.001
	Twin	77(57.9%)	56(42.1%)	0.13(0.04-0.40)	<0.001
	Triple	5(29.4%)	12(70.6%)	0.30(0.10-0.90)	0.033
Place of delivery	Hospital	256(65%)	138(35%)	1	0.001
	Health center	57(86.4%)	9(13.6%)	0.30(.09-1.06)	0.063
	Home	18(85.7%)	3(14.3%)	0.29(0.14-0.61)	0.001
Sex	Male	141(62.4%)	85(37.6%)	0.56(0.38-0.83)	0.004

	Female	190(74.5%)	65(25.5%)		
Pre-eclamsia	No	252(75.9%)	80(24.1%)	2.79(1.85-4.19)	<0.001
	Yes	79(53%)	70(47.0%)		
Eclamsia	No	322(69.5%)	141(30.5%)	2.28(0.88-5.87)	0.087
	Yes	9(50%)	9(50%)		
Birth weight	1500-2499 gram	209(77.7%)	60(22.3%)	1	<0.001
	1000-1499 gram	112(59.9%)	75(40.1%)	2.33(1.54-3.51)	<0.001
	<1000 gram	10(40%)	15(60%)	5.22(2.23-12.22)	<0.001
Gestational age	Median 32 wks (IQR(3))			0.72(0.66-0.80)	<0.001
Postnatal age	Median 8 hr (IQR(46))			0.98(0.98-0.99)	0.007
Maternal age	Median 26 year (IQR(7))			1.11(1.06-1.16)	<0.001
Duration of labor	Median 5 hr (IQR(5))			1.03 (0.99-1.07)	0.054

COR: Crude Odd Ratio, CI: Confidence Interval, AOR: Adjusted Odd Ratio, IVH: Intraventricular hemorrhage, IQR: Inter-quartile Range, RDS; Respiratory Distress Syndrome

In adjusted analysis factors that continued to be associated with increased odds of IVH were Hypothermia (AOR=2.04(1.28-3.25)) Preclamsia (AOR=1.97(1.22-3.18)) Gestational age (AOR=0.78 (0.70-0.87)), Maternal age, (AOR=1.08(1.02-1.13)) and Duration of labor (AOR=1.07(1.02-1.11)) was statistically significant with Intraventricular hemorrhage at a p-value of <0.05 with 95% confidence interval (table 7).

Table 7. Multivariate logistics regression analysis of independent factors associated with IVH with p value of p<.05 among preterm neonates attending at Sphmmc governmental hospital, Adisabeba, Ethiopia 2024.

Variables		IVH		AOR (95%)	P- value
		No	Yes		
Hypothermia	No	184(78.3%)	51(21.7%)	2.04(1.28-3.25)	0.003*
	Yes	147(59.8%)	99(40.2%)		

Preeclamsia	No	252(75.9%)	80(24.1%)	1.97(1.22-3.18)	0.005*
	Yes	79(53%)	70(47%)		
Gestational age	Median 32 wks (IQR (3))			0.78(0.70-0.87)	<0.001**
Maternal age	Median 26years(IQR (7))			1.08(1.02-1.13)	0.002*
Duration of labor in hour	Median 5hrs (IQR (5))			1.07(1.02-1.11)	0.001*

COR: Crude Odd Ratio, CI: Confidence Interval, AOR: Adjusted Odd Ratio, IVH: Intraventricular hemorrhage, IQR: Inter – quartile Range ** p< 0.001, * p < 0.05.

6. Discussion

This study assess the magnitude and associated factors of intraventricular hemorrhage among preterm neonates. This study showed that magnitude of intraventricular hemorrhage among preterm neonates was 31.2%. This was comparable with that was reported in study done at United Kingdom 36.5%, Zambia University Teaching Hospital 34.2%, and Western Kenya 33.8%, and Tibebe Ghion Specialized Hospital in Ethiopia 27.04 % (9, 23, 27, 29). Lower than that was reported in study done in Pakistan at Lahore hospital 55% (25). This discrepancy may be due to sample size variation, in the present study the sample size was higher as compared to studies at Lahore hospital. But higher than study conducted at Canada 24.4%, Iran 20% and Ghana 8.88% (24, 26, 28). This is may be may be due to sampling technique variation, the present was used simple random sampling technique as compared to cense method.

In the present study the grade of intraventricular hemorrhage was grade II intraventricular hemorrhage was the majority 57 (11.9%), followed by grade I 55(11.4%), grade III 31 (6.4%), and grade IV 7 (1.5%).where as studies done at Tibebe Ghion Specialized Hospital in Ethiopia was grade I is the most observed 24 (12.24%) which was followed by grade II 19 (9.7%) and grade III 9 (4.6%), and IVH grade IV accounts 1 (0.5%) (9). This may be due to methodological difference. Our finding shows that the magnitude of intraventricular hemorrhage was higher in the birth weight less than 1000gm (60%), 1000gm-1499gm (40.1%) as compared to birth weight between 1500gm-2499gm (22.3%). This study was supported by study conducted in Tibebe Ghion Specialized Hospital birth weight 1000gm-1499gm (16.3%) and birth weight between 1500gm-2499gm (10.7%)(9).

In our study gestational age <37wk (AOR=**0.782(0.702-0.870)** and a **p-value of < 0.001** was associated with intraventricular hemorrhage. This finding was supported by several studies conducted in Atlanta, Korea, Brazil, Nigeria, Zambia, Kenya and Tibebe Ghion Specialized Hospital (9, 27, 30, 33, 37, 40, 41). This may be due to blood vessels of premature neonates are not fully developed, making them more vulnerable to bleeding. In the present study, we reported that preterm neonates with hypothermia (AOR = **2.042; 1.283-3.250; P= 0.003**) have 2 times higher probabilities of developing intraventricular hemorrhage compared with preterm neonates without hypothermia. This finding was supported by the studies conducted in Taiwan (36). This

similarity may be due to hypothermia can lead to vasoconstriction of the blood vessel, decreased Cerebral blood flow and reduced oxygen supply to the brain this leads to ischemia, this increase risk of intraventricular hemorrhage.

According to this study maternal age (AOR= 1.082; **1.028-1.138 P; 0.002**) was associated with IVH. This finding was supported by studies conducted in china (38). This may be due to older mothers are more likely to have placental abnormalities or insufficiency this can lead to fetal distress and compromise the baby's neurological development, potentially increasing the risk of IVH. The other associated factor of IVH was pre-eclampsia (AOR=**1.97; 1.22-3.18; P; 0.005**). Pre-eclampsia was 1.9 times higher probabilities of developing intraventricular hemorrhage compared with preterm neonates without pre-eclampsia. This may due to pre-eclampsia is associated with abnormalities in the coagulation system, leading to an increased risk of bleeding disorders in both maternal and fetus this leads to increase the risk of IVH. Duration of labor (AOR= **1.07; 1.028-1.116; P; 0.001**) also one of the associated factor of IVH in this study. This finding was supported studies conducted in England (32). This is may be due to prolonged labor might be increased pressure on the baby's head, which may cause damage to the blood vessels in the brain.

7. Strength and Limitation of the study

The simple random sampling technique was used to determine magnitude and associated factors of intraventricular hemorrhage among preterm neonates. This study has several limitations; it was cross-sectional that makes it prone to bias from several uncontrolled variables. Since the study was single centered the finding might not represent the all source population.

8. Conclusion and recommendation

The magnitude of IVH was found to be high in preterm neonates. The magnitude was greater in newborns that were born in infants who had very low birth weight, showing having a smaller birth weight increased the risk of IVH. Majority of the neonates with intraventricular hemorrhage presented with grades II of the condition. Lower gestational age and maternal age was strongly associated with intraventricular hemorrhage.

Hospitals: the reduction of preterm births and low birth weight should be special follow up by prenatal care providers. Increased the number of radiant warmer, incubator in NICU to prevent hypothermia. Pregnant mothers should be strict in attending antenatal care follow-up appointments to identify potential risk factors for the development of IVH.

Cranial ultrasonography screening should be done for all preterm neonates.

Researcher: Future studies should follow-up both neonates with and without intraventricular hemorrhage to determine causality.

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10. Appendix

Information sheet and informed voluntary consent form for Administration of St Paul's Hospital Millennium Medical College.

My name is **Bereket Molla** I am Studying MSC in Neonatal Nursing at St. Paul Hospital Millennium Medical College. I kindly request you to lend me your attention to explain to you about the study and why your institutions being selected as the study setting.

1. The aims of this study is to assess the magnitude and associated factors of Intraventricular hemorrhage in preterm neonates admitted in St. Paul's Hospital millennium Medical college, Adisabeba, Ethiopia 2024.

2. Procedure and Durations

We will collect medical record from hospital card room with permissions. Then we will fill secondary data from medical records chart of each patient for 30min.

3. Risk and Benefits

The risk of taking secondary data from the patient file is minimal, but the finding from this research may reveal important information for the hospital, providers and for the patients.

4. Confidentiality

The information's provided will kept confidential. There will be no information that will identify the participants in particular. The finding of the study will be general for the study community and will not reflect any thing particular of the individual persons. Code is given to the questionnaires to avoid showing names and card number.

5. Right

The hospital /card room has the right to get the medical chart of the patient at any time. The hospital has the right to stop this study if any misdeeds and unethical procedure observed during the data collections process in the hospital premises.

6. Contact address

Bereket Molla: Principal investigator

Phone Number: + 251-9 75 01 71 82

E-mail: bereketmolla76@gmail.com

7. Declaration of informed voluntary consent

I have read the participant information sheet .I have clearly understood the purpose of the research ,the procedures, confidentiality the risk and benefits ,issues of confidentiality ,the rights to get the patients file at any time and the contact address for any queries .I had given the opportunity to ask questions for things that may have been unclear . I am informed; the hospital has the right to stop this study if any misdeeds and unethical procedure observed during the data collections process in the hospital premises .Therefore I declare my voluntary consent on behalf of hospital management to allow conducting the study in the hospital with my initials.

Name and signature of Hospital administration: _____ Date _____

Name and signature of data collector: _____ Date _____

English version checklist

A checklist format prepared in order to collect information on the Magnitude of Intraventricular Hemorrhage (IVH) and associated factor among preterm neonates admitted in St. Paul's Hospital millennium Medical College, Adisabeba, Ethiopia 2024.

Part I: Socio-Demographic related data	
Maternal Age: _____	
Part II: Sonographic finding	
201. Is there evidence of IVH? 1. ☐ Yes 2. ☐ No	
202. If yes what is the grade of IVH? 1. ☐ Grade- I (confined to the germinal matrix) 2. ☐ Grade-II ($\leq 50\%$ of the lateral ventricle volume) 3. ☐ Grade-III ($\geq 50\%$ of the lateral ventricle volume) 4. ☐ Grade-IV (periventricular infarction /hemorrhage)	
Part III. Neonatal related	
301. Pregnancy I. ☐ Singleton II. ☐ Twins III. ☐ Triplets 302. place of delivery 1, ☐ Home 2, ☐ Hospital 3, ☐ health center 303. mode of delivery 1, ☐ SVD 2, ☐ Cesarean section 3, ☐ Instrumental 304. Duration of labor: _____ in hours 305. Post Natal dates _____	307. gestational age in weeks: _____ wks 308. Birth weight: _____ gm 309. Apgar Score of at 0 and 5 minutes: ____ 310. Was antenatal corticosteroid used? 1. ☐ Ye 2. ☐ No 311. IF yes at which GA? _____ 312. Diagnosis of the neonate (tick all that apply) 1. ☐ Respiratory Distress Syndrome 2. ☐ neonatal infections, sepsis, meningitis 3. ☐ Perinatal asphyxia 4. ☐ Hypoglycemia

306. Sex 1. ☐ Male 2. ☐ Female	5. ☐ Hypothermia 6. ☐ Other, specify: _____
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Part IV: obstetric related	
401. Hypertensive disorders of pregnancy	1. ☐ Yes 2. ☐ No
402. If yes, check type (TICK ALL THAT APPLY):	
1. ☐ Pre-eclampsia	
2. ☐ Superimposed pre-eclampsia	
3. ☐ Eclampsia	
4. ☐ Chronic hypertension	
403. Antepartum hemorrhage (APH):	1. ☐ Yes 2. ☐ No
404. Other maternal illnesses:	1. ☐ Yes 2. ☐ No
405. If yes specify: _____	
406. Spontaneous labor	1. ☐ Yes 2. ☐ No
407. PROM	1. ☐ Yes 2. ☐ No
408. Induction of labor	1. ☐ Yes 2. ☐ No

Declaration

I declare that this Research proposal **Magnitude and Associated Factors of Intraventricular Hemorrhage among Preterm Neonates Admitted in St. Paul's Hospital millennium Medical college, Addis Ababa,** is my own work that have not been addressed in the study area as far as my knowledge touched and all the sources I used has been indicated and acknowledged as complete reference.

Name of investigator

Signature

Date

Name of advisor/s

1. _____

2. _____

Name of invigilators

1. _____

2. _____