



Research Article

Online ISSN (3219-2789)

Incidence and Associated Factors of Intraventricular Hemorrhage in Preterm Neonates at Ramadi Teaching Hospital for Maternity and Children, Ramadi City, Iraq

Roaa Jasim¹, Rana Fahmi Shitran² , Raid Muhmid Al-Ani^{3*} 

¹Department of Pediatrics, Al-Ramadi Teaching Hospital for Maternity and Children, Anbar, Iraq; ²Department of Pediatrics, College of Medicine, University of Anbar, Anbar, Iraq; ³Department of Surgery/Otolaryngology, College of Medicine, University of Anbar, Anbar, Iraq

Received: 10 May 2026; Revised: 1 July 2026; Accepted: 5 July 2026

Abstract

Background: Intraventricular hemorrhage (IVH) is a common complication in premature infants, and it is associated with a high risk of neurodevelopmental impairment and mortality. **Objective:** To estimate the incidence of IVH in preterm neonates and the associated factors that increase it. **Methods:** This is a prospective cohort study that included 89 preterm newborns admitted to the neonatal intensive care unit (NICU) in Ramadi Maternity and Children Teaching Hospital from December 2024 to June 2025. IVH was diagnosed by ultrasonography on day 3 and day 7 of the delivery and admission to the NICU. **Results:** 89 neonates revealed different grades of IVH in 15(16.9%). There are significant associations between IVH and neonate male sex ($p=0.021$), lowest gestational age ($p=0.045$), low birthweight ($p=0.015$), need for positive pressure ($p=0.042$), and the use of Continuous Positive Airway Pressure (CPAP) and surfactant ($p=0.031$). There is a significant association between sepsis and the incidence of IVH ($p<0.001$) and preterm infants who developed hypoglycemia ($p=0.005$). Preterm infants were found to have a murmur due to patent ductus arteriosus ($p=0.02$). **Conclusions:** The incidence of IVH in preterm neonates at Ramadi, Iraq, was 16.9%. Neonatal factors were male sex, decreased gestational age, low birth weight, the need for positive pressure for resuscitation, the need for CPAP and surfactant, having sepsis, hypoglycemia, and having a murmur due to patent ductus arteriosus. Regarding maternal factors: premature rupture of membrane and multiparity.

Keyword: Intraventricular hemorrhage; Incidence; Iraq; Preterm; Ramadi.

معدل الحوادث والعوامل المرتبطة بالنزيف داخل البطين لدى الأطفال الخدج في مستشفى الرمادي التعليمي، الرمادي/العراق

الخلاصة

الخلفية: يُعد النزف داخل البطينات الدماغية من المضاعفات الشائعة لدى حديثي الولادة الخدج، ويرتبط بارتفاع خطر الإعاقة العصبية النمائية والوفيات. **الهدف:** تقدير معدل حدوث النزف داخل البطينات الدماغية لدى حديثي الولادة الخدج وتحديد العوامل المرتبطة بزيادة احتمالية حدوثه. **الطرائق:** أجريت هذه الدراسة كدراسة أتريابية مستقبلية وشملت حديثي الولادة الخدج المقيولين في وحدة العناية المركزة لحديثي الولادة في مستشفى الرمادي التعليمي للنسائية والأطفال خلال الفترة من كانون الأول 2024 إلى حزيران 2025. بلغ حجم العينة 89 خديجاً. تم تشخيص النزف داخل البطينات الدماغية باستخدام التصوير بالأمواج فوق الصوتية في اليومين الثالث والسابع بعد الولادة. **النتائج:** أظهرت الدراسة حدوث النزف داخل البطينات الدماغية لدى 15 خديجاً (16.9%). وُجدت علاقة ذات دلالة إحصائية بين حدوث النزف وكل من جنس الذكر ($P=0.021$)، انخفاض عمر الحمل ($P=0.045$)، انخفاض وزن المواليد ($P=0.015$)، والحاجة إلى الضغط الإيجابي أثناء الإنعاش ($P=0.042$). كما ارتبط حدوث النزف بالحاجة إلى جهاز الضغط الهوائي الإيجابي المستمر والسورفاكتانت ($P=0.031$)، ووجود الإنتان ($P<0.001$)، ونقص سكر الدم ($P=0.005$)، ووجود لغط قلبي بسبب بقاء القناة الشريانية السالكة ($P=0.02$). أما العوامل الأمومية فشملت تمزق الأغشية المبكر وتعدد الولادات. **الاستنتاجات:** بلغ معدل حدوث النزف داخل البطينات الدماغية لدى الخدج في الرمادي/العراق 16.9%. وتضمنت العوامل المرتبطة به جنس الذكر، انخفاض العمر الحولي، انخفاض وزن الولادة، الحاجة إلى الإنعاش بالضغط الإيجابي، استخدام الضغط الهوائي الإيجابي المستمر والسورفاكتانت، الإنتان، نقص سكر الدم، وبقاء القناة الشريانية السالكة، إضافة إلى تمزق الأغشية المبكر وتعدد الولادات لدى الأمهات.

***Corresponding author:** Raid M. Al-Ani, Department of Surgery/Otolaryngology, College of Medicine, University of Anbar, Anbar, Iraq; Email: med.raed.alani2003@uoanbar.edu.iq

Article citation: Jasim R, Shitran RF, Al-Ani RM. Incidence and Associated Factors of Intraventricular Hemorrhage in Preterm Neonates at Ramadi Teaching Hospital for Maternity and Children, Ramadi City, Iraq. *Al-Rafidain J Med Sci.* 2026;11(1):123-128. doi: <https://doi.org/10.54133/ajms.v11i1.3088>

© 2026 The Author(s). Published by Al-Rafidain University. This is an open access journal issued under the CC BY-NC-SA 4.0 license (<https://creativecommons.org/licenses/by-nc-sa/4.0/>).



INTRODUCTION

One kind of bleeding that happens in the brain's ventricular system, which produces and circulates cerebrospinal fluid (CSF), is called intraventricular hemorrhage (IVH). Premature babies frequently experience this problem, particularly if they are delivered before 32 weeks of gestation, and it is linked to a significant risk of neurodevelopmental damage and death [1]. There are four levels of IVH severity based on how much bleeding can be seen on

head ultrasonography or brain imaging tests [2]. Through the years, there has been a decline in the overall incidence of IVH. It is still a significant contributor to morbidity in premature babies. Contrary to 14% of infants weighing 751-1,000 g and 24% of infants ≤ 750 g, the risk is negatively correlated with gestational age and birth weight; 7% of children weighing 1,001-1,500 g had severe IVH (grade III or IV) [3]. There are several known risk factors that raise the possibility that a newborn will have IVH. These risk factors fall into three categories:

neonatal, fetal, and maternal [4]. Fetal IVH risk may rise in cases of distress during labor and delivery [5]. Premature birth and low birth weight are two neonatal risk factors for IVH. The greatest risk for IVH occurs in infants born before 32 weeks of gestation or weighing less than 1500 grams at delivery. This phenomenon occurs because the cerebral blood vessels of premature newborns are more fragile and still developing [5]. Furthermore, the presence of an umbilical arterial catheter, mechanical ventilation, and respiratory distress syndrome increases the risk of IVH. These elements may cause variations in cerebral blood flow and blood pressure, which may raise the risk of IVH. Another risk factor for IVH is neonatal sepsis, which can lead to inflammation and damage to blood vessel integrity [6]. Additional risk factors for IVH include the use of anticoagulant drugs like aspirin, which can raise the risk of bleeding, and the existence of patent ductus arteriosus, which can cause alterations in blood flow and pressure inside the brain [7]. Depending on the extent of the bleeding and the existence of related comorbidities, IVH might show different clinical presentations. While severe IVH can cause symptoms such as bradycardia, apnea, seizures, and altered mental status, mild IVH may not cause any symptoms at all [2,5]. Intraventricular hemorrhage (IVH) is usually diagnosed using neuroimaging methods such as cranial computed tomography (CT) scans or head ultrasonography. Depending on the infant's age and the extent of the bleeding, several IVH diagnostic techniques may be used [8]. Head ultrasonography is the main diagnostic method used to identify IVH in premature newborns. Head ultrasonography can be done at the patient's bedside and is non-invasive and sedation-free. High-risk infants may receive serial head ultrasounds to monitor the onset or progression of IVH [9]. A cranial CT scan can be utilized to confirm the diagnosis in full-term infants or infants with suspected severe IVH. When head ultrasonography is unsatisfactory or the diagnosis is unclear, a CT scan may be beneficial since it is more sensitive in identifying IVH than head ultrasonography [10]. This study aims to assess the incidence of IVH in preterm newborns with its associated risk factors.

METHODS

Study design and settings

This study was designed as a prospective cohort study that included preterm newborns who had been admitted to the neonatal intensive care unit (NICU) in Ramadi Teaching Hospital for Maternity and Children in the period between December 2024 and June 2025.

Inclusion criteria

Preterm neonates are admitted from resuscitation rooms in hospitals, and neonates who are referred from private hospitals in Ramadi city within a few hours of delivery and preterm neonates who are referred from other hospitals within the first two days

of their lives, and resuscitation notes are written on referral paper.

Exclusion criteria

Preterm neonates with major congenital anomalies, preterm neonates with a family history of bleeding tendency, preterm neonates who have died before day 3 or on day 3 before the ultrasound has been done for them, preterm neonates whose family refused to participate in the study, and preterm neonates delivered by normal vaginal delivery at home or by midwives.

Data collection and outcome measurements

The data was collected from NICU files of the patients as well as the interviews with their family members, using a preformed questionnaire developed by the researcher and then refined and amended by the supervisor. The dependent variable was the presence or absence of intraventricular hemorrhage, which was diagnosed by ultrasonography on day 3 and day 7 of the delivery and admission to the NICU. The independent variables were mainly those related to neonatal risk factors, which included the following variables: Gestational age of the preterm at birth. GA was assessed using the New Ballard assessment and divided into 4 groups [11]. Birth weight at delivery Neonates were weighed using Seca™ electronic scales and divided into 4 groups [12]. The number of fetuses, whether they were single or multiple, and the mode of delivery, indicating if it was a normal vaginal delivery or a cesarean section, were recorded. The registrar doctor in the resuscitation room helps the researcher to identify the number of neonates who need active resuscitation, like positive pressure (Ambu bag), inotropic drugs, or intubation at birth. Vitamin K is available for administration in Ramadi hospitals and in the NU for those born elsewhere who did not receive it. The parameters in the NICU include the need for O₂, surfactant, CPAP, or the need for O₂, surfactant, CPAP, or mechanical ventilator. Clinical signs and symptoms of neonatal sepsis Neonates frequently exhibit modest, nonspecific signs and symptoms. Initial symptoms frequently include tachypnea, poor eating, lethargy, and temperature instability [3]. All the above were confirmed by high C-reactive protein and positive blood culture. In addition, a blood glucose test was done periodically by the nurse in the NICU using glucometers to detect neonates with hypoglycemia (blood glucose concentration <47 mg/dL) [13]. The neonates who had murmurs were further sent for echocardiographic study in the echo department in our hospital to detect cardiovascular pathology. The maternal risk factors also had been studied. Maternal age, parity, and whether they had gestational hypertension or not. Antenatal visits and the mother's use of any steroids were also considered. The history of maternal urinary tract infection, leaking liquor, or premature rupture of the membranes is also significant.

Ethical considerations

The study protocol was approved by the local research ethics committee of the NICU department at Ramadi Teaching Hospital for Maternity and Children, and verbal consent was provided by the neonates' parents. The protocol was also approved by the Research Ethics Committee of the pediatrics department at the Iraqi Board of Medical Specialties.

Statistical analysis

The data was gathered using a paper-based questionnaire, then entered and double-checked using Microsoft Excel 2016, and then transferred and analyzed using the Statistical Packages for Social Sciences (SPSS v.26). The categorical data were presented by frequencies and percentages, and Pearson's chi-square or Fisher's exact test was used to test their association. The age of the mothers was represented by mean $\pm$ standard deviation and compared using Student's t-test. The alpha level of significance was 0.05.

RESULTS

The total number of preterm neonates admitted to the NCU in Ramadi Teaching Hospital for maternity and children over a period of seven months was 276; 187 were excluded, so the current study included 89 neonates who had been investigated for intraventricular hemorrhage (IVH), and the ultrasound on the 3rd and then on the 7th day revealed different grades of IVH in 15 (16.9%) of the investigated neonates (Figure 1). This study shows a significant association between neonatal sex and IVH incidence ($p=0.021$). Intraventricular hemorrhage was significantly associated with the gestational age of the included neonates ($p=0.045$). Low birth weight and

IVH were significantly associated ($p=0.015$), and there was a significant association between the need for positive pressure and the incidence of IVH ($p=0.042$).

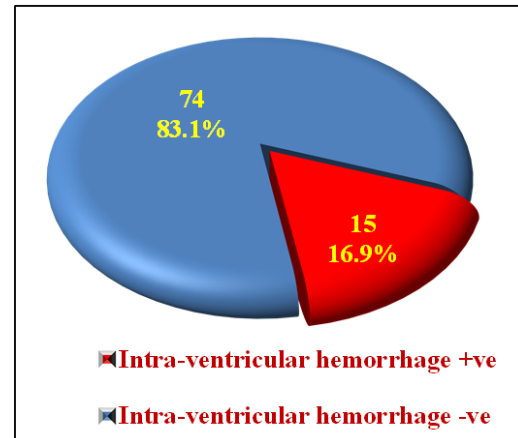


Figure 1: Incidence of Intraventricular hemorrhage among samples of newborns.

In the neonatal care unit, neonates needed the use of CPAP and surfactants, which significantly exceeded ($p=0.031$) the number of neonates who did not need CPAP. A significant association between sepsis indicators (high C-RP and positive blood culture) and the incidence of IVH ($p<0.001$). The neonates who developed hypoglycemia, this condition is found to be significantly associated with the incidence of IVH ($p=0.005$). Neonates in this study found to have a murmur due to PDA was also significantly associated with the development of IVH ($p=0.02$). Other factors like number of births, mode of delivery, and the need for using drugs in neonatal care units did not have a significant association with the occurrence of IVH. Almost all neonates needed oxygen, and only one case needed to be intubated; he died after the progression of IVH (Table 1).

Table 1: Neonatal risk factors of Intra-ventricular hemorrhage occurrence

Variables		Intra-ventricular hemorrhage			p-value*
		Positive (n=15)	Negative (n=74)	Total (n=89)	
Sex	Male	12(25.5)	35(74.5)	47(52.8)	0.021
	Female	3(7.1)	39(92.9)	42(47.2)	
Gestational age (weeks)	28 – <30	8(36.4)	14(63.6)	22(24.7)	0.045
	30 – <32	3(12)	22(88)	25(28.1)	
	32 – <34	3(8.8)	31(91.2)	34(38.2)	
	34 – <36	1(12.5)	7(87.5)	8(9)	
Birth weight	1 – < 1.5 kg	12(29.3)	29(70.7)	41(46.1)	0.015
	1.5 – < 2 kg	2(6.3)	30(93.8)	32(36)	
	2+ kg	1(6.3)	15(93.8)	16(18)	
Number of newborns	Single	9(16.7)	45(83.3)	54(60.7)	0.953
	Multiple	6(17.1)	29(82.9)	35(39.3)	
Mode of delivery	Normal vaginal delivery	6(21.4)	22(78.6)	28(31.5)	0.435
	Cesarean section	9(14.8)	52(85.2)	61(68.5)	
Positive pressure	Yes	11(25)	33(75)	44(49.4)	0.042
	No	4(8.9)	41(91.1)	45(50.6)	
Drug	Yes	4(36.4)	7(63.6)	11(12.4)	0.065
	No	11(14.1)	67(85.9)	78(87.6)	
Surfactant and CPAP	Yes	10(27)	27(73)	37(41.6)	0.031
	No	5(9.6)	47(90.4)	52(58.4)	
CR-Protein & Blood culture	Positive	10(47.6)	11(52.4)	21(23.6)	0.001
	Negative	5(7.4)	63(92.6)	68 (76.4)	
Hypoglycemia	Yes	7(38.9)	11(61.1)	18(20.2)	0.005
	No	8(11.3)	63(88.7)	71(79.8)	
Murmur	Yes	4(44.4)	5(55.6)	9(10.1)	0.02
	No	11(13.8)	69(86.3)	80(89.9)	

Values are presented as frequency and percentage. * Pearson's Chi-square test.

For maternal risk factors. Premature rupture of the membranes had a highly significant impact ($p < 0.001$) on the incidence of IVH among the neonates, where 8 (44.4%) of 18 neonates for mothers with PROM had IVH compared to 7 (9.9%) of 71 neonates for mothers who did not have PROM. The analysis also found that IVH developed in 12 (30%) of 40 neonates for

multiparous women compared to 2 (9.1%) of primiparous mothers and 1 (3.7%) of grand multiparous mothers ($p = 0.01$). Maternal urinary tract infection, antenatal steroid usage, and gestational hypertension did not associate with IVH in their neonates (Table 2).

Table 2: Distribution of the preterm neonates according to Intra-ventricular hemorrhage occurrence and their maternal factors

Variables		Intra-ventricular hemorrhage			p-value*
		Positive (n=15)	Negative (n=74)	Total (n=89)	
Urinary tract infection	Yes	3(17.6)	14(82.4)	17(19.1)	0.923
	No	12(16.7)	60(83.3)	72(80.9)	
PROM	Yes	8(44.4)	10(55.6)	18(20.2)	0.001
	No	7(9.9)	64(90.1)	71(79.8)	
Antenatal steroid use	Yes	8(13.6)	51(86.4)	59(66.3)	0.244
	No	7(23.3)	23(76.7)	30(33.7)	
Gestational hypertension	Normal	12(18.5)	53(81.5)	65(73)	0.771
	Controlled	2(14.3)	12(85.7)	14(15.7)	
	Uncontrolled	1(10)	9(90)	10(11.2)	
Parity	Primipara	2(9.1)	20(90.9)	22(24.7)	0.01
	Multipara	12(30)	28(70)	40(44.9)	
	Grand multipara	1(3.7)	26(96.3)	27(30.3)	

Values are presented as frequency and percentage. * Pearson's Chi-square test.

The distribution of IVH grades in the 15 neonates according to their gestational age is illustrated in Figure 2.

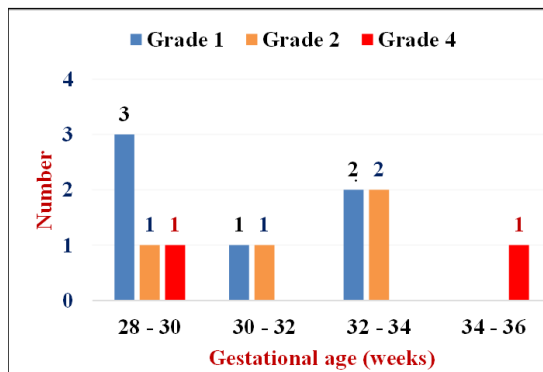


Figure 2: Grades of Intraventricular hemorrhage according to gestational age of the preterm neonates.

Ultrasound was used to detect IVH grades on the third day of admission, where 4 cases were found to have grade 1, grades 2 and 4 were found in one case each, and no case had grade 3. On the 7th day, the neonates were reassessed, and the ultrasound revealed that 2 additional cases were classified as grade 1, 3 additional cases were classified as grade 2, and a similar number of cases were found to have developed grade 3. In addition to that, one case was added to grade 4 (Table 3). IVH was detected in 6 cases (40%) out of 15 in the first 3 days, 9 cases (60%) in the first 3 days, and 9 cases (60%) out of 15 between D3 and D7.

Table 3: Intraventricular hemorrhage grades according to the time of ultrasound

IVH grades	Ultrasound (day-3)	Ultrasound (day-7)	Total
I	4	2	6
II	1	3	4
III	0	3	3
IV	1	1	2

DISCUSSION

The current study found IVH in 15 out of 89 (16.9%) preterm neonates at Al-Ramadi Maternity and Children Teaching Hospital, Iraq. In comparison with other studies, IVH incidence in premature infants born across studies, a study by Mohammed *et al.* of outcomes of preterm neonates in Elwiya Pediatric Teaching Hospital in Baghdad, Iraq, revealed that out of 350 preterm neonates, 97 had IVH (27.7%) [14]. The lower result of IVH in this study in comparison with Mohammed *et al.* may be due to more adequate antenatal and neonatal care, in addition to different study designs (case-control by Mohammed *et al.*, while this study is a cohort study). While in Saudi Arabia, Abolfotouh *et al.* reported a range of 13% to 27% [15]. Regarding neonatal factors, a significant association between neonate sex and IVH was found in the present study, as IVH was more in males compared to females. This was in parallel with a study by Abolfotouh *et al.* in Saudi Arabia that showed IVH was more in male neonates [15]. In China, Huang *et al.* reported that male sex was a risk factor for IVH in neonates [16]. Intraventricular hemorrhage was significantly associated with the gestational age of the included neonates in this study, with a higher percentage of IVH as gestational age decreased. Mohammed *et al.* reported that IVH was more in preterm neonates [14]; similar results to the present study were also reported by Çizmeçi *et al.* in Turkey [17] and Wang *et al.* in China [18], showing that the IVH percentage was higher as gestational age decreased in neonates because premature infants have fragile blood vessels in the germinal matrix that are prone to rupture. Low birth weight and IVH were significantly associated in the current study with a higher percentage of IVH in preterm neonates of less than 1.5 kg compared to those with heavier weights; similar results were reported in previous studies in the UAE by El-Atawi *et al.* [19] and in China by Zhao *et*

al. [20]. In the present study, a significant association between the need for positive pressure for resuscitation and the incidence of IVH was reported; a higher percentage of IVH was found in those who needed positive pressure for resuscitation. This was in line with a study by Tsao *et al.* [21] and the study of Marzban *et al.* [22]. In the neonatal care unit, there is a significant association between IVH and the need for CPAP and surfactant. Neonates who needed the use of CPAP and surfactants were more likely to have IVH compared to neonates who did not need CPAP and surfactants. Similar results were reported in studies by Tsao *et al.* [21], Marzban *et al.* [22], and Helwich *et al.* [23]. In the current study, a significant association was reported between sepsis indicators (high CRP and positive blood culture) and the incidence of IVH. This association may be explained by the fact that infection and sepsis may cause abnormal fluctuations of blood pressure, resulting in unstable cerebral blood pressure, which leads to an increase in the risk of IVH; however, in Kuwait, Kartam *et al.* reported that the risk for IVH was similar for all neonates irrespective of their sepsis indicators [24]. The main distinction between the current study and the study of Kartam *et al.* is that neonates included are of higher risk categories with gestational age less than 32 weeks, whereas the current study included all preterm neonates. Other studies agreed with the current study and reported a significant association between sepsis and IVH, including that reported in the Kapoor *et al.* study [25]. Hypoglycemia is found to be significantly associated with the incidence of IVH in the present study. This finding was in parallel with that reported by Çizmeçi *et al.* [17], De Angelis *et al.* [26], and Jagła *et al.* [27]. A murmur due to PDA was also significantly associated with the development of IVH, due to fluctuations in cerebral blood flow and pressure. Numerous studies have shown an association between PDA and many of the complications of prematurity, including IVH [28,29]. Regarding maternal factors, premature rupture of the membranes (PROM) is associated with increased incidence of IVH in neonates; this might be attributed to the fact that inflammation or infection of the mothers increases inflammatory cytokines and elevation in leukocyte count in the blood of their babies. These cytokines impaired the autoregulation of cerebral vasculature or interfered with the integrity of endothelial cells. These findings were in line with a previous study reported by Kartam *et al.* [24]. This study found a significant association between maternal parity and IVH, with neonates of multiparous women experiencing a higher incidence of IVH. Similar findings were reported in a previous study by Pekcevik *et al.* [30]. The present study did not find a significant association between antenatal steroids and the incidence of IVH. A previous study by Al-Mouqdad *et al.* in Saudi Arabia reported an association between antenatal use of steroids and decreased risk of IVH [31]. These results may be explained by the fact that antenatal steroids do not play a major role in preventing mild IVH (they are

more effective in severe IVH), and the most common type of IVH observed in the current study was grade 1 IVH; additionally, there were differences in the sample included and the study design. Wei *et al.* showed that after stratified analysis there was no significant association between IVH and antenatal use of steroids in infants > 30 weeks of gestational age [32]. Using ultrasound for grading of IVH on day 3 and day 7 showed that grade 1 was the most encountered in 40% (6 cases of grade 1 out of 15 of IVH on day 7 by ultrasound); grade II was found in 4 out of 15 (27%), grade III was found in 3 out of 15 (20%), and grade IV was found in 2 out of 15 (13%) on day 7. Chevallier *et al.* reported that the most frequent IVH grade was grade 1, with percentages of 17%, 12.1%, 3.3%, and 3.8% for grades I, II, and IV, respectively [33].

Study Limitations

This study had several limitations that must be acknowledged. First, the study was conducted in a single tertiary care center in Ramadi city, which may limit the generalizability of the findings to other hospitals or regions in Iraq. Second, the sample size was relatively small, particularly the number of preterm neonates who developed IVH, which may have affected the statistical power of detecting some associations. Third, only short-term outcomes during the first week of life were evaluated, while long-term neurodevelopmental outcomes of the affected neonates were not assessed. Fourth, cranial ultrasonography was performed only on day 3 and day 7; therefore, some very early or late cases of IVH might have been missed. In addition, the study depended mainly on clinical records and parental interviews for some maternal and neonatal variables, which may have introduced information bias. Finally, some potentially important risk factors such as detailed ventilatory parameters, coagulation profiles, and maternal socioeconomic factors were not assessed.

Conclusion

The incidence of IVH in preterm neonates was 16.9%, and the most common grade of IVH was grade 1. Male sex, decreased gestational age, low birth weight, being preterm and needing positive pressure for resuscitation, who needed CPAP and surfactants, having sepsis indicators, hypoglycemia, and having a murmur due to PDA were neonatal risk factors for IVH. PROM and multiparity were maternal risk factors for IVH.

Conflict of interests

The authors declared no conflict of interest.

Funding source

The authors did not receive any source of funds.

Data sharing statement

The data that supports the findings of this study are available from the corresponding author upon a reasonable request.

REFERENCES

- Rabe H, Diaz-Rossello JL, Duley L, Dowswell T. Effect of timing of umbilical cord clamping and other strategies to influence placental transfusion at preterm birth on maternal and infant outcomes. *Cochrane Database Syst Rev*. 2019;9(9):CD003248. doi: 10.1002/14651858.CD003248.pub4.
- Juul SE, Comstock BA, Wadhawan R, Mayock DE, Courtney SE, Robinson T, et al. A randomized trial of erythropoietin for neuroprotection in preterm infants. *N Engl J Med*. 2020;382(3):233-243. doi: 10.1056/NEJMoa1907423.
- Bao L, Huang J. Risk factors for intraventricular hemorrhage in very low birth weight infants: a systematic review and meta-analysis. *Front Pediatr*. 2026;13:1728632. doi: 10.3389/fped.2025.1728632.
- Smyser CD, Kidokoro H, Inder TE. Magnetic resonance imaging of the brain at term equivalent age in extremely premature neonates: to scan or not to scan? *J Paediatr Child Health*. 2012;48(9):794-800. doi: 10.1111/j.1440-1754.2012.02535.x.
- Vohr BR. Neurodevelopmental outcomes of premature infants with intraventricular hemorrhage across a lifespan. In: *Seminars in Perinatology*. 2022 Aug 1 (Vol. 46, No. 5, p. 151594). WB Saunders. doi: 10.1016/j.semperi.2022.151594.
- Schmid MB, Hopfner RJ, Lenhof S, Hummler HD, Fuchs H. Cerebral oxygenation during intermittent hypoxemia and bradycardia in preterm infants. *Neonatology*. 2015;107(2):137-146. doi: 10.1159/000368294.
- Khanafer-Larocque I, Soraisham A, Stritzke A, Al Awad E, Thomas S, Murthy P, et al. Intraventricular hemorrhage: risk factors and association with patent ductus arteriosus treatment in extremely preterm neonates. *Front Pediatr*. 2019;7:408. doi: 10.3389/fped.2019.00408.
- Conde-Agudelo A, Diaz-Rossello JL. Kangaroo mother care to reduce morbidity and mortality in low birthweight infants. *Cochrane Database Syst Rev*. 2016;(8):CD002771. doi: 10.1002/14651858.CD002771.
- Song J, Wang Y, Xu F, Sun H, Zhang X, Xia L, et al. Erythropoietin improves poor outcomes in preterm infants with intraventricular hemorrhage. *CNS Drugs*. 2021;35(6):681-690. doi: 10.1007/s40263-021-00817-w.
- Dan AM, Vasilescu DI, Dragomir I, Vasilescu SL, Voicu D, Cirstoiu MM. Cranial ultrasonography—Standards in diagnosis of intraventricular hemorrhage and ventricular dilatation in premature neonates. *Children*. 2025;12(6):768. doi: 10.3390/children12060768.
- Stewart DL, Barfield WD; Committee on fetus and newborn. Updates on an at-risk population: Late-preterm and early-term infants. *Pediatrics*. 2019;144(5):e20192760. doi: 10.1542/peds.2019-2760.
- Hamilton BE, Martin JA, Osterman MJK. Births: Provisional data for 2020. *Vital Statistics Rapid Release*; no 12. Hyattsville, MD: National Center for Health Statistics. May 2021. doi: 10.15620/cdc:104993.
- Adamkin DH. Neonatal hypoglycemia. *Semin Fetal Neonatal Med*. 2017;22(1):36-41. doi: 10.1016/j.siny.2016.08.007.
- Mohammed SI, Razzak Obaid AA, Majeed BA. Maternal risk factors and outcomes of premature neonates admitted to the neonatal care unit in Al-Elwiya pediatric teaching hospital in Baghdad, Iraq. *Iranian J Neonatol*. 2022;13(3). doi: 10.22038/IJN.2022.61680.2176.
- Abolfotouh MA, Al Saif S, Altwajri WA, Al Rowaily MA. Prospective study of early and late outcomes of extremely low birthweight in Central Saudi Arabia. *BMC Pediatrics*. 2018;18(1):280. doi: 10.1186/s12887-018-1248-y.
- Huang J, Wang Y, Tian T, Zhu T, Tang J, Gao Q, et al. Risk factors for periventricular-intraventricular haemorrhage severity in preterm infants: a propensity score-matched analysis. *BMC Pediatrics*. 2023;23(1):341. doi: 10.1186/s12887-023-04114-x.
- Çizmecci MN, Akın MA, Özek E. Turkish neonatal society guideline on the diagnosis and management of germinal matrix hemorrhage-intraventricular hemorrhage and related complications. *Turkish Arch Pediatrics*. 2021;56(5):499-512. doi: 10.5152/TurkArchPediatri.2021.21142.
- Wang Y, Song J, Zhang X, Kang W, Li W, Yue Y, et al. The impact of different degrees of intraventricular hemorrhage on mortality and neurological outcomes in very preterm infants: a prospective cohort study. *Front Neurol*. 2022;13:853417. doi: 10.3389/fneur.2022.853417.
- El-Atawi K, Elhalik M, Kulkarni T, Abdelsamed A, Alexander L, Satyan AD. Risk factors, diagnosis, and current practices in the management of intraventricular hemorrhage in preterm infants: a review. *System*. 2016;16:17. doi: 10.19080/AJPN.2016.01.555561.
- Zhao Y, Zhang W, Tian X. Analysis of risk factors of early intraventricular hemorrhage in very-low-birth-weight premature infants: a single center retrospective study. *BMC Pregnancy Childbirth*. 2022;22(1):890. doi: 10.1186/s12884-022-05245-2.
- Tsao PC. Pathogenesis and prevention of intraventricular hemorrhage in preterm infants. *J Korean Neurosurg Soc*. 2023;66(3):228-238. doi: 10.3340/jkns.2022.0288.
- Marzban A. Factors associated with intraventricular hemorrhage in very low birth weight neonates in Mousavi Hospital in Zanjan in 2012-2013. *Ultrasound*. 2017;4(8):9. Available at: <http://nmjournal.zums.ac.ir/article-1-487-en.html>
- Helwich E, Rutkowska M, Bokinić R, Gulczyńska E, Hożejowski R. Intraventricular hemorrhage in premature infants with respiratory distress syndrome treated with surfactant: incidence and risk factors in the prospective cohort study. *J Mother Child*. 2017;21(4):328-335. doi: 10.34763/devperiodmed.20172104.328335.
- Kartam M, Embaireeg A, Albalool S, Almesafer A, Hammoud M, Al-Hathal M, et al. Late-onset sepsis in preterm neonates is associated with higher risks of cerebellar hemorrhage and lower motor scores at three years of age. *Oman Med J*. 2022;37(2):e368. doi: 10.5001/omj.2022.41.
- Kapoor S, Sharma R, Sapare AK, Aggarwal R. Intraventricular haemorrhage in very preterm neonates. *Int J Contemp Pediatr*. 2018;5(4):1414-1418. doi: 10.18203/2349-3291.ijcp20182538.
- De Angelis LC, Brigati G, Polleri G, Malova M, Parodi A, Minghetti D, et al. Neonatal hypoglycemia and brain vulnerability. *Front Endocrinol*. 2021;12:634305. doi: 10.3389/fendo.2021.634305.
- Jagla M, Szymońska I, Starzec K, Kwinta P. Impact of early glycemic variability on mortality and neurologic outcome of very low birth weight infants: Data from a continuous glucose monitoring system. *Dev Period Med*. 2019;23(1):7-14. doi: 10.34763/devperiodmed.20192301.071.
- McLoughlin RJ, Dacier BM, Hazeltine MD, Hirsh MP, Sullivan KP, Cleary MA, et al. Intraventricular hemorrhage and patent ductus arteriosus ligation association with infant mortality. *J Surg Res*. 2020;252:192-199. doi: 10.1016/j.jss.2020.03.011.
- Terrin G, Di Chiara M, Boscarino G, Metrangola V, Faccioli F, Onestà E, et al. Morbidity associated with patent ductus arteriosus in preterm newborns: a retrospective case-control study. *Italian J Pediatr*. 2021;47(1):9. doi: 10.1186/s13052-021-00956-2.
- Pekcevik Y, Pasinli A, Ozer EA, Erdogan N. Risk factors of germinal matrix intraventricular hemorrhage in premature infants. *Iranian J Pediatr*. 2014;24(2):191. PMID: 25535539.
- Al-Mouqdad MM, Abdelrahim A, Abdalgader AT, Alyaseen N, Khalil TM, Taha MY, et al. Risk factors for intraventricular hemorrhage in premature infants in the central region of Saudi Arabia. *Int J Pediatr Adolesc Med*. 2021;8(2):76-81. doi: 10.1016/j.ijpam.2019.11.005.
- Wei JC, Catalano R, Profit J, Gould JB, Lee HC. Impact of antenatal steroids on intraventricular hemorrhage in very-low-birth weight infants. *J Perinatol*. 2016;36(5):352-356. doi: 10.1038/jp.2016.38.
- Chevallier M, Debillon T, Pierrat V, Delorme P, Kayem G, Durox M, et al. Leading causes of preterm delivery as risk factors for intraventricular hemorrhage in very preterm infants: results of the EPIPAGE 2 cohort study. *Am J Obstet Gynecol*. 2017;216(5):518-e1. doi: 10.1016/j.ajog.2017.01.002.