Scientific Research Publishing

Open Journal of Pediatrics, 2026, 16(5), 697-705
https://www.scirp.org/journal/ojped
ISSN Online: 2160-8776
ISSN Print: 2160-8741

Etiological Profile and Predictors of Mortality for Neonatal Hemorrhage at the Oueme Departmental University Hospital Center in 2024 (Benin)

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How to cite this paper: Bognon, G., Tohodjèdé, Y., Ladjouan, M., Tchiakpè, N., Azankpo, T. and Sagbo, G. (2026) Etiological Profile and Predictors of Mortality for Neonatal Hemorrhage at the Oueme Departmental University Hospital Center in 2024 (Benin). *Open Journal of Pediatrics*, **16**, 697-705.
https://doi.org/10.4236/ojped.2026.165068

Received: August 20, 2026
Accepted: September 21, 2026
Published: September 24, 2026

Abstract

Introduction: Neonatal hemorrhage is a common emergency associated with significant morbidity and mortality, for which hospital data remain limited in Benin. The objective of this study was to determine the etiological profile and predictors of mortality associated with neonatal hemorrhage at CHUD-Ouémé in 2024. **Methods**: This was a descriptive and analytical prospective cohort study conducted from July 1 to December 31, 2024, in the neonatal unit at CHUD-Ouémé. All newborns aged 0 to 28 days presenting with hemorrhagic manifestations were included. Sociodemographic, clinical, therapeutic, and outcome data were collected. Factors associated with death were identified using multivariate logistic regression, with a significance threshold of $p < 0.05$. **Results**: The hospital frequency was 11.9%. The mean age was 87.3 ± 34.32 hours, and 99% of cases occurred during the early neonatal period. Non-external hemorrhages predominated (86.2%), primarily subcutaneous (77%). The main causes were obstetric trauma (89.0%), thrombocytopenia (12.0%), disseminated intravascular coagulation (6.9%), and hemorrhagic disease of the newborn (6.4%). The case-fatality rate was 14.7%. In the multivariate analysis, low birth weight (OR = 3.23; 95% CI: 1.7 - 6.1, p = 0.0001), external hemorrhage (OR = 4.2; 95% CI: 1.8 - 9.4, p = 0.0003), moderate placental abruption (OR = 5.1; 95% CI: 1.7 - 13.2, p = 0.001) or high (OR = 12.1; 95% CI: 3.5 - 41.3, p = 0.001), neonatal infection (OR = 3.8; 95% CI: 2.1 - 6.8, p < 0.0001), DIC (OR = 2.2; 95% CI: 1.5 - 3.3, p < 0.0001), and neonatal hemorrhage (OR = 3.3; 95% CI: 1.1 - 10.2, p < 0.02) increased the risk of death. **Conclusion**: Neonatal

hemorrhages are common at CHUD-Ouémé, and their case-fatality rate remains high. Obstetric trauma is the leading cause. Preventing obstetric and infectious complications, as well as improving the management of severe cases, could help reduce neonatal mortality.

Keywords

Neonatal Hemorrhage, Birth Trauma, Neonatal Mortality, Prognostic Factors

1. Introduction

Neonatal hemorrhages constitute major medical and surgical emergencies in the perinatal period and are associated with considerable morbidity and mortality [1] [2]. In newborns, the vulnerability of hemostatic mechanisms—characterized by physiological immaturity of vitamin K-dependent coagulation factors, increased vascular fragility, and particular susceptibility to hypoxia—exposes them to a high risk of severe bleeding [3]. In sub-Saharan Africa, the hospital prevalence of neonatal hemorrhages remains concerning, varying across studies between 2.17% and 9.2% of admissions to neonatology and pediatric intensive care units [4]-[7]. Diagnosis is based on a decision-making triad combining rapid clinical evaluation, hemostasis laboratory tests (prothrombin time, aPTT, platelet count, fibrinogen), and medical imaging (particularly transfontanellar and abdominal ultrasound), which help determine the location, severity, and etiology of the hemorrhage [8]. Clinical manifestations are dominated by severe visceral involvement, primarily respiratory hemorrhages (34.1%), gastrointestinal hemorrhages (31.7%), and cerebro-meningeal hemorrhages (17.0%), followed by cutaneous-mucosal sites (26.8%) [7]. The etiologies are multifactorial and mainly include hemorrhagic disease of the newborn (HDN) due to vitamin K deficiency, obstetric trauma, neonatal thrombocytopenias, perinatal asphyxia, severe sepsis complicated by disseminated intravascular coagulation (DIC), as well as rare congenital coagulopathies [3] [9]. Therapeutic management requires early and multidisciplinary medical-surgical resuscitation. It combines maintenance of hemodynamic and hematological stability (transfusion of packed red blood cells, platelet concentrates, and fresh frozen plasma), control of hemostasis (administration of vitamin K1, tranexamic acid, and compression measures), correction of underlying causes (antibiotic therapy, anticonvulsant treatment, or surgical intervention), and appropriate metabolic support [5] [6]. Although systematic prophylaxis with vitamin K1 at birth has revolutionized the prevention of HDN, its implementation remains incomplete or delayed in some cases, particularly during home deliveries or due to supply chain disruptions [4]. Without adequate and immediate management, the outcome may be complicated by dramatic events. Hemorrhagic shock, cerebral anoxia secondary to acute anemia, and ischemic-hemorrhagic intracranial lesions expose newborns to a high risk of death or major long-term neurodevelopmental sequelae (cer-

ebral palsy, hydrocephalus, psychomotor delay), observed in nearly 40% of survivors [10]. In low-resource countries, specific mortality remains alarming and can reach 34.1%, with DIC and delayed transfer being the main factors contributing to excess mortality [7]. In Benin, despite the widespread adoption of national prevention guidelines, the frequency of neonatal hemorrhages remains high. Limited financial and technical access to emergency paraclinical investigations frequently delays etiological diagnosis, thereby compromising the vital and functional prognosis of newborns. It is in this context that the present study, conducted at the Centre Hospitalier Universitaire Départemental de l'Ouémé (CHUD-O) in 2024, was undertaken. It aims to determine the etiological profile and predictive factors of mortality in neonatal hemorrhages at CHUD-O in order to optimize local management strategies and provide evidence-based data to help reduce neonatal mortality, in alignment with the Sustainable Development Goals (SDG 3) by 2030.

2. Methods

This was a descriptive and analytical study with prospective data collection, conducted from July 1 to December 31, 2024, in the Neonatology Unit of the Pediatrics Department at CHUD-O. All newborns aged 0 to 28 days who were hospitalized during the study period and presented with a hemorrhagic manifestation—regardless of site, volume, or etiology—were included through non-probability sampling with exhaustive recruitment. Newborns presenting only with physiological genital bleeding were excluded.

The primary dependent variable was the occurrence or non-occurrence of death related to neonatal hemorrhage. Hemorrhage was defined as any externalized or internal bleeding, irrespective of severity or associated clinical or biological abnormalities. The independent variables studied included sociodemographic characteristics of the newborns and their mothers (newborn's age and sex, maternal age), gestational and perinatal history (maternal medical history, course of pregnancy and delivery, resuscitation at birth, administration of vitamin K1), clinical features of the hemorrhage, paraclinical data (complete blood count, hemostasis tests, liver function tests, CRP, microbiological tests, electrolytes, and imaging), the retained etiology (birth trauma, hemorrhagic disease of the newborn, disseminated intravascular coagulation, thrombocytopenia), and administered treatments (transfusions of packed red blood cells, platelets, or fresh frozen plasma; vitamin K; antibiotic therapy; oxygen therapy). Thrombocytopenia was defined as a blood platelet count lower than 150,000/μL (or $<150 \times 10^9$/L) on a full blood count sample without platelet aggregates. Birth trauma was diagnosed based on a history of dystocic or instrumental delivery associated with an identifiable mechanical lesion (cephalohematoma, major caput succedaneum, subgalea hematoma) with or without active bleeding. Hemorrhagic disease of the newborn (HDN) was defined by the presence of spontaneous hemorrhage (gastrointestinal, umbilical cord, or intracranial) related to a deficiency in vitamin K-dependent factors (II, VII, IX, X), characterized by a prolonged PT/aPTT, and rapidly corrected by vitamin K1 administration. DIC was defined by the combination of thrombocy-

topenia, a marked decrease in prothrombin time/fibrinogen levels, a prolonged activated partial thromboplastin time, and elevated D-dimer levels. Paucigravidity and multigravidity were defined as a history of 2 - 3 pregnancies and at least 4 pregnancies, respectively. Pauciparity and multiparity corresponded to 2 - 3 deliveries and at least 4 deliveries beyond the threshold of viability, respectively. The various pathologies and underlying etiologies were managed according to the department's standardized protocols. Case fatality was calculated based on the total number of deaths, regardless of whether they were directly attributable to hemorrhage. Data were collected using a pretested digital questionnaire on the KoBoCollect® application, combining medical record review, clinical examination of the newborns, and direct interviews with parents when data were missing. Data analysis was performed using Epi Info version 7.2.1.0. Qualitative variables were expressed as frequencies and percentages, while quantitative variables were presented as means with standard deviations. Comparisons of proportions were performed using the Chi-square test (or Fisher's exact test when appropriate). Multivariate analysis using logistic regression was conducted to identify factors associated with death. The statistical significance threshold was set at $p < 0.05$.

The study was conducted in accordance with good clinical practices and ethical principles. The protocol received approval from the Local Ethics Committee for Biomedical Research and administrative authorization from the CHUD-O Directorate (0110/MS/DDS-O/CHUD-0/DG/DAF/SRH/SA). Written informed consent was systematically obtained from the parents prior to inclusion, and the anonymity and confidentiality of the data were rigorously ensured.

3. Results

A total of 218 out of 1833 hospitalized newborns presented with neonatal hemorrhage, representing a hospital frequency of 11.9%. The mean age of the newborns at admission was 87.3 ± 34.32 hours (range: 0 to 552 hours). The vast majority of newborns (99%) were between 0 and 7 days of age. The sex ratio was 2.07. Most mothers were aged 15 to 25 years (61.5%), with a mean age of 25.18 ± 5.57 years (range: 17 to 40 years). Obstetrically, 42.7% of mothers were primigravida, 32.1% paucigravida, and 25.2% multigravida. The mothers were mainly primiparous (43.6%) and pauciparous (20.6%). Only 22.5% of mothers had attended at least 8 antenatal consultations (ANC), and 42.2% had undergone more than three obstetric ultrasounds. Maternal pathologies during pregnancy are presented in Table 1. Delivery occurred vaginally in 68.4% of cases, of which 20.8% were instrumental deliveries. Complications during labor were recorded in the majority of newborns (95.0%), primarily fetal asphyxia (74.9%), premature rupture of membranes (21.3%), and nuchal cord (3.9%). Neonatal resuscitation was required in nearly half of the infants (48.6%) (ventilation in 44.9%, external cardiac massage in 3.7%). Most newborns were born at term (79.8%). More than one-quarter of the infants had low birth weight (26.1%). Vitamin K1 was administered at birth in 89.4% of the newborns, and 87.6% received exclusive breastfeeding. Non-externalized hemorrhages were the most frequent (86.2%). The distribution of the

characteristics of the hemorrhages is presented in Table 2. The main associated pathologies were neonatal infection (39.9%), anoxo-ischemic encephalopathy (30.3%), and respiratory distress (29.4%). The etiologies of neonatal hemorrhage were dominated by obstetric trauma (89.0%), thrombocytopenia (12.0%), disseminated intravascular coagulation (DIC) (6.9%), and hemorrhagic disease of the newborn (HDN) (6.4%). More than half of the newborns had anemia (57.4%). Management included antibiotic therapy (39.9%), magnesium sulfate administration (30.3%), oxygen therapy (26.6%), and vitamin K1 (18.8%). Transfusion of packed red blood cells and fresh frozen plasma was performed in 6.4% and 4.6% of newborns, respectively. The outcome was unfavorable in 65.5% of cases, marked by anemia (28.4%), jaundice (21.5%), neurological sequelae (0.9%), and death (14.7%). All newborns who developed DIC died. In bivariate analysis, factors significantly associated with death were low birth weight ($p = 0.0001$), lack of exclusive breastfeeding ($p = 0.0006$), externalized hemorrhage ($p = 0.0003$), gastrointestinal ($p = 0.002$), subcutaneous ($p < 0.0001$), and respiratory sites ($p = 0.0006$), moderate or large volume of bleeding ($p = 0.001$), associated neonatal infection ($p < 0.0001$), DIC ($p < 0.0001$), and HDN ($p < 0.02$). In multivariate analysis, factors that independently increased the risk of death were low birth weight (OR = 3.23 [1.7 - 6.1], $p = 0.0001$), externalized hemorrhage (OR = 4.2 [1.8 - 9.4], $p = 0.0003$), moderate volume (OR = 5.1 [1.7 - 13.2], $p = 0.001$) to large volume (OR = 12.1 [3.5 - 41.3], $p = 0.001$) of bleeding, associated neonatal infection (OR = 3.8 [2.1 - 6.8], $p < 0.0001$), DIC (OR = 2.2 [1.5 - 3.3], $p < 0.0001$), and HDN (OR = 3.3 [1.1 - 10.2], $p < 0.02$). Conversely, exclusive breastfeeding (OR = 0.24 [0.10 - 0.57], $p = 0.0006$), birth trauma (OR = 0.10 [0.06 - 0.10], $p < 0.0001$), and thrombocytopenia (OR = 0.30 [0.09 - 0.81], $p = 0.01$) were significantly associated with the risk of death related to neonatal hemorrhage (Table 3).

Table 1. Distribution of newborns according to maternal pathologies during pregnancy.

Maternal Pathology	Number of Cases	Percentage (%)
Premature rupture of membranes	36	16.5
Pre-eclampsia	23	12.4
Gestational hypertension	17	7.8
Maternal fever in the third trimester	6	2.7
Anemia during pregnancy	1	0.4
Chronic fetal distress	1	0.4
Chorioamnionitis	1	0.4

Table 2. Distribution of newborns according to the clinical characteristics of the hemorrhage.

Type of Hemorrhage		Number of Cases	Percentage (%)
Non-externalized	Subcutaneous	168	77.0
	Cephalohematoma	14	6.4
	Subgaleal hematoma	5	2.3
	Conjunctival	1	0.5

Continued

Externalized	Gastrointestinal	13	6.0
	Respiratory	10	4.6
	Skin at injection site	5	2.3
	Umbilical cord	2	0.9
Volume of bleeding	Small	37	17.0
	Moderate	144	66.0
	Large	37	17.0

Table 3. Distribution of factors associated with an unfavorable outcome of neonatal hemorrhage in multivariate analysis.

Variable	Unfavorable Outcome		p-value	OR	95% CI [OR]
	Yes	No			
Low birth weight					
No	48	113	0.0001	1	1.7 - 6.1
Yes	33	24		3.23	
Exclusive breastfeeding					
No	18	9	0.0006	1	
Yes	63	128		0.24	0.1 - 0.57
Type of hemorrhage					
Non-externalized	61	127	0.0003	1	
Externalized	20	10		4.2	1.8 - 9.4
Volume of bleeding					
Small	4	33		1	
Moderate	55	89	0.001	5.1	1.7 - 15.2
Large	22	15		12.1	3.5 - 41.3
Associated clinical repercussions & pathologies					
Neonatal infection	49	38	<0.0001	3.8	2.1 - 6.8
Etiology					
Obstetric trauma	64	130	<0.0001	0.1	0.06 - 0.4
Thrombocytopenia	4	22	0.01	0.3	0.09 - 0.81
Disseminated intravascular coagulation (DIC)	15	0	<0.0001	2.2	1.5 - 3.3
Hemorrhagic disease of the newborn (HDN)	9	5	<0.02	3.3	1.1 - 10.2

4. Discussion

In this study, the hospital frequency of neonatal hemorrhages at CHUD-Ouémé was 11.9%. This rate, which is markedly higher than the 5.05% and 5.9% reported by Hasbaoui *et al.* in Morocco and Jabnoun *et al.* in Tunisia, respectively, can be explained by the tertiary referral center status of CHUD-O [5] [11]. Indeed, this facility receives a high proportion of high-risk pregnancies and critically ill newborns. Furthermore, the inclusion of all hemorrhagic manifestations, including minor localized forms such as serosanguinous bumps and ecchymoses, directly

contributed to this high prevalence [5] [11]. The mean age at admission was 87.3 ± 34.32 hours, and nearly all newborns (99%) were in the early neonatal period. This finding is consistent with the observation of Salem *et al.* in Tunisia, who reported that 78.7% of cases occurred within the first two days of life [6]. This early onset is explained by the high prevalence of obstetric trauma, whose manifestations appear immediately after birth [6]. A clear male predominance was observed (67.4%; sex ratio 2.07), a phenomenon frequently reported in the neonatal literature, although the exact underlying mechanism has not been formally elucidated [6]. In contrast to the studies by Salem *et al.* and Faye *et al.* in Dakar, where externalized and visceral forms predominated (gastrointestinal in 80% or 31.7%, and respiratory in 34.1%) [5]-[7]. In this study, there was a very strong predominance of non-externalized hemorrhages (86.2%), mainly represented by subcutaneous bleeding (77%) and cephalohematomas (6.4%). This clinical profile is directly correlated with the major etiology identified in this sample: obstetric trauma, which was implicated in 89.0% of cases. This high figure reflects frequently unfavorable delivery conditions in under-equipped settings, as illustrated by the significant rate of instrumental deliveries (20.8%) and labor complications such as fetal asphyxia (74.9%). In comparison, Salem *et al.* and Faye *et al.* reported obstetric trauma in only 2.6% and 7.3% of cases, respectively, with their series being dominated by hemorrhagic disease of the newborn (HDN) and disseminated intravascular coagulation (DIC) [6] [7]. In this study, HDN accounted for only 6.4% of cases, reflecting the positive impact of the policy of systematic vitamin K1 prophylaxis at birth, which was administered to 89.4% of the newborns [5] [6]. The case fatality rate observed in this study was 14.7%. Mortality reached 100% among infants who developed DIC, a result identical to that reported by Faye *et al.* in Dakar [7]. Neonatal infections and anoxo-ischemic encephalopathy, strongly associated with hemorrhages, act as major triggering factors of this consumptive coagulation and fibrinolysis cascade [7] [11]-[16]. The risk of death was multiplied by 3.23 in newborns with low birth weight who had hemorrhage (OR = 3.23 [1.7 - 6.1], p = 0.0001). Low birth weight or preterm newborns have inherent vascular and hemostatic immaturity that exposes them to hemodynamic complications and intraventricular hemorrhages [17] [18]. Similarly, moderate (OR = 5.1 [1.7 - 13.2], p = 0.001) to large (OR = 12.1 [3.5 - 41.3], p = 0.001) volume of bleeding increased the risk of death by 5.1 and 12.1 times, respectively. Since the total blood volume of a newborn is estimated at approximately 80 mL/kg, an acute blood loss of only 15 to 20 mL is sufficient to cause significant anemia with hypovolemic shock and hemodynamic decompensation [19] [20]. An externalized hemorrhage, which increased this risk by a factor of 4.2 (OR = 4.2 [1.8 - 9.4], p = 0.0003), often reflects severe systemic or visceral involvement compared with isolated traumatic cutaneous lesions, which in this study were instead associated with a reduced risk of death (OR = 0.1 [0.06 - 0.1], p < 0.0001) [6] [21]. Such severe systemic or visceral involvement is observed in disseminated intravascular coagulation (DIC) and hemorrhagic disease of the newborn, both of which were predictive factors of

death in this study. Exclusive breastfeeding significantly reduced the risk of death in newborns with hemorrhage (OR = 0.24 [0.1 - 0.57], p = 0.0006). This effect can be explained by the fact that infants who received exclusive breastfeeding were predominantly term newborns with normal birth weight who benefited from the immunological and trophic properties of breast milk [22].

5. Conclusion

Neonatal hemorrhages remain a frequent emergency at CHUD-Ouémé and are associated with a high mortality rate. The etiologies are dominated by obstetric trauma. The main predictive factors of death identified were low birth weight, externalized hemorrhage of moderate to large volume, and the presence of neonatal infection. Reducing this mortality will require improvements in delivery conditions, prevention of neonatal infections, and enhancement of technical capacity for the management of severe cases of neonatal hemorrhage.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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