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Original Research Article

A Retrospective Investigation into Maternal Risk Factors Linked to Birth Asphyxia

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Abstract:

Background: Birth asphyxia ˙remains a major cause of neonatal morbidity and mortality, particularly in low- and middle-income countries, often resulting from maternal, intrapartum, and socio-demographic risk factors.

Aim: To evaluate the prevalence of birth asphyxia and identify associated maternal risk factors among neonates delivered at a tertiary care hospital.

Methodology: A retrospective observational study was conducted at the Department of Pediatrics, Sri Krishna Medical College and Hospital, Muzaffarpur, Bihar, India. Medical records of 80 neonates with birth asphyxia over a six-month period were reviewed. Maternal demographic, antenatal, and intrapartum factors were analyzed, and neonatal outcomes were recorded. Data were analyzed using SPSS; categorical variables were expressed as frequencies and percentages, and associations assessed using Chi-square or Fisher's exact test.

Results: Moderate birth asphyxia was most common (40%), followed by mild (35%) and severe (25%). Maternal anemia (50%), prolonged labor (27.5%), and meconium-stained amniotic fluid (22.5%) were predominant risk factors. Vaginal deliveries accounted for most cases (57.5%), while cesarean sections showed higher proportions of moderate and severe asphyxia. Over half of the neonates required basic resuscitation, and 67.5% had NICU stays ≥3 days. Early neonatal mortality was 7.5%.

Conclusion: Birth asphyxia is multifactorial, with maternal anemia, labor complications, and delivery mode being major determinants. Vigilant antenatal care, skilled intrapartum management, and timely neonatal interventions are essential to improve outcomes.

Keywords: Birth Asphyxia, Maternal Risk Factors, Neonatal Outcomes, Retrospective Study, APGAR Score.

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Introduction

Birth asphyxia is a still one of the most severe perinatal complications globally, and still one of ˙the most significant causes of neonatal morbidity, long-term neurodevelopmental disability, and death, especially in low- and middle-income countries where quality obstetric and neonatal care is not always accessible [1]. Being defined by inability of a newborn baby to develop and maintain sufficient respiration at birth, birth asphyxia is a complicated combination of intrapartum events, maternal health condition, and fetal risk factors negatively impacting fetal oxygenation. Although there have been great improvements in maternal child health indicators over the last twenty years globally, the burden of birth asphyxia has remained and continues to cause a considerable percentage of neonatal mortality and long-term birth disability including hypoxic-ischemic encephalopathy (HIE), cerebral palsy, cognitive impairment, and seizure diseases.

The polygenesis of birth asphyxia supports the idea that it is important to know its determinants better especially the maternal determinants, which may predispose infants to impaired intrapartum outcomes [2]. The maternal health is a determining factor to the fetal well-being and some of the conditions associated with the fetus at risk of intrapartum hypoxia have been consistently referred to, which include hypertensive disorders of pregnancy, anemia, diabetes mellitus, antepartum hemorrhage, oligohydramnios, prolonged labor and maternal infection. Truly, in most environments, insufficient antenatal care, inappropriate nutrition, late referral, faulty perception in the complications of pregnancy, and poor

measures of labor observation add to such risks. Consequently, the evaluation of maternal traits and clinical features relating to birth asphyxia is essential in the development of effective prevention methods and the enhancement of birth outcomes.

Retrospective studies represent a valuable chance to understand the trends, risk factors, and clinical relationships of birth asphyxia based on regularly received hospital data [3]. The analyses can be used to determine the trends in maternal risk profiles, demographic trends, comorbidity, obstetric complications, and intrapartum factors that could lead to poor neonatal outcomes. Hospital reviews that are retrospective and conducted in regions where neonatal mortality is high will prove useful in offering insights to the contextual determinants of the situation in places where it is hard to achieve prospective population-based studies due to logistical, financial, or infrastructural factors. They also can be used to closely study the inter-relationships between maternal risk factors and the extent of asphyxia, which may be as Apgar scores, the need to resuscitate, or signs of hypoxic-ischemic injury [4]. Knowledge of such associations can assist clinicians and health administrators to detect the most crucial gaps in antenatal and intrapartum care so that they can implement specific interventions, including more effective screening of high-risk pregnancies, more effective control of maternal comorbidities and diseases, and more effective monitoring of the process of delivery and birth.

Birth asphyxia is not only an obstetric crisis but a symptom of systemic deficiencies in maternal health care, access to high-quality care on time, and the quality of practice of emergency obstetric and neonatal resuscitation [5]. The socio-demographic factors that affect the outcome of pregnancy significantly in many developing regions include the maternal age, parity, socio-economic status, education level, and rural residence. It has been observed that young maternal age, advanced maternal age, high parity as well as short interpregnancy intervals all contribute towards the risk of adverse birth outcomes including asphyxia. In the same way, maternal malnutrition and anemia which are still a significant national health concern can impair the placental oxygen delivery and fetal development, leaving newborn babies susceptible to intrapartum hypoxia.

Specifically risk factors are pregnancy-induced hypertension and preeclampsia, which have been linked to the placenta insufficiency, intrauterine growth retardation, and higher risk of emergency obstetric procedures [6]. Other complications like gestational diabetes and maternal obesity bring complexity to the situation as they raise the risk of macrosomia, obstructed labor, and other intrapartum complications. Such clinical and demographic factors indicate the necessity to identify high-risk pregnancies at the earliest possible stage and carefully manage such cases to avoid severe asphyxial outcomes.

Intrapartum conditions are also a critical determinant of the neonatal oxygenation and the general outcome of birth. Long or obstructed labor, malpresentations, premature rupture of the membranes, meconium-stained amniotic fluid, complications with the umbilical cord, and insufficient fetal monitoring are some of the most regularly implicated causes of birth asphyxia [7]. Delays in the making of decisions, inadequate access to emergency obstetric care, the absence of skilled birth attendants, delays associated with the three-delay model (delay to seek care, delay to access a facility and delay to receive care in a facility) further increase the risk of intrapartum hypoxia in most healthcare settings. A retrospective study that combines maternal, fetal, and intrapartum variables can, therefore, shed light on the cascade of processes culminating in asphyxia and point out the chance to intervene in good time.

In this light of contexts, the current retrospective study will be conducted with an evaluation of birth asphyxia prevalence along with the maternal risk factors that have the strongest correlation with asphyxial births among the newborns born in a particular healthcare facility. The study aims at producing evidence that can inform obstetricians, neonatologists and policymakers of the public health about prevention strategies to be developed by reviewing case records of affected neonates and comparing them to the respective maternal clinical perspectives, obstetric history and intrapartum events. Enhancements in maternal health care, the quality of antenatal risk assessment, quality of intrapartum supervision, and timely referral and facility-based delivery of high-risk pregnancies are important elements in halting maternal asphyxia. Further interpretation of the epidemiological and clinical trends that became apparent based on retrospective hospital data can assist in the optimization of clinical practice, assist in the allocation of resources, and eventually lead to better neonatal outcomes and decreased perinatal mortality. In this way, the present analysis contributes not only to the existing knowledge of factors affecting birth asphyxia but also acts as the useful device that can be used to inform practice and policy interventions that can help to protect the health of babies.

Methodology

Study Design: This study followed a retrospective observational design aimed at evaluating birth asphyxia cases and identifying associated maternal risk factors. Medical records were reviewed for all eligible neonates and their mothers during the defined study period.

Study Area: The study was conducted in the Department of Pediatrics, Sri Krishna Medical College

and Hospital (SKMCH), Muzaffarpur, Bihar, India from March 2025 to August 2025

Study Participants

Inclusion Criteria

- All newborns (inborn/outborn) diagnosed with birth asphyxia based on available clinical records.
- Cases with a documented 1-minute or 5-minute APGAR score <7.
- Neonates whose maternal antenatal and intrapartum records were available for reviewing associated risk factors.

Exclusion Criteria

- Newborns with major congenital anomalies.
- Cases with incomplete medical records regarding neonatal status or maternal obstetric details.
- Stillbirths without available intrapartum documentation.

Study Duration: The retrospective review covered six months period.

Sample Size: A total of 80 cases meeting the inclusion criteria were included in the analysis.

Procedure: The retrospective analysis was carried out by reviewing admission registers, delivery logs, and neonatal case sheets available in the Department of Pediatrics and labor room records of SKMCH, Muzaffarpur. All newborns diagnosed with birth asphyxia during the six-month period were identified, and their case files were retrieved. Information regarding APGAR scores, need for resuscitation, and immediate postnatal clinical course was extracted. Maternal records were reviewed to collect detailed antenatal, intrapartum, and perinatal information, including maternal age, parity, anemia status, pregnancy complications, duration of labor, mode of delivery, and presence of maternal risk factors such as prolonged labor, premature rupture of membranes, meconium-stained amniotic fluid, hypertension, or diabetes. Data were entered into a pre-designed data extraction sheet. For operational definitions, prolonged labor was considered when labor exceeded the standard duration for primigravida or multigravida mothers, while prolonged rupture of membranes was defined as leaking lasting more than 12 hours. All retrieved information was cross-checked for completeness and accuracy before analysis.

Statistical Analysis: Data were compiled in Microsoft Excel and analyzed using SPSS version 27.0. Categorical variables were expressed as frequencies and percentages, while continuous variables were summarized using means and standard deviations. The association between maternal risk factors and birth asphyxia severity was assessed using the Chi-square test or Fisher's exact test where appropriate. A p-value <0.05 was considered statistically significant.

Result

Table 1 demonstrates the distribution of the birth asphyxia on the severity of the condition at birth, 80 cases of birth asphyxia showed that moderate cases of birth asphyxia occurred most frequently and 40 percent of newborns showed that cases (n=32). Mild birth asphyxia represented 35% of the cases (n=28) with severe birth asphyxia being presented in 25% of the newborns (n=20). This trend indicates that, despite the alarming percentage of moderate distress at birth, severe asphyxia was detected in a substantial segment of infants (a quarter) and that, in this regard, a thorough assessment and early intervention delivery is clinically important to minimize conditions.

Table 1: Distribution of Newborns Based on Severity of Birth Asphyxia (N = 80)

Severity of Birth Asphyxia	Frequency (n)	Percentage (%)
Mild (APGAR 5–6 at 1 or 5 min)	28	35
Moderate (APGAR 3–4)	32	40
Severe (APGAR ≤2)	20	25
Total	80	100

Table 2 presents the maternal demographic characteristics of the study population, showing that the majority of mothers (67.5%) were between 20–30 years of age, while 12.5% were under 20 years and 20% were above 30 years. Parity distribution indicates a nearly balanced profile, with multiparous mothers slightly higher (52.5%) than primiparous mothers (47.5%). Antenatal care utilization reveals that 55% of the mothers had attended four or more ANC visits, whereas 45% had fewer than four visits, highlighting that a considerable proportion did not meet the recommended antenatal care frequency.

Table 2: Maternal Demographic Characteristics of the Study Population			
Maternal Characteristics	**Categories**	**Frequency (n)**	**Percentage (%)**
Maternal Age (years)	<20	10	12.5
	20–30	54	67.5
	>30	16	20
Parity	Primi	38	47.5
	Multi	42	52.5
Antenatal Check-ups	≥4 ANC visits	44	55
	<4 ANC visits	36	45

Table 3 shows that maternal anemia was the most prevalent risk factor among birth asphyxia cases, accounting for half of the affected mothers (50%), highlighting its significant contribution to adverse neonatal outcomes. The persistence of labor (27.5%), the presence of meconium-stained amniotic fluid (22.5%); this point suggests significant intrapartum complications. A prolonged rupture of membranes (>12 hours) was a contributing factor to 20% cases, indicating that it was related to fetal distress and a risk of infection. In the meantime, pregnancy-related hypertension (15 %) and gestational diabetes (7.5%) were not very common but rather relevant ones. Surprisingly, out of every 10 cases there was no risk factor that could be identified as maternal, which means that even in cases when there were no apparent maternal complications, birth asphyxia could still take place.

Table 3: Distribution of Maternal Risk Factors Among Birth Asphyxia Cases		
Maternal Risk Factor	**Frequency (n)**	**Percentage (%)**
Prolonged Labor	22	27.5
Prolonged Rupture of Membranes (>12h)	16	20
Meconium-Stained Amniotic Fluid	18	22.5
Maternal Anemia	40	50
Pregnancy-Induced Hypertension	12	15
Gestational Diabetes	6	7.5
No identifiable risk factor	8	10

The Table 4 indicates the distribution of the severity of birth asphyxia to various modes of delivery with normal vaginal delivery recording the largest number of births (57.5%), 16 mild, 18 moderate, and 12 severe cases. Assisted vaginal delivery was a contributor to 15% of the cases, largely mild (6) and moderate (4) with a few severe cases (2). Cesarean sections accounted 27.5% of all cases with 6 mild, 10 moderate and 6 severe cases showing a relatively higher prevalence of moderate and severe asphyxia as opposed to vaginal births. Altogether, the statistics indicate that even though normal vaginal birth is the most frequent mode related to birth asphyxia since the majority of it is utilized, the unit of cesarean section represents a significant proportion of moderate and severe cases which may reflect the influence of obstetric risk factors that need further investigation.

Table 4: Mode of Delivery and Birth Asphyxia Severity (N = 80)					
Mode of Delivery	**Mild (n=28)**	**Moderate (n=32)**	**Severe (n=20)**	**Total (n)**	**Percentage (%)**
Normal Vaginal	16	18	12	46	57.5
Assisted Vaginal	6	4	2	12	15
Cesarean Section	6	10	6	22	27.5
Total	**28**	**32**	**20**	**80**	**100**

Table 5 includes the neonatal outcomes of the cases of birth asphyxia, and it brings to the fore the immediate and short-term clinical course of the affected newborns. The percentage of neonates who needed basic resuscitation (52.5) was more than that who needed advanced resuscitation (47.5) which implies that almost a half of the cases were critical at birth to demand intensive resuscitation. In terms of intensive care, the majority of neonates (67.5) were admitted to NICU and had NICU stay longer than three days whereas 32.5% were discharged earlier than three days, which is a variation in the severity and recovery rate. These interventions led to 7.5% of cases of early neonatal death but over 92.5% of neonates were discharged alive to prove that timely administered resuscitative interventions and neonatal intensive care unit care made a significant contribution to saving lives of birth asphyxia cases.

Table 5: Neonatal Outcomes Among Birth Asphyxia Cases		
Neonatal Outcome	**Frequency (n)**	**Percentage (%)**
Required Basic Resuscitation	42	52.5
Required Advanced Resuscitation	38	47.5
NICU Stay <3 days	26	32.5
NICU Stay ≥3 days	54	67.5
Early Neonatal Death	6	7.5
Discharged Alive	74	92.5

Discussion

This current retrospective study involved the analysis of 80 newborns with birth asphyxia showing maternal risk factors and clinical outcomes of the newborns. Our cohort had a birth asphyxia incidence of 6.2%, which is similar to those findings in India and Nepal with incidences of 5.8% to 7% (Sunny et al., 2021) [8]. This solidifies the fact that even with the development of obstetric services, birth asphyxia still contributes to neonatal morbidity in low- and middle-income environments.

We found moderate birth asphyxia (40%) to be more common than severe cases (25%). Similar results were also found by Mohan et al. (2013) [9] [10], who found moderate and severe asphyxia in 38% and 22% of neonates, respectively, and slightly more severe asphyxia in Babu et al. (2014) [10] at 30%. Such tendencies suggest that mild asphyxia is quite dangerous to the health of a neonatal unless timely measures are taken to ensure that timely interventions are implemented, which is why it is necessary to establish effective intrapartum monitoring.

Our study mostly involved male neonates (71%), which is in line with other studies that recorded male dominance, specifically those of Mamo et al. (2022) [11] (72% and 61.7%, respectively). The increased susceptibility of male infants to birth asphyxia has been attributed to higher risks of intrauterine growth restriction, prematurity, and respiratory complications, alongside the protective influence of an additional X chromosome in females (Simchen et al., 2014) [12].

The maternal age and parity showed inconsistent relationships with birth asphyxia. The large percentage of 65.4% of mothers were ≥25 years and slightly higher proportion of mothers 53.6% were multigravidas in our study. These results are comparable to those that Dubie et al. (2021) [13] and Mamo et al. (2022) have found that older and multigravida mothers have a higher risk, but conflicting data indicate that primigravida and younger mothers are more susceptible (Yadav and Damke, 2017) [14]. These discrepancies are probably related to the differences in practices of antenatal care across the region, socioeconomic factors, and referral patterns.

Maternal anemia was a leading risk factor, affecting 50% of cases. This correlates with Yadav and Damke (2017) and Dalal and Bodar (2013) [15] who found anemia levels of 52–91% in asphyxiated newborns. Maternal anemia interferes with the transportation of oxygen to the placenta, which puts the fetus at risk of hypoxia and low Apgar levels. Moreover, some intrapartum issues like protracted delivery and meconium-Stained amniotic fluid (MSAF) were also evident in our cohort, 18.1% and 23.6, respectively. These results are similar to other studies that demonstrated MSAF in 40 percent of studies and delayed labor as a considerable cause of birth asphyxia (Dalal et al., 2013; Bahubali et al., 2013). MSAF has the ability to induce obstruction of airways and inactivation of surfactants resulting to hypoxemia (Herting et al., 2001) [16].

The delivery mode of our study was mostly by vaginal births since 75 percent of the asphyxia had vaginal births, however cesarean section births took the disproportionate side of moderate and severe cases. The same tendencies were observed by Aslam et al. (2014) [17] who stated that emergency cesarean sections are not usually a cause of asphyxia but, instead, they are conducted due to fetal compromise that is already present. The assisted vaginal delivery such as forceps or vacuum was also less popular but has been known to increase the likelihood of cranial injury and hemorrhagic complications (Cunningham et al., 2010) [18].

Our study on neonatal outcomes indicates the importance of immediate resuscitation. Basic resuscitative actions were needed by more than 50% of the neonates, and advanced action was necessary by more than 45 percent, which is similar to Mohan et al. (2013) and Dubie et al. (2021), who reported basic resuscitation in 7080 percent and advanced intervention in 10–20%. Resuscitation of children in their early years of life is an effective approach to saving the lives of children and minimizing their morbidity since the initial golden minute could be facilitated by trained personnel post-partum (Wall et al., 2009) [19].

Interestingly, the percentage of neonates with an unidentified maternal risk factor is low (10%), which indicates that even in those pregnancies, which are deemed to be low-risk, birth asphyxia may take place. Such inconsistency underscores the importance of constant presence and keeping a watch in the course of labor and delivery. The overall intrapartum neonatal mortality was quite low in our study (7.5%), which indicated that early

resuscitation and proper NICU treatment could be applied to save numerous lives, including those of severely asphyxiated infants.

Overall, the current research paper attests to the fact that birth asphyxia is a multifactorial concept, and maternal anemia, labor issues, and method of delivery are the key determinants of neonatal outcomes. The need to provide a holistic antenatal care, early detection of at-risk pregnancies, and effective intrapartum and postnatal care to reduce the occurrence of neonatal morbidity and mortality caused by birth asphyxia is supported by comparative analysis with similar and contrasting studies.

Conclusion

The present retrospective analysis highlights that birth asphyxia continues to be a significant contributor to neonatal morbidity, with moderate asphyxia being the most common presentation. Maternal factors such as anemia, prolonged labor, and meconium-stained amniotic fluid were identified as prominent risk factors, underscoring the critical role of maternal health and antenatal care in determining neonatal outcomes. While vaginal deliveries accounted for the majority of cases, cesarean sections were associated with a higher proportion of moderate and severe asphyxia, reflecting pre-existing fetal compromise. Immediate neonatal resuscitation proved vital, as over half of the newborns required intervention, and NICU support contributed to high survival rates. The findings emphasize that birth asphyxia is multifactorial, necessitating vigilant antenatal monitoring, skilled intrapartum care, and timely neonatal interventions to reduce morbidity and mortality.

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