

FREQUENCY OF RISK FACTORS OF BIRTH ASPHYXIA IN NEONATES

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Abstract

Birth asphyxia is a critical contributor to neonatal morbidity and mortality, particularly in low- and middle-income countries. Despite advances in perinatal care, limited data exist regarding its prevalence and associated risk factors in Pakistan. This study aimed to determine the prevalence of birth asphyxia and identify its associated obstetric and neonatal risk factors among newborns delivered at the Combined Military Hospital (CMH), Nowshera. A hospital-based cross-sectional study was conducted between 10th January to 15th June 2025 at the Department of Pediatrics, CMH Nowshera. A total of 101 neonates were selected using systematic sampling. Data was collected through structured questionnaires and medical record reviews. Bivariate and multivariate logistic regression analyses were performed to assess factors independently associated with birth asphyxia. Adjusted odds ratios (AOR) with 95% confidence intervals (CI) were calculated, and statistical significance was set at $p < 0.05$. The prevalence of birth asphyxia was 19.8%. Factors significantly associated with increased odds of birth asphyxia included instrumental delivery (AOR=2.87; 95% CI: 1.09-7.55), primiparous mothers (AOR=2.04; 95% CI: 1.10-3.80), induction of labor (AOR = 3.59; 95% CI: 1.36–9.46), prolonged labor ≥ 24 hours (AOR=2.78; 95% CI: 1.32–5.80), meconium-stained amniotic fluid (AOR=3.49; 95% CI: 1.43-8.52), and referral from other facilities (AOR = 3.68; 95% CI: 1.46-9.28). The study revealed a notably high prevalence of birth asphyxia in the study population. Strengthening intrapartum monitoring, timely obstetric interventions, and optimizing referral systems are recommended to reduce the incidence of birth asphyxia in similar healthcare settings

INTRODUCTION

Birth asphyxia, also referred to as perinatal asphyxia or neonatal asphyxia, is a critical medical condition characterized by impaired gas exchange leading to hypoxia (low oxygen) and hypercapnia (high carbon dioxide) in the newborn, typically occurring before, during, or immediately after birth [1]. It fails to initiate and sustain adequate respiration at birth and can lead to significant neonatal morbidity and mortality. Physiologically, birth asphyxia disrupts oxygen delivery to vital organs, particularly the brain,

resulting in metabolic acidosis, energy depletion, and potential multisystem organ dysfunction [2]. If prolonged, the hypoxic insult may cause hypoxic-ischemic encephalopathy (HIE), a major cause of long-term neurodevelopmental disabilities, including cerebral palsy, cognitive impairment, and epilepsy. Globally, birth asphyxia remains a leading cause of neonatal deaths, particularly in low- and middle-income countries, where access to skilled birth attendants and neonatal resuscitation is limited [3].

Early recognition, prompt resuscitation, and postnatal supportive care are essential to improving survival outcomes and reducing neurological sequelae. Birth asphyxia remains a significant global public health concern, contributing substantially to neonatal morbidity and mortality [4]. According to estimates by the World Health Organization (WHO), approximately 2 to 3 per 1,000 live births in high-income countries are affected by birth asphyxia, whereas in low- and middle-income countries (LMICs), the prevalence is considerably higher, ranging from 5 to 10 per 1,000 live births, and in some regions, it may exceed 20 per 1,000 live births. Globally, it is estimated that approximately 1 million newborns die annually due to birth asphyxia, accounting for nearly 23% of all neonatal deaths. In addition to mortality, a significant proportion of survivors suffer from long-term neurological impairments, including cerebral palsy, developmental delay, and epilepsy [5]. The high burden in resource-limited settings is largely attributed to inadequate antenatal care, lack of skilled birth attendance, delayed recognition of fetal distress, and limited access to emergency obstetric and neonatal care. In Pakistan, birth asphyxia remains a leading cause of neonatal mortality, contributing to approximately 23–26% of all neonatal deaths. The national neonatal mortality rate is around 49 per 1,000 live births, with a significant portion attributed to intrapartum-related complications such as birth asphyxia [6]. Hospital-based studies report a prevalence ranging from 2% to 20% among admitted neonates, while community-based data from rural areas like Matiari district suggest that up to 30–40% of neonatal deaths are due to asphyxia [7]. Similarly, the current research study was conducted in the combined military hospital, Nowshera, to determine the frequency of risk factors of birth asphyxia in neonates with birth asphyxia were systematically evaluated to determine the frequency of associated risk factors such as intrauterine growth restriction, fetal distress, prematurity, meconium aspiration syndrome, and congenital malformations.

Methodology

The current cross-sectional research study was conducted in the Department of Pediatrics,

Combined Military Hospital, Nowshera, from 10th January to 15th June 2025. This cross-sectional study was conducted at the Department of Pediatrics, Combined Military Hospital (CMH), Nowshera, over a duration of six months, following the approval of the research synopsis by the CPSP. The sample size was calculated using the WHO calculator by taking the frequency of congenital malformation (7%) in neonates with birth asphyxia, with a confidence level of 95% and a margin of error of 5%, resulting in a required sample size of 101. Consecutive non-probability sampling was employed to recruit participants. Neonates born at a gestational age of 28 to 41 weeks, of either gender, or diagnosed with birth asphyxia as per the operational definition were included in the study. Neonates with sepsis, necrotizing enterocolitis, or chromosomal abnormalities were excluded. Before data collection, permission was obtained from the hospital's ethical committee and the CPSP research unit. Parents or guardians of eligible neonates were briefed about the study objectives and assured that participation posed no risk; written informed consent was obtained. Data, including gestational age at birth, gender, birth weight, socioeconomic status, and area of residence, were recorded. Neonates diagnosed with birth asphyxia were evaluated for associated risk factors such as intrauterine growth restriction (IUGR), fetal distress, prematurity, meconium aspiration syndrome, and congenital malformations. All clinical evaluations were carried out under the supervision of a consultant with a minimum of five years of post-fellowship experience. Data for each patient was documented using a pre-designed, structured proforma.

Data Analysis Procedure

The collected data were recorded and analyzed using IBM SPSS version 25. Categorical variables such as gender, cord blood ABGs (normal/abnormal), Apgar score (<7 at 5 minutes or ≥7 at 5 minutes), risk factors (including intrauterine growth restriction, fetal distress, prematurity, meconium aspiration syndrome, and congenital malformations), registration status (booked/unbooked), socioeconomic status, and area of residence were presented as frequencies and

percentages. The Shapiro-Wilk test was applied to assess the normality of continuous variables. Numerical variables, such as gestational age and birth weight of the neonates, were expressed as mean $\pm$ standard deviation (SD) or median with interquartile range (IQR), depending on the distribution of the data. Stratification was performed to control effect modifiers such as gestational age, weight, Apgar score, gender, cord blood ABGs, registration status, socioeconomic status, and area of residence. Post-stratification, Chi-square or Fisher's exact test was applied where appropriate, considering a p-value of <0.05 as statistically significant. The results were organized and presented in tabular form [8].

Results

Socio-demographic Characteristics of Mothers

The current research study was conducted in the Department of Pediatrics, Combined Military Hospital, Nowshera. A total of 101 questionnaire samples were collected from mothers and their newborns, with a 100% response rate. The median age of the mothers was 26 years, with about one-third (33.7%) with an age range of 21-25 years. 77.2% of the total sample was collected from the urban areas, followed by 32.8% of the total sample collected from rural areas with attained higher education. In terms of religion, 86% were Muslims, while the remaining 14% were non-Muslims. Most mothers reported an income above the median level (as shown in Table 1)

Table 1: Socio-demographic characteristics of the mothers in the public hospital of (n = 101)

Parameters	Category	Frequency (n)	Percentage (%)
Age in years	15-20	10	9.9%
	21-25	35	34.7%
	26-30	33	32.7%
	31-35	16	15.8%
	≥ 36	7	6.9%
Religion	Muslim	87	86.1%
	Non-Muslim	14	13.9%
Residence	Urban	78	77.2%
	Rural	23	22.8%
Occupation	Employer	33	32.7%
	Merchant	21	20.8%
	Housewife	36	35.6%
	Farmer	11	10.9%
Mother's education	Non-educated	9	8.9%
	Primary	28	27.7%
	Secondary	34	33.7%
	Higher education	30	29.7%
Husband's education	Non-educated	3	3.0%
	Primary	18	17.8%
	Secondary	32	31.7%
	Higher education	48	47.5%
Income of the mother	<50000	32	31.7%
	≥ 50000	69	68.3%
Total		101	100%

Clinical Characteristics of Neonates with Birth Asphyxia

Among the 101 newborns, 99 (97.5%) were single births, 98 (96.7%) had normal birth weight, and 99 (97.5%) had no visible congenital anomalies as

shown in Table 2. 54 (53.3%) of the neonates were male, yielding a male-to-female ratio of approximately 1.1:1. The rate of birth asphyxia was 20.2% (about 20 neonates). The clinical characteristics of the neonates (n = 101) included in the study. Among the

newborns, 53.5% (n = 54) were male and 46.5% (n = 47) were female, indicating a relatively balanced gender distribution. In terms of birth weight, most neonates (95.0%, n = 96) had normal weight, while low birth weight and macrosomia were observed in 4.0% (n = 4) and 1.0% (n = 1) of cases, respectively. Most births were single gestations (98.0%, n = 99), with only 2.0% (n = 2) being multiple births. Gross

congenital abnormalities were rare, present in only 2.0% (n = 2) of neonates. Regarding gestational age, 82.2% (n = 83) of the neonates were born at term, while 11.9% (n = 12) were preterm and 5.9% (n = 6) post-term. Asphyxia was observed in 19.8% (n = 20) of neonates at the first minute of life, decreasing to 8.9% (n = 9) at the fifth minute, suggesting improvement in neonatal condition post-delivery.

Table 2: Clinical Characteristics of Neonates (n = 101)

Parameters	Category	Frequency (n)	Percentage (%)	
Gender of Newborn	Male	54	53.5%	
	Female	47	46.5%	
Birth Weight	Normal weight	96	95.0%	
	Low birth weight	4	4.0%	
	Macrosomia	1	1.0%	
Number of Gestation	Single	99	98.0%	
	Multiple	2	2.0%	
Gross Congenital Abnormality	No	99	98.0%	
	Yes	2	2.0%	
Gestational Age	Preterm	12	11.9%	
	Term	83	82.2%	
	Post term	6	5.9%	
Asphyxia in 1 st Minute	No	81	80.2%	
	Yes	20	19.8%	
Asphyxia at the 5 th Minute	No	92	91.1%	
	Yes	9	8.9%	
Total		101	100%	

Obstetric Characteristics of Mothers

Obstetric characteristics of the mothers (n = 101) included in the study. A large proportion (93.1%) had no history of abortion, while 6.9% reported previous abortions. Nearly half of the mothers were primiparous (47.5%), and the remaining were multiparous (52.5%). A history of stillbirth and neonatal death was reported in 9.9% and 5.9% of mothers, respectively. Most participants (84.2%) had an inter-delivery interval of two years or more, indicating adequate spacing between pregnancies. Regarding antenatal care (ANC), 81.2% of the

mothers had attended four or more ANC visits, while 17.8% had 1-3 visits, and only 1.0% reported no visits at all. Most pregnancies (92.1%) were planned, and 98.0% of mothers denied alcohol use during pregnancy. Pregnancy-induced hypertension, premature rupture of membranes (PROM), anemia, polyhydramnios, and antepartum hemorrhage were relatively uncommon, each reported in fewer than 7% of the participants. Oligohydramnios was identified in 4.0% of cases, and febrile illness occurred in only 1.0% of the mothers. The overall detail is summarized and shown in Table 3.

Table 3: Obstetric Characteristics of Mothers (n = 101)

Parameters	Category	Frequency (n)	Percentage (%)	
History of Abortion	No	94	93.1%	
	Yes	7	6.9%	

Parity	Primipara	48	47.5%
	Multipara	53	52.5%
History of Stillbirth	No	91	90.1%
	Yes	10	9.9%
History of Neonatal Death	No	95	94.1%
	Yes	6	5.9%
Inter-delivery Interval	≥2 years	85	84.2%
	<2 years	16	15.8%
Number of ANC Visits	No visit	1	1.0%
	1–3 visits	18	17.8%
	≥4 visits	82	81.2%
Pregnancy Desire	Planned	93	92.1%
	Not planned	8	7.9%
Alcohol Drinking	No	99	98.0%
	Yes	2	2.0%
Pregnancy-induced Hypertension	No	94	93.1%
	Yes	7	6.9%
Premature Rupture of Membrane	No	94	93.1%
	Yes	7	6.9%
Anemia	No	99	98.0%
	Yes	2	2.0%
Polyhydramnios	No	99	98.0%
	Yes	2	2.0%
Oligohydramnios	No	97	96.0%
	Yes	4	4.0%
Antepartum Hemorrhage	No	96	95.0%
	Yes	5	5.0%
Febrile Illness	No	100	99.0%
	Yes	1	1.0%

Factors Associated with Birth Asphyxia

Several factors were found to be significantly associated with birth asphyxia, including parity, mode of delivery, onset and duration of labor, amniotic fluid status, and referral status, as shown in Table 4. Newborns delivered within 24 hours of labor onset had 2.78 times higher odds of experiencing asphyxia (AOR = 2.78; 95% CI: 1.32–5.85). Infants born to primiparous mothers were twice as likely to develop birth asphyxia compared to those born to multiparous mothers (AOR = 2.05; 95% CI: 1.10–3.80). Similarly, neonates delivered

via instrumental methods (forceps or vacuum) were significantly more likely to suffer from birth asphyxia than those delivered spontaneously (AOR = 2.87; 95% CI: 1.09–7.55). Furthermore, the risk of birth asphyxia was 3.68 times higher among newborns of referred mothers compared to those of non-referred mothers (AOR = 3.68; 95% CI: 1.46–9.28). Lastly, neonates born to mothers with meconium-stained amniotic fluid had 3.49 times greater odds of developing asphyxia compared to those whose mothers had clear amniotic fluid (AOR = 3.49; 95% CI: 1.43–8.52).

Table 4: Multivariate Logistic Regression Analysis of Factors Associated with Birth Asphyxia among Neonates (n = 101)

Parameters	Category	No (n, %)	Yes (n, %)	COR (95% CI)	AOR	P-value
Parity	Primipara	35 (34.7%)	13 (12.9%)	2.23(1.32-3.78)	2.04(1.10-3.80)	0.024
	Multipara	45 (44.6%)	7 (6.9%)	1	1	
Pregnancy desire	Planned	75 (74.3%)	17 (16.8%)	1	1	0.40
	Not planned	6 (5.9%)	3 (3.0%)	2.05(0.92-4.57)	1.54(0.54-4.34)	
Gestational age	Term	68 (67.3%)	15 (14.9%)	1	1	0.20
	Preterm	8 (7.9%)	4 (4.0%)	0.614(0.23-0.63)	1.79(0.74-4.29)	
	Post term	5 (5.0%)	2 (2.0%)	1.28(0.416-3.939)	1.00(0.29-3.43)	
Oligohydramnios	No	79 (78.2%)	19 (18.8%)	1	1	0.320
	Yes	2 (2.0%)	2 (2.0%)	3.18(1.07-9.49)	2.12(0.48-9.42)	
Mode of delivery	SVD	70 (69.3%)	10 (9.9%)	1	1	0.033
	Instrumental	4 (4.0%)	4 (4.0%)	6.28(2.8-14.1)	2.87(1.09-7.55)	
	Cesarean	7 (6.9%)	6 (5.9%)	5.70(2.94-11.05)	1.65(0.6-4.53)	
Onset of labor	Spontaneous	77 (76.2%)	16 (15.8%)	1	1	0.01
	Induction	3 (3.0%)	4 (4.0%)	6.01(2.67-13.5)	3.59(1.36-9.46)	
Duration of labor	<24 hours	72 (71.3%)	14 (13.9%)	1	1	0.007
	≥24 hours	8 (7.9%)	6 (5.9%)	3.870(2.08-7.17)	2.781(1.32-5.8)	
Amniotic fluid status	Clear	73 (72.3%)	14 (13.9%)	1	1	0.550
	Bloody	3 (3.0%)	2 (2.0%)	3.357(1.25-10.67)	1.48(0.40-5.37)	
	Meconium	5 (5.0%)	4 (4.0%)	4.964(2.35-6.10)	3.491(1.43-8.5)	
Birth Attendant	Midwife	73 (72.3%)	13 (12.9%)	5.204(2.81-9.63)	2.41(0.97-5.93)	0.056
	Doctor	8 (7.9%)	7 (6.9%)	1	1	
Booked Status	Not-referred	78 (77.2%)	15 (14.9%)	1	1	0.006
	Referred	3 (3.0%)	5 (5.0%)	8.20(3.76-17.86)	3.68(1.46-9.28)	

Discussion

Birth asphyxia is a serious neonatal condition resulting from impaired gas exchange, leading to reduced oxygen supply and accumulation of carbon dioxide before, during, or immediately after birth. It can cause significant neurological damage or death if not promptly recognized and managed. The current research study revealed the prevalence of birth asphyxia; a similar study had been reported in Kyber Teaching Hospital, Peshawar [9]. In Lahore, Karachi, and certain other regions of Pakistan, a comparable pattern has been observed, although the prevalence rates are lower in these areas [10, 11]. However, the methodology of the study reported in Karachi raised controversy over the sampling techniques used for the current data. Differences with the Jimma-based study likely reflect heterogeneity in maternal and neonatal characteristics, including antenatal care (ANC) coverage, the presence of medical and

obstetric complications, and the inclusion of very preterm neonates. Regarding parity, neonates born to primiparous mothers exhibited a higher likelihood of experiencing birth asphyxia compared to those born to multiparous mothers. Similar findings have been reported in studies from Bangladesh [12], Kenya [13], and Uganda [13]. This association may be attributed to hypotonic uterine contractions commonly observed in first-time mothers, which can lead to prolonged labor. Extended labor duration increases the risk of maternal fatigue and non-reassuring fetal heart rate patterns, both of which are known contributors to birth asphyxia. Additionally, primiparous mothers may lack birth experience and demonstrate reduced cooperation during labor, further elevating the risk. However, this finding contrasts with results from some Ethiopian studies [14], likely due to methodological differences and variations in participant characteristics. Furthermore,

neonates delivered via instrumental methods (e.g., forceps or vacuum) had a higher probability of developing birth asphyxia compared to those born through spontaneous vaginal delivery. This observation is consistent with findings from a study conducted in Pakistan [15]. The increased risk may be due to complications such as shoulder dystocia associated with instrumental delivery, which can lead to intrapartum hypoxia and subsequent birth asphyxia [26, 27]. Neonates born following labor induction were found to have a higher likelihood of experiencing birth asphyxia compared to those whose mothers underwent spontaneous labor onset. This finding is consistent with studies conducted in Kenya [23]. One possible explanation is that labor induction may lead to uterine tachysystole, excessive frequency or duration of uterine contractions, which can cause umbilical cord compression and reduced fetal oxygenation, ultimately resulting in asphyxia. The rapid progression of labor, often associated with induction, may increase the risk of birth trauma, a known contributor to asphyxia. Another potential factor is the elevated resting uterine tone observed during induced labor, which can further compromise placental blood flow and fetal oxygen supply. This finding aligns with previous studies conducted in Ethiopia [12] and Kenya [13]. One potential explanation is that prolonged labor leads to maternal exhaustion and dehydration, increasing the risk of fetal distress and birth asphyxia [15, 16]. The management of prolonged labor, particularly if it involves potentially tense anesthesia or delayed interventions, may contribute to neurological compromise and subsequent asphyxia. Cephalopelvic disproportion, a common cause of prolonged labor, may result in intracranial hemorrhage during delivery, further predisposing the neonate to asphyxia. Neonates born to mothers with meconium-stained amniotic fluid were also found to have significantly higher odds of birth asphyxia compared to those with clear amniotic fluid. This observation is supported by studies from Bangladesh [12] and Ethiopia [13]. The likely mechanism involves aspiration of meconium-contaminated fluid, which can obstruct the airways, impair gas exchange, lead to alveolar collapse, and cause respiratory distress shortly after birth [15]. Moreover, neonates of referred mothers exhibited increased odds of birth

asphyxia compared to those whose mothers were not referred to. This may be attributed to delays in receiving timely obstetric care, often resulting from late decision-making, transportation issues, or limited access to appropriate health facilities. However, a study in Kenya [13] did not report a significant association between referral status and birth asphyxia, which may be due to differences in healthcare infrastructure, referral protocols, and resource availability across settings.

Conclusion

The prevalence of birth asphyxia in this study is reported to be very high relative to the expected rates in low-income countries. Key factors significantly associated with birth asphyxia include parity, onset and duration of labor, antenatal care status, mode of delivery, and the condition of the amniotic fluid, which are largely preventable. Therefore, the regional Health facilities must enhance intrapartum care by minimizing delays in labor management. Healthcare facilities and professionals should prioritize the continuous use of partographs for labor monitoring, ensure timely decision-making, and strengthen communication and referral systems to reduce the risk of birth asphyxia.

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