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FREQUENCY AND PREDISPOSING RISK FACTORS OF BIRTH ASPHYXIA IN THE NEONATAL CARE UNIT OF AL-KHANSAA MATERNITY AND PEDIATRIC TEACHING HOSPITAL, MOSUL, IRAQ

Iman Idriss Yaseen[1*] MBChB FIBMS/FM, Reyad Ebraheem Hussien[2] MBChB CABP, Zakariya Zuhair Al Hayali[3] MBChB CABP

[1]Specialist Family Medicine Doctor, Healthcare Sector In Al-Hamdaniya, Iraq.
[2]Specialist Pediatrician, Department of Pediatrics, Al Qayara General Hospital, Iraq.
[3]Specialist Pediatrician, Department of Pediatrics, Mosul General Hospital, Iraq.

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***Corresponding Author: Iman Idriss Yaseen, MBChB FIBMS/FM**

Specialist Family Medicine Doctor, Healthcare Sector In Al-Hamdaniya, Iraq.

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ABSTRACT

Background & Objective: Birth asphyxia is a severe worldwide medical challenge responsible for high rates of neonatal mortality and long-term neurodevelopmental sequelae. This study aimed to determine the precise frequency of birth asphyxia within the Neonatal Care Unit (NCU) of Al-Khansaa Maternity and Pediatric Teaching Hospital in Mosul, Iraq, and to systematically identify the key maternal, fetal, and intrapartum predisposing factors driving this condition. **Methods:** A prospective case series design was implemented from March 1st to June 30th, 2013. The study monitored 200 neonates admitted to the NCU during randomly assigned operational intervals. Clinical diagnosis of birth asphyxia was systematically evaluated using neonatal depression parameters, specifically established as an Apgar score < 4 at 5 minutes of life as verified by supervising neonatologists. Comprehensive statistical evaluations including Independent t-tests, Chi-square tests, and Fisher's exact tests were executed via Minitab v16 to analyze risk associations. **Results:** Out of the 200 monitored neonatal admissions, 34 infants met the strict criteria for birth asphyxia, representing a localized institutional frequency of 17.0%. Bivariate statistical analytical tests identified highly significant correlations between the clinical manifestation of birth asphyxia and maternal anemia ($p = 0.035$, mean maternal Hb 11.41 ± 1.26 vs. 11.75 ± 0.79 g/dL; $p = 0.042$), maternal pregnancy-induced toxemia (PET) ($p = 0.016$), mechanical obstructed labor ($p < 0.001$), and a prolonged second stage of labor ($p = 0.002$). Conversely, no statistically significant correlations were demonstrated between birth asphyxia and neonatal biological sex ($p = 0.149$), structural gestational age ($p = 0.180$), absolute birth weight ($p = 0.806$), maternal age ($p = 0.530$), parity ($p = 0.973$), geographic residence, or parental educational attainments. **Conclusions:** The high institutional frequency of birth asphyxia in this series underscores critical operational deficits in regional intrapartum management. Mechanical obstructed labor, maternal toxemia, and severe gestational anemia comprise the primary targets for preventive intervention. Enhancing structured antenatal surveillance, promoting institutional access for high-risk gestations, and deploying standardized neonatal cardiotocography (CTG) along with resuscitation infrastructure are strongly recommended to mitigate regional perinatal. indices.

KEYWORDS: Birth Asphyxia; Perinatal Hypoxia; Hypoxic Ischemic Encephalopathy; Apgar Score; Obstructed Labor; Pregnancy-Induced Toxemia; Neonatal Care Unit; Mosul.

1. INTRODUCTION

Perinatal or birth asphyxia represents an acute, catastrophic insult to the fetus or newborn stemming directly from a marked lack of oxygenation or systemic hypoperfusion to various vital organs.[1] Birth asphyxia continues to be a severe clinical issue globally.[2,3] It stands as the second most prevalent cause of preventable newborn death worldwide, directly trailing acute

infectious syndromes.[4] The World Health Organization (WHO) estimates that between four and nine million neonates suffer from birth asphyxia annually, culminating in approximately 1.2 million deaths and an equal number of survivors plagued by profound, long-term neurological morbidity, including cerebral palsy, secondary epilepsy, and speech or learning developmental delays.[2,5]

A central impediment to establishing synchronized global documentation on birth asphyxia is the historical deficiency of a single standardized clinical definition.[6,7] The World Health Organization comprehensively defines perinatal asphyxia from a practical standpoint as a clinical 'failure to initiate and sustain breathing at birth'.[2] In contrast, western scholarly associations, including the American Academy of Pediatrics (AAP) and the American College of Obstetricians and Gynecologists (ACOG), mandate that a definitive designation of perinatal asphyxia requires the simultaneous validation of profound metabolic or mixed acidemia (pH < 7.00 in an umbilical artery sample), an Apgar score between 0 and 4 for longer than 5 minutes, early-onset neurological sequelae, and multi-organ system involvement.[6]

The primary neuropathological consequence of birth asphyxia is Hypoxic-Ischemic Encephalopathy (HIE), an evolving pattern of abnormal neurological signs manifesting sequentially across the first days of life.[1,8] The clinical severity of HIE is classified using the Sarnat and Sarnat grading system into three stages (Mild/Stage I, Moderate/Stage II, and Severe/Stage III).[5,9] The underlying physiological mechanism involves a dual-phase cellular injury pathway[10]: an initial hypoxic phase marked by acute tissue necrosis, anaerobic glycolysis, and energy failure[11], followed by a secondary reperfusion stage where a cascade of reactive oxygen species (ROS), glutamate-mediated excitotoxicity, and lipid peroxidation triggers apoptosis.[10,12] Organs with massive metabolic rates, particularly the brain, suffer the most structural devastation.[1,13]

In developing nations, the epidemiological burden of birth asphyxia is multi-fold higher than in industrialized regions.[8,14] While mortality is below 0.1% in developed nations[15], case fatality rates in low-resource settings frequently exceed 40%.[14,16] In Iraq, historical data remain scarce and disjointed.[17] Prospective tracking in Karbala documented an HIE incidence of 2.67 per 1,000 live births[17], while separate surveillance in Basra recorded a localized birth asphyxia incidence of 10.1 per 1,000 live births.[18] Consequently, there is an urgent research need to gather localized data to help map predisposing parameters.[19] This study investigates the frequency and maternal-fetal predisposing risk factors of birth asphyxia within the Neonatal Care Unit (NCU) of Al-Khansaa Maternity and Pediatric Teaching Hospital in Mosul, Iraq.

2. METHODS

Administrative authorization and ethical approval were secured from the Directorate of Health of the Nineveh Governorate and the institutional review board of Al-Khansaa Maternity and Pediatric Teaching Hospital (Mosul, Iraq). In accordance with the principles of the Declaration of Helsinki, structured informed consent was systematically obtained from the parents or legal guardians of each neonate enrolled. All participant identifiers were coded to preserve strict confidentiality.

This investigation adopted a prospective case series design to track all neonatal admissions during a consecutive four-month period, extending from March 1st to June 30th, 2013.[20] A systematic time-block sampling protocol was used: all neonates of both sexes admitted to the NCU during two randomly allocated full 24-hour days each week throughout the 4-month duration were consecutively enrolled to achieve a sample size of 200 neonates to ensure statistical power.

The clinical case designation for birth asphyxia was based on the standard guidelines of the AAP and ACOG.[6,21] A neonate was formally diagnosed with birth asphyxia if they demonstrated severe depression at birth, strictly evidenced by an Apgar score of less than 4 at the 5th minute of life, as independently verified by the attending consultant pediatrician.[22] Conversely, neonates admitted for other indications who maintained an Apgar score ≥ 4 at the 5th minute were classified into the non-asphyxiated comparison cohort.[23]

Data collection was performed via direct, face-to-face clinical interviews with the mothers or immediate relatives, supplemented by a rigorous review of internal obstetric admission records and labor delivery charts.[24] Statistical analysis was carried out using Minitab v16 and Excel 2010. Descriptive statistics were computed using means and standard deviations (±SD) for quantitative variables, and frequencies and percentages for categorical indicators. Continuous quantitative variables were evaluated using the Independent Student's t-test. Associations between categorical variables were evaluated using the Pearson Chi-square (χ^2) test, or Fisher's exact test for low-frequency contingency cells where appropriate.[25] The statistical threshold for clinical and epidemiological significance was defined as a p-value less than 0.05 ($p < 0.05$).

3. RESULTS

3.1 Socio-Demographic Characteristics of the Cohort

A total of 200 neonates admitted to the NCU met the criteria for evaluation and were successfully enrolled. The cohort comprised 101 males (50.5%) and 99 females (49.5%). Urban inhabitants constituted the majority (60.0%), followed by suburban areas (31.5%) and rural sectors (8.5%). Maternal educational attainment showed that 75.0% had completed secondary schooling or attained higher university degrees. No active tobacco smoking was reported among the mothers; however,

passive smoking exposure affected 49.0% of maternal participants. Table 1 provides a comprehensive overview of these socio-demographic parameters.

Table 1: Baseline institutional socio-demographic distribution of the study sample (N=200).

Sociodemographic Parameter	Frequency (n)	Percentage (%)
Neonatal Biological Sex		
Male	101	50.50%
Female	99	49.50%
Geographical Residence		
Urban	120	60.00%
Suburban	63	31.50%
Rural	17	8.50%
Maternal Educational Attainment		
Illiterate	1	0.50%
Primary School	49	24.50%
Intermediate & Secondary School	84	42.00%
University & Post-graduate	66	33.00%
Passive Smoke Exposure	98	49.00%

3.2 Frequency and Primary Indications for NCU Admission

Out of the 200 neonatal admissions monitored, 34 infants were formally diagnosed with birth asphyxia based on an Apgar score < 4 at the 5th minute, representing an overall local institutional frequency of 17.0%. The predominant indication for admission across the wider sample was routine observational checking of the newborn following complicated delivery steps (n = 153, 76.5%). Other reasons for admission included isolated low Apgar scores at the 1st minute only (2.5%), meconium aspiration syndrome (1.5%), neonatal jaundice (1.0%), infant of a diabetic mother protocols (1.0%), and gross congenital anomalies (0.5%), as presented in Table 2.

Table 2: Structured distribution of the population according to indication of admission.

Primary Indication for NCU Admission	Frequency (n)	Percentage (%)
Routine Observational Checking	153	76.50%
Birth Asphyxia (Apgar < 4 at 5 min)	34	17.00%
Isolated Low Apgar Score at 1st Minute	5	2.50%
Meconium Aspiration Syndrome (MAS)	3	1.50%
Neonatal Jaundice (Hyperbilirubinemia)	2	1.00%
Infant of Diabetic Mother (IDM) Protocol	2	1.00%
Congenital Anomaly	1	0.50%

3.2.1 Visual Representation of Indications for NCU Admission

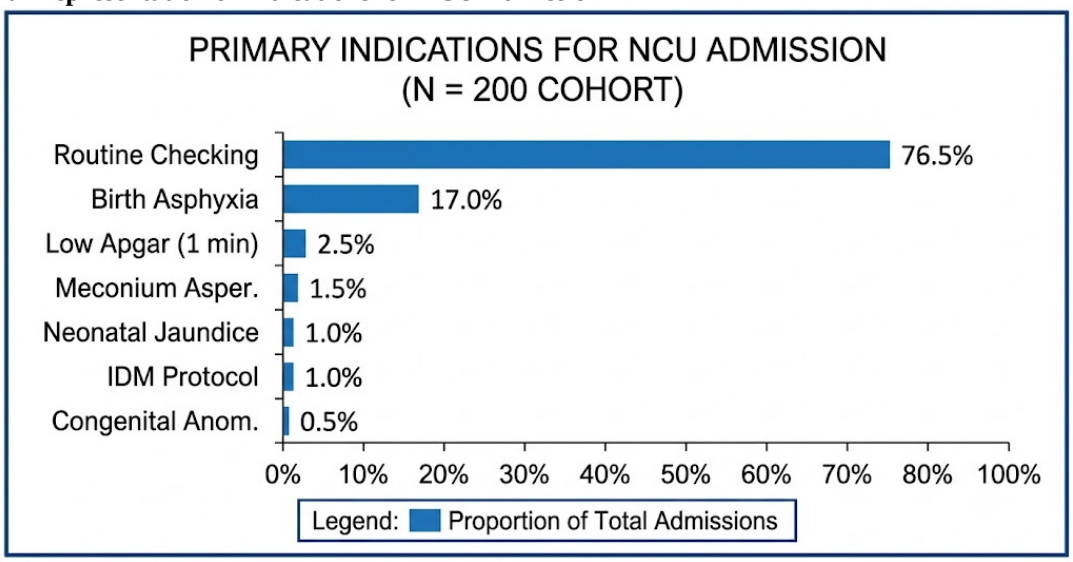

Chart 1: Horizontal distribution bar-chart modeling native operational indications for primary NCU triage admissions.

3.3 Quantitative Clinical Baselines of Mothers and Neonates

Analysis of baseline maternal continuous variables across the entire cohort showed a mean age of 27.35 ± 5.89 years. The cohort showed a mean parity of 1.73 ± 1.91, a mean gravidity of 3.09 ± 2.19, and a history of previous spontaneous abortions averaging 1.36 ± 0.71. For neonatal parameters, structural gestational age extended across a narrow range from 35.0 to 41.0 weeks, with an overall mean maturity of 37.71 ± 1.00 weeks. Absolute birth weight ranged from 1,800 to 4,500 grams, with a mean sample weight of 3,264.5 ± 452.8 grams. Serial Apgar parameters showed a mean score of 6.52 ± 2.06 at the 1st minute, 7.26 ± 1.66 at the 5th minute, 7.75 ± 1.01 at the 10th minute, and 7.90 ± 1.08 at the 20th minute. These quantitative characteristics are detailed in Table 3.

Table 3: Comprehensive overview of maternal and neonatal quantitative baseline parameters (N=200).

Clinical Variable	Mean	Std. Dev (±SD)	Minimum	Maximum
Maternal Age (years)	27.35	5.89	18.0	45.0
Maternal Parity (Para)	1.73	1.91	0	10
Maternal Gravidity	3.09	2.19	1	11
Previous Abortions	1.36	0.72	0	4
Gestational Age (weeks)	37.71	1.00	35.0	41.0
Birth Weight (grams)	3264.5	452.8	1800.0	4500.0
Apgar Score - 1 Minute	6.52	2.06	2	8
Apgar Score - 5 Minutes	7.26	1.66	2	10
Apgar Score - 10 Minutes	7.75	1.01	2	10
Apgar Score - 20 Minutes	7.90	1.08	0	10

3.4 Maternal Co-Morbidities and Gestational Obstetric Complications

Pre-gestational chronic medical conditions were documented in 5.5% of the total study population (n = 11). In contrast, acute complications during the index pregnancy or delivery were highly prevalent. Mechanical obstructed labor was documented in 27 cases (13.5%), oligohydramnios in 22 cases (11.0%), cephalopelvic disproportion (CPD) in 20 cases (10.0%), multiple twin gestations in 14 cases (7.0%), and acute antepartum hemorrhage (APH) in 16 cases (8.0%, divided between 9 cases of abruptio placentae and 7 cases of placenta previa). Documented maternal clinical anemia affected 5 mothers (2.5%), while 48.0% (n = 96) of the sample experienced completely uneventful gestations. The specific distribution of these complications is detailed in Table 4.

Table 4: Distribution of obstetric and medical complications during the index pregnancy.

Obstetric & Gestational Complications	Frequency (n)	Percentage (%)
Obstructed Labor	27	13.50%
Oligohydramnios	22	11.00%
Cephalopelvic Disproportion (CPD)	20	10.00%
Multiple Pregnancy (Twins)	14	7.00%
Abruptio Placentae	9	4.50%
Placenta Previa	7	3.50%
Maternal Anemia	5	2.50%
No Documented Gestational Complication	96	48.00%

3.5 Bivariate Risk Analysis: Maternal and Fetal Continuous Parameters

To clarify the predisposing drivers of birth asphyxia, continuous clinical parameters were stratified and compared between the asphyxiated (n = 34) and non-asphyxiated (n = 166) cohorts using an independent t-test. No statistically significant differences were observed regarding mean maternal age (p = 0.530), parity (p = 0.973), or gravidity (p = 0.661). Similarly, structural neonatal biological components showed no statistical correlation with birth asphyxia, including gestational age (p = 0.180) and baseline birth weight (p = 0.806). However, a highly significant statistical association was identified regarding maternal hemoglobin (Hb) levels. Mothers of asphyxiated neonates demonstrated a significantly lower mean Hb concentration than mothers of non-asphyxiated neonates (11.41 ± 1.26 g/dL vs. 11.75 ± 0.79 g/dL; p = 0.042). Furthermore, when evaluated as a categorical block via Chi-square analysis, maternal anemia was significantly more prevalent in the asphyxiated group (8.82% vs. 1.20%; p = 0.035). Table 5 provides the comprehensive bivariate comparative data matrix.

Table 5: Bivariate matrix comparing maternal and fetal parameters between cohorts (*Independent t-test, **Chi-square test).

Clinical Parameter	Asphyxiated Cohort (n=34)	Non-Asphyxiated Cohort (n=166)	t / χ^2	p-value
Maternal Age (years)*	26.76 ± 5.49	27.46 ± 5.98	0.630	0.530
Maternal Parity (Para)*	1.74 ± 1.99	1.72 ± 1.90	0.030	0.973
Maternal Gravidity*	3.24 ± 2.57	3.05 ± 2.11	0.440	0.661
Maternal Hemoglobin (g/dL)*	11.41 ± 1.26	11.75 ± 0.79	2.050	0.042 (S)
Gestational Age (weeks)*	37.50 ± 1.13	37.75 ± 0.97	1.350	0.180
Absolute Birth Weight (g)*	3247 ± 460	3268 ± 453	0.250	0.806
Maternal History of Abortion**	14 (41.18%)	50 (30.12%)	3.020	0.082
Gestational Maternal Anemia**	3 (8.82%)	2 (1.20%)	4.440	0.035 (S)

3.6 Comparison of Serial Longitudinal Apgar Progressions

Longitudinal verification of neonatal depression profiles showed highly significant differences in mean Apgar scores between the two groups at every clinical tracking interval ($p < 0.001$). At the 1st minute of life, the asphyxiated cohort exhibited a profound depression score of 2.88 ± 1.01, compared to 7.26 ± 1.28 for the non-asphyxiated group. At the critical 5-minute diagnostic baseline, the asphyxiated group remained severely depressed at 3.82 ± 1.06, whereas the comparison cohort averaged a normal score of 7.96 ± 0.43. Despite aggressive resuscitation efforts, the asphyxiated cohort continued to show lower average scores at both the 10-minute (6.12 ± 1.55 vs. 8.08 ± 0.30) and 20-minute (6.97 ± 2.34 vs. 8.09 ± 0.31) intervals, demonstrating the severity of the initial hypoxic insult. These variations are summarized in Table 6.

Table 6: Longitudinal tracking of serial Apgar scores between clinical cohorts (Independent t-test).

Apgar Evaluation Interval	Asphyxiated Cohort (n=34)	Non-Asphyxiated Cohort (n=166)	t-value	p-value
Apgar Score - 1 Minute	2.88 ± 1.01	7.26 ± 1.28	19.35	< 0.001 (HS)
Apgar Score - 5 Minutes	3.82 ± 1.06	7.96 ± 0.43	34.12	< 0.001 (HS)
Apgar Score - 10 Minutes	6.12 ± 1.55	8.08 ± 0.30	11.24	< 0.001 (HS)
Apgar Score - 20 Minutes	6.97 ± 2.34	8.09 ± 0.31	5.15	< 0.001 (HS)

3.6.1 Longitudinal Disparity in Serial Apgar Score Tracking

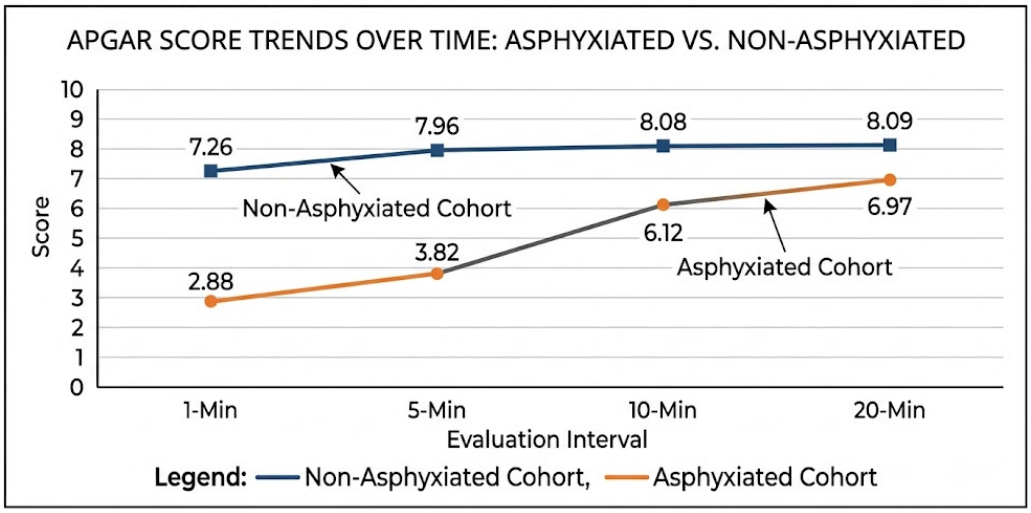

Chart 2: Longitudinal line-graph visualization modeling the divergent recovery paths in post-resuscitation Apgar indices.

3.7 Categorical Risk Association: Socio-Demographics and Environmental Factors

Pearson Chi-square analysis was used to assess potential associations between categorical parameters and birth asphyxia. A higher proportion of asphyxiated neonates were male compared to the non-asphyxiated cohort (61.76% vs. 48.19%), but this difference did not reach statistical significance ($p = 0.149$). Similarly, no significant statistical differences were observed based on geographic residence (urban: 67.65%, suburban: 17.65%, rural: 14.71%; $p = 0.090$ and 0.327). Maternal educational background also showed no association with birth asphyxia ($p = 0.728$ and 0.706). Furthermore, maternal exposure to passive tobacco smoke showed a

comparable distribution between the two groups (52.94% vs. 48.19%; p = 0.614), indicating no significant risk elevation, as shown in Table 7.

Table 7: Evaluation of socio-demographic and environmental categorical dimensions (Chi-square test).

Categorical Factor	Asphyxiated (n)	Asphyxiated (%)	Non-Asphyx (n)	Non-Asphyx (%)	p-value
Neonatal Sex					
Male	21	61.76%	80	48.19%	0.149
Female	13	38.24%	86	51.81%	
Geographic Residence					
Urban (Ref Group)	23	67.65%	97	58.43%	---
Suburban	6	17.65%	57	34.34%	0.090
Rural	5	14.71%	12	7.23%	0.327
Maternal Education					
Primary School	7	20.59%	42	25.30%	0.728
Intermediate/Secondary	16	47.06%	68	40.96%	0.706
University & Higher	11	32.35%	55	33.13%	---

3.8 Categorical Risk Association: Obstetric Complications and Pathologies

In contrast to socio-demographic variables, specific intrapartum obstetric complications showed powerful statistical associations with birth asphyxia. Mechanical obstructed labor was highly prevalent in the asphyxiated group, affecting 32.35% (n = 11) of cases compared to just 9.61% (n = 16) in the non-asphyxiated comparison group (p < 0.001). Similarly, a prolonged second stage of labor was significantly correlated with birth asphyxia, affecting 11.76% of the asphyxiated cohort compared to 0.60% of the comparison group (p = 0.002). Pregnancy-induced toxemia (PET) also showed a significant risk correlation, with an 8.82% prevalence in the asphyxiated cohort versus 0.60% in the non-asphyxiated group (p = 0.016).

Several other clinical complications did not show statistically significant associations within this sample. These included placenta previa (p = 0.223), abruptio placentae (p = 0.182), oligohydramnios (p = 0.295), cephalopelvic disproportion in isolation (p = 0.802), and multiple twin gestations (p = 0.079). These categorical risk correlations are detailed in Table 8.

Table 8: Bivariate statistical cross-tabulation of obstetric complications and birth asphyxia (Chi-square / Fisher's exact).

Obstetric/Labor Complication	Asphyxiated (n)	Asphyxiated (%)	Non-Asphyx (n)	Non-Asphyx (%)	p-value
Mechanical Obstructed Labor	11	32.35%	16	9.61%	< 0.001 (HS)
Prolonged 2nd Stage of Labor	4	11.76%	1	0.60%	0.002 (S)
Pregnancy-Induced Toxemia (PET)	3	8.82%	1	0.60%	0.016 (S)
Abruptio Placentae	3	8.82%	6	3.61%	0.182
Cephalopelvic Disproportion (CPD)	3	8.82%	17	10.24%	0.802
Oligohydramnios	2	5.88%	20	12.05%	0.295
Placenta Previa	0	0.00%	7	4.22%	0.223
Multiple Twin Gestations	0	0.00%	14	8.43%	0.079

3.8.1 Key Obstetric Complications Driving Birth Asphyxia Risk

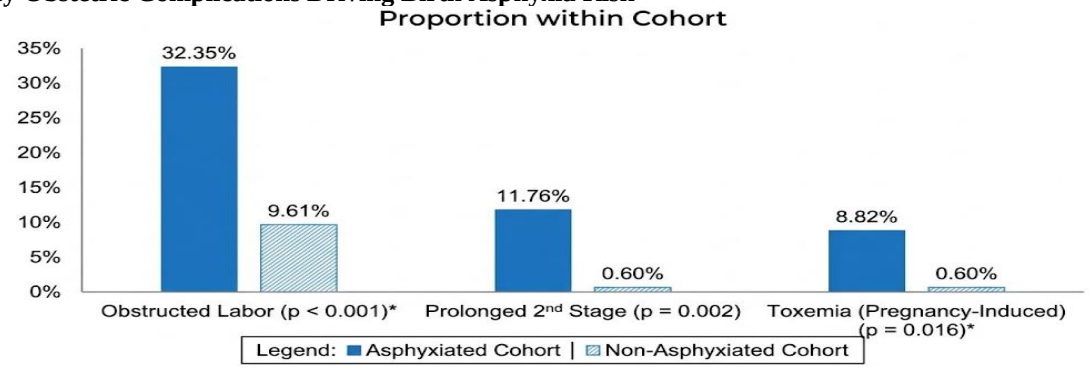

Chart 3: Clustered risk composition chart detailing the significant obstetric parameters discovered in bivariate screening.

3.9 Influence of Delivery Mode on Asphyxia Risk

Analysis of the primary mode of delivery showed a highly significant statistical association with the development of birth asphyxia (p = 0.002). More than half of the asphyxiated neonates were delivered via Normal Vaginal Delivery (n = 18, 52.94%), whereas NVD accounted for only 27.11% (n = 45) of deliveries in the non-asphyxiated comparison group. Conversely, Cesarean Sections were highly prevalent among the non-asphyxiated cohort, accounting for 72.29% (n = 120) of cases compared to 44.11% (n = 15) in the asphyxiated group. Instrumental vacuum extraction was used rarely, accounting for 2.94% (n = 1) of the asphyxiated group and 0.60% (n = 1) of the non-asphyxiated group. These distributions are presented in Table 9.

Table 9: Statistical cross-tabulation comparing delivery mode configurations (Chi-square analysis).

Primary Mode of Delivery	Asphyxiated (n)	Asphyxiated (%)	Non-Phyx (n)	Non-Phyx (%)	p-value
Normal Vaginal Delivery (NVD)	18	52.94%	45	27.11%	0.002 (S)
Cesarean Section (Elective/Emergent)	15	44.11%	120	72.29%	---
Instrumental Vacuum Assisted	1	2.94%	1	0.60%	0.410

4. DISCUSSION

The prospective institutional tracking conducted within the NCU of Al-Khansaa Maternity and Pediatric Teaching Hospital revealed a local birth asphyxia frequency of 17.0% among monitored admissions. At first glance, this institutional rate appears significantly elevated when compared with previous landmark studies executed within Iraq. For instance, tracking conducted by Mohammed in Karbala documented a localized Hypoxic-Ischemic Encephalopathy frequency of 2.67 per 1,000 live births.[17] Similarly, surveillance by Na'ama within the Basra Maternity and Child Hospital identified a regional birth asphyxia incidence of 10.1 per 1,000 live births.[18] In international contexts, such as Swedish surveillance by Thorberg et al. in Gothenburg, the documented incidence of HIE was low, at 1.8 per 1,000 live births, due to advanced electronic networks.[26]

This apparent divergence in frequency is primarily due to fundamental differences in sampling methodology and structural denominators. The historical studies in Basra[18], Karbala[17], and Gothenburg[26] estimated absolute asphyxia incidences across the entire denominator of total live institutional births. In contrast, this investigation estimated the frequency of birth asphyxia specifically within the denominator of active admissions to the specialized Neonatal Care Unit. In the operational workflow of Al-Khansaa Hospital, healthy neonates delivered via uncomplicated NVD bypass NCU admission entirely. Conversely, the NCU systematically receives all neonates delivered via Cesarean section, a subset of complex NVDs, and any infant exhibiting clinical distress or physical illness. This selective admission pathway concentrates high-risk cases within the unit, resulting in a higher institutional frequency that reflects the specialized caseload of the NCU rather than a generalized population incidence.

Bivariate analysis showed that neonatal sex carried no statistically significant association with asphyxia risk (p = 0.149), aligning with Basra data.[18] Similarly, neonatal structural weight (p = 0.806) and gestational age (p = 0.180) showed no significant correlations, consistent with both the Karbala and Basra series.[17,18] Regarding maternal socio-demographic indicators, age (p = 0.530), parity (p = 0.973), and geographic residence showed no significant correlation with birth asphyxia risk.[18] Maternal passive tobacco smoke exposure affected nearly half the cohort (49.0%) but did not significantly alter risk (p = 0.614).

In contrast to socio-demographic factors, maternal clinical anemia emerged as a potent pre-gestational driver of birth asphyxia. Mothers of asphyxiated infants demonstrated significantly lower mean hemoglobin concentrations (11.41 ± 1.26 g/dL vs. 11.75 ± 0.79 g/dL; p = 0.042), and categorical anemia carried a significant risk correlation (p = 0.035). Chronic maternal anemia reduces systemic oxygen transport capacity, compromising placental oxygen delivery and leaving the fetus highly vulnerable to acute hypoxia during the stress of uterine contractions.

Among intrapartum complications, mechanical obstructed labor showed a powerful statistical correlation with birth asphyxia, affecting 32.35% of the asphyxiated cohort compared to 9.61% of non-asphyxiated infants (p < 0.001). This is closely tied to a prolonged second stage of labor, which also showed a highly significant association (p = 0.002). These findings are consistent with data from developing country settings[8,14], where limited access to timely obstetric interventions allows mechanical dystocia to progress, causing prolonged fetal cranial compression and umbilical cord occlusion. Additionally, pregnancy-induced toxemia (PET) showed a significant risk correlation (p = 0.016), matching patterns recorded in the Karbala series.[17] PET causes progressive spiral artery vasospasm and placental insufficiency, which compromises fetal metabolic reserve and increases risk during delivery.

Finally, the analysis of delivery modes revealed that 52.94% of asphyxiated neonates were delivered via Normal Vaginal Delivery, compared to an NVD rate of only 27.11% among non-asphyxiated infants (p = 0.002). Conversely, non-asphyxiated infants had a high rate of Cesarean section (72.29%). This indicates that Cesarean section was not a causative factor for asphyxia in this

setting; rather, the association was driven by emergency surgeries performed for indications like fetal distress, CPD, or failure to progress. These results suggest that timely, elective Cesarean sections may serve a protective role against birth asphyxia by avoiding the metabolic stress of a prolonged, complicated vaginal delivery.[18]

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS

Based on the prospective clinical data gathered in this study, the following conclusions are drawn:

1. The localized institutional frequency of birth asphyxia within the Al-Khansaa NCU was 17.0%, a figure driven by the unit's specialized role as a tertiary referral center that concentrates high-risk deliveries.
2. No significant statistical correlations were demonstrated between birth asphyxia and neonatal biological sex, absolute birth weight, or structural gestational age within the monitored cohort.
3. Maternal baseline socio-demographic indicators—including chronological age, parity, geographical residence, passive smoke exposure, and educational attainment—showed no statistical association with asphyxia risk.
4. Gestational maternal anemia was identified as a powerful predisposing factor, with significantly lower mean hemoglobin levels observed in the mothers of asphyxiated infants.
5. Mechanical obstructed labor, a prolonged second stage of labor, and pregnancy-induced toxemia (PET) were identified as the primary intrapartum risk factors driving birth asphyxia.
6. A significantly higher percentage of asphyxiated neonates were delivered via NVD, indicating that timely, structured utilization of Cesarean sections may offer protection against birth asphyxia in high-risk settings.

5.2 Recommendations

To reduce regional rates of birth asphyxia and improve neonatal outcomes, the following recommendations are proposed.

1. Expand Antenatal Surveillance: Establish comprehensive, high-quality antenatal screening networks to ensure early identification and management of gestational risk factors, including maternal anemia and pregnancy-induced toxemia.
2. Standardize Intrapartum Monitoring: Mandate the routine use of continuous electronic fetal heart rate monitoring via Cardiotocography (CTG), combined with fetal scalp pH microanalysis when indicated, to detect early intrapartum distress.
3. Enhance Obstetric Referral Pathways: Optimize clinical transport and referral networks to ensure that high-risk pregnancies and cases of mechanical dystocia are transferred to specialized tertiary centers before severe intrapartum injury occurs.
4. Provide Standardized Resuscitation Training: Implement continuous, mandatory training programs in neonatal resuscitation (e.g., NRP guidelines) for all physicians, midwives, and nursing staff working in delivery areas.
5. Deploy Neuroprotective Infrastructure: Invest in specialized equipment for therapeutic hypothermia (selective head cooling or whole-body cooling) within regional NCUs to help reduce mortality and long-term disability in infants with moderate-to-severe HIE.
6. Strengthen Public Health Education: Develop community-based health education campaigns to improve awareness of maternal nutrition, the importance of regular antenatal care, and the risks associated with prolonged home deliveries.

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