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Research Article

Incidence, Risk Factors and Outcome of Perinatal Asphyxia at a Tertiary Referral Center in Sierra Leone: A Case-Control Study

Irene Eseohe Akhigbe[1]*, Ronita Désirée Cornelia Luke[1], Nellie Valerie Tayo Bell[1], Amadu Sesay[2], and Haja Safiyatu Sovula[1]

[1]*Consultant Paediatrician, Ola During Children Hospital, University of Sierra Leone Teaching Hospital Complex, Sierra Leone*

[2]*Specialist Obstetrician and Gynaecologist, Princess Christian Maternal Hospital, University of Sierra Leone Teaching Hospital Complex, Sierra Leone*

***Corresponding author**

Irene Eseohe Akhigbe, Consultant Paediatrician and Neonatologist, Ola During Children Hospital, University of Sierra Leone Teaching Hospital Complex, Freetown, Sierra Leone

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Abstract

Background: Perinatal asphyxia is a leading cause of neonatal morbidity and mortality and it is responsible for about a third of neonatal deaths in Sierra Leone. Identifying and addressing the various risk factors associated with perinatal asphyxia could reduce this burden. This study was therefore done to determine the incidence, risk factors and outcome of perinatal asphyxia among neonates delivered at the Princess Christian Maternity Hospital, University of Sierra Leone Teaching Hospital Complex, Freetown, Sierra Leone.

Methods: This is a case control study, conducted from 1st May 2024 to 30th June 2024. Neonates diagnosed with perinatal asphyxia (Apgar score < 7 at 5th minute) were considered as "cases" (N = 110) while neonates born either with normal vaginal delivery or by cesarean section having no abnormality were considered as "control" (N = 110).

Results: The incidence rate of perinatal asphyxia was 7.60%. Young maternal age <18 years (p = 0.031), lower maternal educational status (p = 0.040), primigravidity (p = 0.028), primiparity (p = 0.007), abnormal amniotic fluid (p = <0.001), labour duration ≥ 12 hours (p = <0.001) and prolonged rupture of membranes ≥ 24 hours (p = 0.028), were related to the occurrence of perinatal asphyxia. Out of the 110 asphyxiated neonates, 7 died giving a case fatality of 3.4%.

Conclusion: Various risk factors led to the high incidence of perinatal asphyxia in this study. Improving the quality of antenatal care; labour monitoring; and strengthening capacity of healthcare workers on neonatal resuscitation, are crucial in reducing morbidity and mortality associated with perinatal asphyxia.

INTRODUCTION

The first month of life is the most fragile stage of child survival, with 2.3 million newborn deaths recorded globally in 2022 [1]. Sub-Saharan Africa bears the highest burden, with a neonatal mortality rate of 27 neonatal deaths per 1000 live births [1]. Approximately 75% of these deaths occur during the first week of life, and about 1 million newborns die within the first 24 hours predominantly due to premature births, birth complications, neonatal infections and congenital anomalies [1-3].

In Sierra Leone, the newborn mortality rate is 31 deaths per 1,000 live births, which represent a quarter of under-five deaths [4]. Prematurity-related complications, intrapartum-events (including perinatal asphyxia) and neonatal infections accounts for 80% of these deaths, most of which are preventable with timely and effective interventions [5].

Perinatal asphyxia alone, contributes to approximately one-third of neonatal deaths in Sierra Leone [5].The occurrence of asphyxia can be linked to antepartum, peripartum, and fetal risk factors [6]. In resource-limited settings, reducing its burden requires optimizing the management of these risk factors while ensuring preparedness for neonatal resuscitation at delivery [7].

Despite the significant impact of perinatal asphyxia, limited data exists on its associated risk factors in Sierra Leone. This study therefore aimed to evaluate the incidence, associated risk factors, and outcomes of perinatal asphyxia in a tertiary referral facility within Sierra Leone.

METHODOLOGY

Study location

The University of Sierra Leone teaching hospital complex consists of six hospitals which includes the Princess Christian Maternity Hospital (PCMH) and the Ola During Children Hospital (ODCH), in the capital city of Freetown, Sierra Leone. Both facilities are located within the same premises with PCMH serving as the tertiary referral hospital for Obstetrics and Gynaecology; and ODCH is the tertiary referral hospital for Paediatric care. Annually, over 8,000 deliveries occur in PCMH, and babies requiring in-hospital care are transferred to the neonatal unit of ODCH. This study was conducted at the delivery and neonatal units of PCMH and ODCH respectively.

Study design

This study was a prospective case control study, conducted from 1st May 2024 to 30th June 2024, using a non-probability sampling method.

Recruitment of study subject

The cases were newborns delivered at term and diagnosed of having perinatal asphyxia. Perinatal asphyxia was defined as babies who were unable to establish breathing at birth with one of the following criteria: Apgar score < 7 at the 5th minute and/or; the notion of resuscitation having lasted at least 10 minutes and/or; the presence of signs of early encephalopathy [8,9]. The controls represented newborns delivered directly after the birth of the cases and showed no signs of asphyxia. For each case included, one control was recruited. When two cases are consecutive, we took as controls the two newborns following these two with an Apgar score greater than 7. All newborns with Apgar < 7 but with a clinically detectable congenital defect and neonates born at home/ others facilities were excluded.

Data collection

A pre-tested survey form was used for data collection. Data on the condition of the newborn were collected from the birth examination. The socio-demographic factors of the mothers were noted and questions regarding possible risk factors were asked directly. Some parameters were obtained from obstetric and antenatal clinic (ANC) records. The parameters studied were frequency, socio-demographic characteristics (maternal age, education level, marital status), antepartum factors (gravidity, parity, ANC visits, use of long-lasting insecticidal nets, presence of fever in the third trimester of pregnancy, presence of chronic illnesses in the mother), intrapartum parameters (reason for admission, presentation of the fetus, appearance of the amniotic fluid, duration of labour), fetal factors (sex of the newborn, birth weight) and prognosis (Sarnat score, duration of resuscitation, outcomes of perinatal asphyxia). Sarnat's classification [10], into minor (I), moderate (II) and severe (III) neonatal encephalopathy are the most widely used. The data was collected by four trained resident doctors under the supervision of a senior paediatric resident on a daily basis. The investigators made a daily follow-up of the neonates in the neonatal unit to determine their admission outcomes.

Data analysis

Data was entered into the Statistical Package for Social Sciences (SPSS) version 25.0 for IBM electronic spreadsheet. Frequencies and percentages were calculated for categorical data. Risk factors for perinatal asphyxia were grouped into antepartum, intrapartum, and fetal variables. Odds ratio (OR) and confidence interval at 95% were used to evaluate the degree of association between these variables and the risk of asphyxia. Multivariate analysis with logistic regression was carried out, to look for independent association. The level of significance was set at p <0.05 in all the statistical analyses.

Ethical considerations

Permission for the study was obtained from the management and the research committee of the hospitals. Written informed consent (by signature or thumbprint) was obtained from those who volunteered.

RESULTS

The incidence rate of perinatal asphyxia among term babies was 7.60% (110/1448) during the period of this study.

Antepartum Risk Factors

The mean age of mothers was 24.90 ± 5.10 years for cases and 27.39 ± 4.21 years for controls. Maternal age less than 18 years (p = 0.031; OR = 2.634; 95% CI [1.042 – 2.661]), low educational status (p = 0.040; OR = 2.080; 95% CI [1.798 – 3.461]) primigravidity (p = 0.028; OR = 2.167; 95% CI [1.613 – 2.997]), and primiparity (p = 0.007; OR = 3.086; 95% CI [2.219 – 3.571]), were risk factors for the occurrence of antepartum perinatal asphyxia (Table 1).

Table 1: Distribution of maternal socio-demographic characteristics and antepartum risk factors for Perinatal asphyxia

Variables	Case(N=110)	Control(N=110)	OR	CI 95%	p-value
	n (%)	n (%)			
Age (years)					
< 18	8 (7.28)	2 (1.83)	2.634	1.042-2.661	0.031
18-29	73 (66.36)	72 (65.45)			
30-39	29 (26.36)	36 (32.72)			
Educational status					
No formal education	18 (16.36)	16 (14.55)	2.080	1.798-3.461	0.040
Primary	31 (28.18)	19 (17.27)			
Secondary	55 (50.00)	58 (52.73)			
Tertiary	6 (5.46)	17 (15.45)			
Gravidity					
<2	49 (44.55)	41 (37.27)	2.167	1.613-2.997	0.028
2-4	57 (51.82)	54 (49.09)			
≥5	4 (3.63)	15 (13.64)			
Marital status					
Single	49 (44.55)	38 (34.55)	1.522	0.884-2.622	0.084
Married	61 (55.45)	72 (65.45)			
Parity					
<2	68 (61.82)	45 (40.91)	3.086	2.219-3.571	0.007
≥2	42 (38.18)	65 (59.09)			
No. of ANC					
<4	37 (33.64)	26 (23.64)	1.638	0.906-2.9959	0.101
≥4	73 (66.36)	84 (76.36)			
ANC facility					
Private	0 (0.00)	3 (2.73)	0.748	0.415-1.350	0.164
Public tertiary/ secondary	75 (68.18)	78 (70.91)			
Public primary	35 (31.82)	29 (26.36)			
IPT					
Yes	100 (90.91)	92 (83.64)	1.957	0.859-4.457	0.106
No	10 (9.09)	18 (16.36)			
LLIN					
Yes	32 (29.09)	36 (32.73)	0.843	0.476-1.495	0.560
No	78 (70.91)	74 (67.27)			
Fever in 3rd trimester					
Yes	29 (26.36)	20 (18.18)	1.611	0.846-3.067	0.145
No	81 (73.64)	90 (81.82)			
Maternal chronic illness					
Yes	5 (4.55)	9 (8.18)	0.534	0.173-1.649	0.269
No	105 (95.45)	101 (91.82)			

Percentages add downward. Abbreviations: ANC: antenatal care; LLIN: Long-lasting insecticidal mosquito nets; IPT: intermittent preventive treatment for malaria

Intrapartum Risk Factors

Risk factors associated with the occurrence of intrapartum perinatal asphyxia were prolonged rupture of membranes ≥ 24 hours (p=0.028; OR = 2.494; CI 95% [1.080 – 5.756]), abnormal amniotic fluid (p= <0.001; OR = 9.905; CI 95% [4.560 – 12.514]), labour duration ≥ 12 hours (p=<0.001; OR = 3.343; CI 95% [2.182 – 5.123]) (Table 2).

Fetal Risk Factors

Birth weight (p=0.385; OR = 1.617; CI 95% [0.807 -3.242]) and gender (p=0.412; OR = 0.799; CI 95% [0.467 -1.367]) were not significantly associated with the risk for perinatal asphyxia (Table 3).

Table 2: Intrapartum risk factors for Perinatal asphyxia

Variables	Case(N=110)	Control(N=110)	OR	CI 95%	p-value
	n (%)	n (%)			
Referred mother					
Yes	54 (49.09)	45 (40.91)	0.718	0.421-1.224	0.223
No	56 (50.91)	65 (59.09)			
Type of presentation					
Cephalic	101 (91.82)	106 (96.36)	0.423	0.126-1.419	0.153
Breech	9 (8.18)	4 (3.64)			
PROM (hours)					
<24	90 (81.82)	101 (91.82)	2.494	1.080-5.756	0.028
≥24	20 (18.18)	9 (8.18)			
Amniotic fluid					
Normal	36 (30.91)	104 (95.55)	9.905	4.560-12.514	<0.001
Abnormal	76 (69.09)	6 (4.45)			
Labour duration(hour)					
<12	41 (37.27)	92 (83.64)	3.343	2.182-5.123	<0.001
≥12	69 (62.73)	18 (16.36)			
Mode of delivery					
Spontaneous vaginal	59 (53.64)	67 (60.91)	1.227	0.735-2.048	0.502
Caesarean	49 (44.56)	42 (38.18)			
Assisted delivery	2 (1.80)	1 (0.91)			

Percentages add downward. Abbreviations: PROM: Prolonged rupture of membranes

Multivariate Analysis

In multivariate analysis, maternal level of education (p = 0.048; OR = 1.110; 95% CI [0.432 – 2.855]), primigravidity (p = 0.008; OR = 3.896; 95% CI [1.161 – 13.073]), primiparity (p = 0.002; OR = 3.804; 95% CI [1.646 – 11.698]), abnormal amniotic fluid (p < 0.001; OR = 4.044; 95% CI [3.017 – 6.114]), long labour duration (p = 0.012; OR = 1.353; 95% CI [1.159 - 5.788]), were statistically associated with perinatal asphyxia (Table 4).

Outcomes of Perinatal asphyxia

Out of the 110 cases of perinatal asphyxia, 103 (96.6%) were discharged, while 7 (3.4%) died. The apgar score was ≤3 at the 5th minute for all babies that died. Amongst the asphyxiated neonates in this study, 42 (38.18%) developed HIE with 13 (30.95%) having mild HIE, 17 (40.48%) had moderate HIE, and 12 (28.57%) had severe HIE (Table 5). Eighty-eight (80%) of the asphyxiated neonates stayed less than 7 days in the hospital, 18 (16.4%) between 7 and 10 days, and 4 (3.6%) more than 10 days.

Table 3: Fetal risk factors for Perinatal asphyxia

Variables	Case(N=110)	Control(N=110)	OR	CI 95%	p-value
	n (%)	n (%)			
Gender					
Male	61 (55.45)	67 (60.91)	0.799	0.467-1.367	0.412
Female	49 (44.55)	43 (39.09)			
Birth weight (grams)					
<2500	18 (16.36)	12 (10.91)	1.617	0.807-3.242	0.385
2500-3999	90 (81.82)	93 (84.55)			
≥4000	2 (1.82)	4 (4.54)			

Percentages add downward.

Table 4: Multivariate analysis of risk factors for Perinatal asphyxia

Variables	OR	CI 95%	p-value
Maternal age	0.908	0.454-1.815	0.358
Educational status	1.110	0.432-2.855	0.048
Parity	3.804	1.646-11.698	0.002
Gravidity	3.896	1.161-13.073	0.008
PROM	1.585	0.520-4.828	0.421
Labour duration	1.353	1.159-5.788	0.012
Amniotic fluid	4.044	3.017-6.114	<0.001

PROM: Prolonged rupture of membranes

Table 5: Sarnat stage among Perinatal asphyxia cases

	Alive (N=35)	Dead (N=7)	p-value
	n (%)	n (%)	
Sarnat I	13 (37.14)	0 (0.00)	<0.001
Sarnat II	17 (48.57)	0 (0.00)	
Sarnat III	5 (14.29)	7 (100.00)	

Percentages add downward.

DISCUSSION

The incidence of perinatal asphyxia varies within the West African sub-region. We report an incidence of 7.60% which is comparable to the 8.00% from a study in Cameroon [11], but higher than 4.50%, 4.85% and 5.1% reported from Benin [12], Niger [13], and Chad [14], respectively. Authors from Nigeria [15], (12.60%) and Burkina Faso [16], (19.80%) have recorded even higher incidence of perinatal asphyxia. Differences across studies may reflect varying methodologies and diagnostic criteria employed. Conversely, in high income countries [17,18], where advanced scientific approaches are used in identifying cases of perinatal asphyxia, a significantly low incidence of less than 1% was reported, implying the possibility of overestimating the number of perinatal asphyxia cases in resource-limited settings.

Young maternal age (<18years), lower educational status, primigravidity and primiparity were significant antepartum risk factors, as corroborated by previous studies [14,19-22]. The combination of a low weight before pregnancy, inadequate prenatal care, ignorance of early danger signs, and cephalo-pelvic disproportion which could make deliveries more difficult and prolonged, could explain our findings [14,19-22]. Although the level of ANC facility and number of ANC visits could ensure prevention, early detection and treatment of obstetric complications, and preparation for delivery [2,3,23], these factors were not significantly associated with the occurrence of perinatal asphyxia in our study. This finding underscores the importance of up scaling the quality of pregnancy monitoring and having qualified personnel and adequate equipment in peripheral health facilities to deal with emergency obstetric and neonatal care.

Similar to other studies [7,8,12,24], intrapartum complications-particularly prolonged labour, prolonged rupture of membranes, and abnormal amniotic fluid-emerged as strong predictors for perinatal asphyxia, highlighting the importance of timely obstetric intervention. The most common complications of prolonged rupture of membrane are amnionitis and endometritis, which increases the risk of infection in-utero leading to hypoxia and thus perinatal asphyxia [25]. Additionally, therapeutic interventions for prolong labour can cause excessive contractions and reduce placenta blood supply resulting in fetal hypoxia, increased intestinal peristalsis and relaxation of the anal sphincter with emission of meconium into the amniotic fluid [17,26,27].

Sexual hormones, particularly oestrogens, are thought to protect female newborns more effectively against anoxo-ischaemic lesions [28]. Although the majority of asphyxiated neonates in our study were males (55.5%), we did not demonstrate any significant association between gender and perinatal asphyxia comparable to previous studies [18,29]. On the contrary, Ilah et al. [30], reported a female predominance without a statistically significant difference.

In our study, out of the 110 asphyxiated neonates, 7 died giving a case fatality of 3.4%. All those who died had severe asphyxia. This aligns with the direct relationship between the severity of asphyxia and death [31]. This case fatality is similar to the 4.2% reported by Douba et al. [29], and 5.4% by Monebenimp et al. [32], but lower than 24.7% and 25.5% observed by Kaye [33], and Ilah et al. [30], respectively. This perinatal asphyxia-related mortality is attributable to the lack of optimal means of care such as advance respiratory supports, parenteral nutrition, and laboratory or imaging studies; whose beneficial effects are well known [34].

CONCLUSION

There is a high incidence of perinatal asphyxia similar to findings within sub-Saharan Africa. Young maternal age, primigravidity, prolong rupture of membranes and

prolong labour were among the identified risk factors. Improving the quality of antenatal care; labour monitoring; and strengthening capacity of healthcare workers on neonatal resuscitation are crucial in reducing morbidity and mortality associated with perinatal asphyxia.

LIMITATIONS

This study was conducted in a referral facility that manages high-risk deliveries, limiting generalizability of study findings. Additionally, reliance on Apgar scores for diagnosis may overestimate the number of cases, as biochemical confirmation (scalp and cord pH, base deficiency and lactate levels) was unavailable. Further studies in primary and secondary health facilities, including long-term outcomes of asphyxiated neonates, are recommended.

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AUTHOR CONTRIBUTIONS

All authors made substantial contributions to the conception and design of the study, acquisition of data, or data analysis and interpretation, took part in drafting the article or revising it critically for important intellectual content, gave final approval of the version to be published, and agree to be accountable for all aspects of the work.

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