Prevalence, case fatality rate and risk factors for mortality among neonates admitted with perinatal asphyxia at a tertiary hospital in northern Nigeria

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Abstract

Documenting the burden and the risk factors for perinatal asphyxia-related mortality is key to its prevention. The goal was to document the factors associated with mortality in perinatal asphyxia in a tertiary health facility in Nigeria. Records of consecutive neonatal admissions (between January 2016 and January 2017) underwent a retrospective analysis. Data were analyzed using Stata statistical software version 16 (Statacorp® Texas, USA). 102 (12.1%) of 841 admitted neonates had perinatal asphyxia; the median age (inter quartile range [IQR]) was 6 (0-168) hours. The mean admission weight ±(SD) was 2.96kg±(0.66) kg. Among inborn neonates, the incidence was 9.7 per 1000 live births. In 49% (50/102) pregnancies the amniotic fluid was clear; in 42% (43/102) it was meconium-stained; and 9 staining was unreported. Case fatality rate was 20.6% (21 of 102). 77(75%) neonates had no HIE, while 24 (24.5%) did. When compared to neonates without HIE, those with HIE II had about 7000 times higher odds of mortality (aOR = 68132.19, P0.01, 95% CI 3 to 1.4X 109). The adjusted odds of mortality for neonate with meconium-stained liquor were about 1900 times higher compared to clear meconium (aOR =1895, P = 0.02, 95%CI = 2.7 to 13072). Neonates with higher mean admission lengths (49.4cm [range = 48.8 to 50]) had 88 times lower odds of death compared to shorter neonates (aOR of 0.12 (95% CI: 0.17 to 0.85; p = 0.03).

Introduction

Neonatal mortality continues to be a leading contributor to infant mortality rate in Low and-Middle Income Countries (LMICs).[1,2] Despite a substantial reduction in other childhood mortality indices, all-cause neonatal mortality had the slowest decline over the past 10 decades.[3] One of the leading causes of neonatal mortality in these settings is acute intrapartum related events, traditionally called birth asphyxia or perinatal asphyxia,[2] which occurs when ischemia and hypoxemia affect the fetus before, during delivery or in the immediate postnatal period.[4] Decrease perfusion and hypoxemia affects all systems organs of the body.[5] At the cellular level, cells adapt to low oxygen supply by switching to anaerobic metabolism, the end product of which is the production of lactic acid.[5] The hallmark of asphyxia is metabolic acidosis and oxidative stress.[5,6] Apgar score is a useful tool to assess the response to resuscitation,[7] it is considered as a non-specific sign of illness in the newborn.[8] However, population based studies documented a strong association between low Apgar score at 5 minutes and cerebral palsy at 5 years of age.[9] In LMIC it is used as a surrogate marker of asphyxia due to lack of adequate facilities for fetal scalp or cord blood sampling for blood gas analysis.[7] Therefore, perinatal asphyxia is defined as an infant having at least one of the following: 5th minute Apgar score of ≤ 5, the need for resuscitation at birth for more than 10 minutes and/or the presence of metabolic acidosis (pH≤7.0 or a cord blood base deficit of ≤-12 mmol/L within an hour of birth).[4,8,10]

Clinically, widespread end-organ affectation of varying severities occurs depending on the duration and extent of the insult.[4] Most vulnerable organs are the brain, heart, kidney and lungs[5]. Affectation of the brain leads to hypoxic-ischemic encephalopathy (HIE), which ranges from mild to severe. Furthermore, some neonates die as a result of the complications[1,11,12,13] and survivors are left with lifelong neurocognitive disabilities.[14]

About 96% of all global cases of perinatal asphyxia occur in LMICs particularly the sub-Saharan Africa.[1-3] In these regions, there is inadequate population-level information on the prevalence of perinatal asphyxia.[2] It is the leading cause of neonatal admissions in Nigeria, accounting for 12.5% to 25% of all newborn admissions.[15-18] Regional variation in prevalence exists and is higher in the north and rural areas, perhaps reflecting the skewed distribution of skilled birth attendants and health facility delivery practices. High frequency of home deliveries, inadequate antenatal care, inade-

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Ethics approval and consent to participate: The Ethics Committee of Aminu Kano Teaching Hospital approved this study (AKTH/MAC/SUB/12A/P-3/08/IV/1490). The study is conformed with the Helsinki Declaration of 1964, as revised in 2013, concerning human and animal rights. All patients participating in this study signed a written informed consent form for participating in this study.

Informed consent: It was a retrospective review of admission records, therefore informed consent was obtained where the patients could be reached, from a legally authorized representative(s) for anonymized patient information to be published in this article.

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quate number of skilled personnel, inadequate fetal monitoring during labor, birth attendant unskilled at neonatal resuscitation and out of pocket health expenditure are some of the underlying causes of perinatal asphyxia.[12,18] Others cite sociocultural factors related to birth practices and newborn care contributing to the high prevalence of perinatal asphyxia.[19] This makes it necessary to describe the burden, document the specific factors associated with perinatal asphyxia and its case fatality rate in our environment where these practices are societal traditions. This would help in identifying opportunities for the prevention of morbidity and improvement of survival.

The objective of this study therefore was, to describe the prevalence of perinatal asphyxia, its case fatality rate and risk factors associated with HIE and mortality at a referral teaching hospital in northern, Nigeria.

Materials and Methods

Research setting

This was a retrospective study of patients admitted to Special Care Baby Unit (SCBU) of Aminu Kano Teaching Hospital (AKTH) between January 2016, to January 2017. AKTH is a tertiary health center located in Kano, northern in Nigeria. Its newborn unit has a 40-bed capacity and an average annual neonatal admission of between 1200 and 1400. The unit serves a population of 20 million people with a fertility rate of 6.7 per woman.[20] Within this setting, the protocol for managing perinatal asphyxia is mainly supportive including resuscitation, provision of oxygen, seizure control, management of raised intracranial pressure, judicious fluid and electrolyte maintenance. There is no facility for cooling.

Eligibility criteria

The record of all the consecutive full-term neonates admitted into the SCBU with the diagnosis of asphyxia during the study period were retrieved from the admission register. Facility protocol for the diagnosis of perinatal asphyxia was an Apgar score of <7 at 5 minutes, the need for resuscitation at birth, or failure to initiate and sustain respiration for neonates born at home according to the World Health Organization (WHO) protocol.[21] We excluded any neonate who was recorded to have major congenital malformation such as congenital hydrocephalus, neural tube defect, microcephaly, dysmorphic facies, symptomatic congenital heart disease, and major abdominal wall defects like gastroscheisis.

Exposure variables

Relevant information including maternal age, educational level, parity, mother's antenatal care parameters (unbooked, booked-place of antenatal care, number of antenatal visits), place of delivery, duration of labor, fetal presentation, mode of delivery, meconium staining of liquor, Apgar score at 5 minutes, presence of HIE as diagnosed using the Sarnat and Sarnat[22] classification done at admission were extracted. The infant's age, weight and lengths at admission were also extracted.

Outcome variable(s)

The primary outcome of interest was mortality defined as death during current admission and the secondary outcome was the presence of HIE.

Data collection

Two research assistants collected the data (qualifications were MBBS degree holders who have completed a one-year internship). They had a week training on all relevant data extraction methods. A specifically developed Case Report Form (CRF) for the purpose of the study was the tool used to collect data. Relevant information was extracted from the unit register and retrieved patients' records. The lead author provided supportive supervision of the data collection process.

The Human Research Ethics Committee of Aminu Kano Teaching Hospital approved the study.

Sample size considerations

All available consecutive SCBU admission and delivery records over 13 months period were included.

Data analysis

Data were entered into an excel spreadsheet, cleaned and imported into Stata statistical software version 16, Statacorp® Texas USA and summarized by descriptive statistics. Normally distributed continuous variables (weight (sktest; p=0.49) and length (sktest; p=0.06) were summarized by means and standard deviation. Skewed data were summarized; infant age (sktest p≤0.001) and maternal age (sktest <0.001) by median and interquartile range. Categorical variables were analyzed for statistical significance (p<0.05) by Chi-square test or Fisher exact test. We compared means of continuous variables; infant weight, infant length using the Student t-test categorized by the outcome. A multiple logistic regression model was developed to test for factors that predict mortality adjusting for confounders. All variables with a p-value of 0.25 or less at the univariate level were included in the model in a stepwise fashion. From the final model, we reported the adjusted odds ratios (aOR) and 95% confidence intervals.

Results

Descriptive statistics

Neonatal characteristics

A total of 841 neonates were admitted into the SCBU during the study period, 34% (n=286) were born at AKTH and 66% n=555) were referred. Of these 102 (12.1%) neonates had admission diagnosis of perinatal asphyxia, with M: F (1.4:1), 41.5% (n=42) were inborn and 58.5% (n=60) were out born. There were 4550 deliveries at AKTH during the study period, of these 200 were stillbirths and 4350 were live birth. The incidence was 9.7 per 1000 live birth among inborn babies. The median (inter quartile range [IQR]) age at presentation for neonates was 6 (0- 168) hours. The mean admission weight ± (SD) was 2.96kg± (0.66) kg and weights ranged from 1.4 to 5.00 kg. The mean admission length ± (SD) was 49±(2.7)cm. Approximately three-quarters of the neonates (77.5%, n=79/102) presented to our unit within the first 6 hours of life. Nine (8.82%) presented between 25 to 48 hours of life, while 14 (13.73%) were admitted at age ≥72 hours. Twenty-five neonates (24.5%) had HIE at presentation while 77 (75%) had no encephalopathy. Of the 25 neonates with HIE, 11(10.8%) had HIE I, 12(11.8%) HIE II, 2(1.96%) HIE III.

Maternal characteristics

Eighty-four (82%) mothers booked for antenatal care (ANC) while 18 (17.7%) were un-booked. The mean±(SD) number of ANC visit was 6± 2.3. Of those that were booked, 60%(82) and 20%(20) visited tertiary and secondary health facilities respectively for their ANC. Almost half (49%, n=50) of the mothers were primipara, while 52 (51%) were multipara. Seventy-four (73%) and 24(23%) of the mothers acquired secondary and tertiary level education, respectively. There was no prescribed medication other than routine ANC drugs use in 91% (n=93/102) of mothers, while only 8% (n=8) and 1% (n=1) had sedatives and non-prescribed drug-use respectively. The majority (75%) of labor lasted 4-12hours. Ninety-one per cent (93/102) of mothers delivered in a health facility while 9% (n=9/102) delivered at home. About 44% of those delivered at home presented to the hospital late after 48 hours of delivery. Mode of delivery was vaginal in 87 (85%) and most (94%) presentation was cephalic.

The amniotic fluid was clear in 49% (n= 50), meconium-stained in 42% (n=43), and a few (9%, n= 9) were home deliveries thus the nature of the liquor stain was not documented. The sociodemographic characteristic of the mother/infant dyad is shown in Table 1.

Case-specific fatality rate of perinatal asphyxia

The case fatality rate due to perinatal asphyxia was 20.6% (21 of 102).

Risk factors for HIE

Table 2 shows the risk factors for HIE. Of the 25 neonates with HIE, 11(10.78%) had HIE I, 12(11.8%) HIE II and 2(1.96%) had HIE III. A significantly higher proportion 84% (n=68) of neonates without HIE survived compared to 16% (n=13) of those with HIE.

Risk factors for mortality

Of the 21 neonates that died, 2(9.5%) had HIE I, 8(38.1%) had HIE II, 2(9.5%) had HIE III, while 9(42%) had no HIE. Table 3 shows the risk factors for mortality. HIE was significantly associated with mortality (X^2 = 27.07, p<0.01.), APGAR score of 0-3 at 5 minute (X^2 = 8.3, p=<0.01), and lower mean infant length of 47.86cm± SD 2.9 range (46.5-49.2) p=0.01were significantly associated with mortality on univariate level (as shown on Table 2). On multivariate analysis, the odds of mortality was almost 7000 times greater in neonates with HIE II (aOR=6813, 95% CI 3 to 1.4X 10^9), compared to neonates with HIE I, and normal length (aOR=0.12, 95% CI=0.17 to 0.85). The adjusted odds of mortality in neonates with meconium stained liquor was about 1900 times higher compared to neonates born via clear liquor (aOR =1895, 95%CI 2.7 to 13072) as shown in Table 2.

Discussion

Around 12% of newborns admitted had a diagnosis of asphyxia. The case fatality rate in this group was 20.6% and significant risk factors for mortality were delivery via meconium-stained amniotic fluids, lower birth length and the presence of HIE.

The prevalence of asphyxia in this study was similar to finding from Abuja, Nigeria where a prevalence of 12.3% was reported.[23] It is lower compared to findings from Ethiopia and Gusau, Nigeria,[24, 25] and was significantly higher than that from an Italian study.[26] Even, higher prevalence compared to this study was reported from rural Nigeria.[27,28] It is conceivable that the prevalence could be much higher if neonates from rural areas are adequately represented in this data. The higher prevalence among the inborn babies could be because our hospital is a fee-paying facility where out of pocket payment by patients is the norm. A large proportion of the population are poor,[29] consequently, many referred out born babies might not be able to afford care at our facility or might have died in the community. The incidence among the inborn was also high 9.7/1000 live birth. The in-hospital incidence rate is lower than that reported by Ekwochi from South-eastern Nigeria with an incidence of 12/1000 livebirth. The majority of the mothers in this study had ANC, with 60% accessing care at a tertiary health facility. Similar observations were reported from Makurdi north-central Nigeria.[15] The reason for this observation could be because the causes of the asphyxia might have been acute intrapartum or peripartum events rather than a protracted problem that could have been identified during ANC. Alternatively, this finding could be a reflection of the quality of ANC in our environment. Even though a great majority of the mothers delivered at a health facility, their neonates had perinatal asphyxia; perhaps this is an indication of inadequate monitoring of fetal wellbeing during labor. Cardiotocography (CTG) is an important tool that is used to monitor the fetus in labor.[30- 34] CTG is however only available in some tertiary centers in LMIC. There is therefore the need to make such important tool available, assessable and affordable in most areas of developing countries. Furthermore, simple antepartum fetal surveillance for example counting of fetal quickening and intermittent auscultations that can be done during ANC, are proven to improve fetal survival and may be protective against adverse fetal and neonatal outcomes.[34,35] Perhaps inadequate emergency preparedness for neonatal resuscitation in Kano might be responsible for the observed high prevalence of asphyxia in hospital delivered neonates.[36] This is an environment where reportedly only about 5% of health care providers have adequate knowledge and practice on neonatal resuscitation and less than half of the facilities conducting delivery had adequate emergency preparation for neonatal resuscitation.[36] This is indicative of an urgent need for capacity building of health care

Table 1. Maternal and personal characteristics of the neonates in the study.

Summary	Mean± SD	Range
Age (hours) (Median IQR)	6	0-168
Weight (kg)	2.95 ± 0.66	1.4-5
Length(cm)	49.11 ± 2.79	40-56
Maternal age (Median IQR)	25	16-44
Variable	**n**	**%**
Parity		
Multi para	52	51.0
Primipara	50	49.0
Ethnicity		
Hausa	65	63.7
Yoruba	13	12.8
Ibo	13	12.8
Others	11	10.8
Address		
Urban	92	90.2
Rural	10	9.8
Maternal education		
Primary or None	4	3.92
Secondary	74	72.6
Tertiary	24	23.5
ANC		
Yes	84	82.4
No	18	17.7
Labour duration		
Prolonged	25	24.8
Not prolonged	76	75.3
Place of delivery		
Health Facility	93	91.2
Home	9	8.8
Not prolonged	76	75.3
Presentation		
Breech	6	5.9
Cephalic	96	94.1

providers on emergency preparedness and neonatal resuscitation.

HIE complicated perinatal asphyxia in 16% of cases, in contrast, Ochoga *et al*.[16] reported a higher proportion of neonates with HIE (47%) and Locatelli *et al.*[26] in Italy reported only 1.1% of neonates developed HIE. The majority of those with HIE had Sarnat stage II. Similar findings were reported by many studies from Nigeria.[16,17,23,25,37,38]

The in-hospital case fatality rate was 20.6% this is similar to a study reported by Idris et al in Kebbi, Nigeria.[28] In contrast, our findings were lower than that of Ilah *et al.*[5] who documented a case fatality rate of 25% but higher than reported Ogunkunle *et al.*[17] with a case fatality rate of 14.7%. Our tertiary facility receives referral of the most-sick newborns and complicated labour from several hospitals, unlike the site in the Ogunkunle *et al.* study, hence the higher case-fatality rate in our cohort. The relatively lower case fatality rate in this study compared to the Ilah study could be because a higher proportion of the mothers in this study had ANC, whereas a lower proportion of ANC was documented in the Ilah study, by inference the fetal monitoring was relatively better among the mothers in this study compared to the Ilah study, hence relatively lower case fatality. Our high case fatality rate might be suggestive of poor neonatal resuscitation at birth. Suboptimal care is an important factor for encephalopathy and mortality.[39,40] A study in Nigeria found that the majority of neonates with asphyxia had poor quality care and had a delay in deciding to present at the appropriate health facility.[41] The findings from our study provide further evidence of an urgent need to implement root cause analysis of an adverse obstetric event at all three tiers of the health care system. This has been proven to improve care and prevent complications and death.[42] Such measures as judicious use of partograph for fetal wellbeing monitoring, the use of protocols on birth preparedness and essential newborn care are appropriate interventions that need to be implemented with fidelity.

The odds of death were a thousand-fold greater in neonates that had HIE. This is in contrast to findings from other Nigerian

Table 2. Crude odds ratio adjusted odds ratio and 95% confidence interval of risk factors for Hypoxic Ischemic Encephalopathy (HIE) among neonates in the study.

	Outcome N= 102		Unadjusted OR	Adjusted OR	95% CI	P
Variable	Neonates with HIE	Neonates with No HIE	X^2; p			
Address			3.59; 0.06			
Urban	25 (27.17)	67 (72.83)				
Rural	0 (0.00)	10 (100)				
Labour			0.01;0.91			
Prolonged	6 (24)	19 (25)		0.59	0.16-2.13	0.42
Not prolonged	19 (25)	60 (75)				
Place of Delivery			0.42; 0.51			
Health Facility	22 (23)	71 (76.3)				
Home	3 (3.3)	6 (66.7)				
Mode of delivery			0.04; 0.83			
SVD	21 (24.14)	66 (75.86)		0.72	0.17-3.00	0.66
C/Section	4 (26.67)	11 (73.33)				
Presenting part			0.2; 0.65			
Cephalic	24 (25.0)	72 (75.00)				
Breech	1 (16.7)	5 (83.33)				
Parity			0.64; 0.42			
Multipara	11 (21.15)	41 (78.85)				
Primipara	14 (28.00)	36 (72.00)				
Mothers Education			1.5; 0.47			
Primary or less	2 (50)	2 (50)				
Secondary	17 (22.9)	57 (77.03)				
Tertiary	6 (25)	18 (75)				
Organ dysfunction			12.28; <0.01	5.8	1.718.57	<0.01
Present	12 (52.17)	11 (87.65)				
Absent	13 (47.8)	66 (83.54)				
Mean ± SD (95%CI)		t test; p				
Maternal age in years (years)	HIE	No HIE	0.85			
	26.52±8.35 (23.07-29.96)	26.87±8.02 (25.04-28.69)				
Infant weight in (kg)	2.9±0.6 (2.7-3.1)	3.0± 0.64 (2.9-3.1)	0.86			
Infant length in (cm)	49.72±2.6 (48.6-50.81)	48.90± 2.8 (48.26-49.55)	0.21	0.84	0.66-1.04	0.12
APGAR SCORE 5th Minute			1.6; <0.21	4.79	0.43-53.00	0.20
0-3	2 (50)	2 (50)				
4-7	28 (22.47)	69 (77.53)				
Amniotic fluid						
Meconium stained	12 (20)	31 (72.09)	0.8; 0.37	0.8	0.26-2.44	0.71
Clear	10 (23.33)	40 (80.00)				
ANC			0.13; 0.72			
Yes	20 (23.81)					
No	5 (27.78)					

studies where HIE was not significantly associated with mortality.[43] Having HIE signifies more severe forms of asphyxia. The higher deaths among this group might relate severity of the insult and the absence of robust protocols for managing HIE including equipment for head and whole-body cooling. About two-third of these neonates where admitted before 6 hours of age and could have benefitted from cooling. However, cooling has not shown consisted outcomes especially from LMIC.[44]

Three-quarters of neonates with an Apgar score of 0-3 at the 5th minute died, this was significantly associated with an increase in death at the univariate level, which is similar to findings by Casey *et al.*[45] who found a significant increase of mortality within 28 days of life in neonates with 5 minute Apgar score of 0-3, compared to less than 1% in those with a score of 4-6.[43] However, the Apgar score was not found to be a predictor of death at the multivariate level after adjusting for confounders. The subjectivity of the Apgar score and its low predictive value might explain this observation.[45,46]

Meconium staining of the liquor was associated with an exponential (1800 times) rate increase in the odds of death among the cohorts in this study. Several studies have reported an association between meconium staining of the liquor and adverse neonatal outcomes including death.[47,48] Similar to this finding Mehta et al found the risk for perinatal asphyxia to be 9.6 times more among neonates with meconium stained liquor. Underlying conditions that cause meconium stain liquor are also the causes of asphyxia; notably placental insufficiency and eclampsia.[50]

Studies have shown neonatal anthropometry particularly weight is associated with a four-fold increase in odds of asphyxia, HIE and mortality among small for gestational infants.[51] Although we did not observe weight to be associated with increased mortality, we showed that infant length was associated with increased mortality. Neonates with higher mean admission lengths (49 cm or more) were 88 times less likely to die compared with fetuses with lower mean length on admission. The length of the neonates is less likely to

Table 3. Crude odds ratio adjusted odds ratio and 95% confidence interval of risk factors for death among neonates in the study.

		Outcome	Unadjusted OR	Adjusted OR	95% CI	P
Variable	Neonates who died	Neonates who survived Alive	X2; p			
HIE			27.07; < 0.01			
HIE 1	2 (9.52)	9 (11.11)				
HIE 2	8 (38.10)	4 (4.94)		68132.19	3-1.4X 109	0.03
HIE 3	2 (9.52)	0 (0)				
NO HIE	9 (42.86	68 (83.95)		0.0002	6.2x 108 -0.9	0.05
ANC			0.69; 0.41			
Yes	16 (76.19)	68 (83.95)		0.46	0.03-5.7	0.55
No	5 (23.81)	13 (16.05)				
Labour			0.01;0. 91	2.2	0.07-75	0.66
Prolonged	5 (23.81)	20 (25)				
Not prolonged	16 (76.19)	60 (75)				
Place of Delivery			0.98; 0.32			
Health Facility	18 (85.71)	75 (92.59)				
Home	3 (14.21)	6 (7.41)				
Mode of delivery			0.39; 0.53			
SVD	17 (80.95)	70 (86.42)		23	0.31-1812	0.15
C/Section	4 (19.05)	11 (13.58)				
Presenting part			0.63; 0.43			
Cephalic	19 (90.48)	77 (95.06)				
Breech	2 (9.52)	4 (4.94)				
Parity			3.29; 0.07			
Multipara	7 (33.33)	45 (55.56)				
Primipara	14 (66. 67)	36 (44.44)		23	0.16-3523	0.22
Mothers Education			1; 0.58			
Primary or less	0 (0)	4 (4.94)				
Secondary	16 (76.19)	58 (71.60)		1.2 x108	0	0.99
Tertiary	5 (23.81)	19 (23.46)		7414713	0	0.99
Address			2.9; 0.09			
Urban	20 (100)	71 (87.65)				
Rural	0 (0)	12 (10.45)				
Mean ± SD (95%CI)		t test; p				
Maternal age(years)	Dead	Alive	0.11	0.79	0.55-1.15	0.23
	24.8±7.9 (20.9-28.7)	27.3±8.5 (25.5-29)				
Infant weight(kg)	2.8±0.7 (2.5-3.1)	3.0± 0.64 (2.9-3.1)	0.09	0.16	0.01-2.60	0.19
Infant length	47.86±2.9 (46.5-49.2)	49.4± 2.7 (48.8-50)	0.01	0.12	0.17-0.85	0.03*
APGAR SCORE 5th Minute			8.3; <0.01			
0-3	3 (75)	1 (25)		0.07	0.00-38.89	0.42
4-7	15 (16.85)	74 (83.15)				
Amniotic fluid						
Meconium stained	12 (66.67)	31 (41.33)	3.7; 0.05	1895	2.7-1307210	0.02
Clear	6 (23.33)	44 (58.67)				

change significantly within a few days of birth unlike the weight, and therefore would be a better index of fetal growth in this cohort. Hence this finding suggests that intrauterine restriction of growth is associated with an increase in mortality among neonates with asphyxia.

Mode of delivery, duration of labour place of delivery were not predictors of mortality.

Limitation

Our study was retrospective and as such made use of neonatal unit records. Retrospective studies are highly dependent on the quality of underlying data, case files and the newborn admission register there were few missing information.

We could not make definitive diagnosis of asphyxia in our study using blood gas analysis. This is a well-known challenge of many resource-constrained settings, thus we used a well-documented proxy measure recognized by the WHO and which has also been used by previous studies.[16]

Conclusions

Case fatality rates among newborn infants with asphyxia is high in our setting and the presence of HIE, meconium aspiration and low admission length as significant factors associated with this. Strengthening the capacity of health facilities on fetal monitoring during labour and emergency preparedness and improving the health workers skills on neonatal resuscitation would help reduce rate of asphyxia and improve survival.

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