ORIGINAL ARTICLE
A 5-YEAR AUDIT OF NEONATAL MORTALITY AT FEDERAL TEACHING HOSPITAL, IDO-EKITI, SOUTHWEST NIGERIA.

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ABSTRACT

Background: *The newborn period is the most vulnerable period of child survival. Sub-Saharan Africa as a region has the highest neonatal mortality rate in the world, and Nigeria has the highest neonatal mortality rate in the region.*

Objectives*: We aimed to identify the common causes of neonatal mortality and determine the predictors of neonatal mortality in Federal Teaching hospital Ido-Ekiti (FETHI), Nigeria.*

Methods: *We did a retrospective review of admitted newborns records from January 2013 to December 2017. Information was extracted on the maternal, sociodemographic and the neonatal characteristics of the participants and the results were analyzed.*

Results: *A total of 1236 babies were admitted in the neonatal ward during the study period out of which 110 babies died giving a neonatal mortality rate of 8.9 % in the hospital. Of the 110 babies that died, 65 (59.1%) were males and 45 (40.1%) were females. Early neonatal mortality constituted 75.5% of the mortalities while late neonatal mortality was 24.5%. The primary diagnoses as causes of neonatal mortality were neonatal sepsis (32.7%), perinatal asphyxia (26.3%) and complications of prematurity (22.7%).Binary logistic regression analysis of selected neonatal characteristics showed that prematurity, low birth weight and the age on admission were the statistically significant predictors of neonatal mortality in the hospital ($p<0.01$).*

Conclusion: *Neonatal mortality rate is still high. Neonatal sepsis, perinatal asphyxia and complications of prematurity were the leading causes of neonatal deaths seen during the study period in our hospital. There is a need to improve on the strategies for better neonatal survival.*

KEYWORDS: ***neonatal mortality, cause of death, predictors, South-West Nigeria***

INTRODUCTION

The neonatal period represents a very vulnerable phase of life when there are substantial risks of acquiring potentially life-threatening diseases. The complexity of the various adaptive processes which the newborn undergoes during the first few days of life may unduly put the newborn at risk of dying.[1,2] Globally, about four million neonatal deaths occur each year with more than 90% of these deaths occurring in sub-Saharan Africa with Nigeria having a high rate of 39 per 1000 live birth replace with. This is higher than that of the African region as a whole as at 2018 (27 per 1000).[3,4]

This high neonatal mortality rate has unfortunately not improved significantly over the years in Nigeria. It stagnated at 41/1000 live births between 1990 and 2013 [5] and thereafter, there was a marginal reduction of the neonatal mortality rate to the present rate of 39/1000 in 2018.[5] These rates are actually tips of the iceberg as many neonatal births and deaths in the communities are undocumented and unreported.[6] Even though several international and national programs for example the Integrated Maternal, Newborn and Child Health (IMNCH) in 2016, IMNCH 2 in 2018, Helping Babies Breathe (HBB), Kangaroo Mother Care (KMC), maternal steroid administration, and recently Essential Newborn Care (ENC) were introduced and implemented to improve perinatal and immediate neonatal care, neonatal mortality rates have not shown significant improvement; neonatal mortality rate has consistently lagged behind the substantial progress in infant mortality rate such that neonatal mortality still contributes about 47% of under-5 mortality in Nigeria.[5,6]

While data on the overall statistics of newborn mortality are generally available from Nigeria Demographic and Health Survey (NDHS) and 2019 Verbal and Social Autopsy (VASA) reports for example, there is need for continual research and data on causes of newborn mortality as determined by facility audit of practice as this may vary by geographical location. This is the first audit of our neonatal unit at the Federal Teaching Hospital, Ido Ekiti, Ekiti state and we aimed to identify the common causes of neonatal mortality and determine the predictors of neonatal mortality in our centre. This will improve neonatal care in the state and invariably in the nation as Nigeria strives to achieve the Sustainable Development Goal 3 for child survival.

MATERIALS AND METHODS

Study design, setting and methodology

This retrospective descriptive study was carried out at the Federal Teaching Hospital Ido-Ekiti (FETHI). The hospital is a tertiary health facility that serves the health needs of communities in Ekiti and neighbouring communities in Ondo, Osun and Kwara States. The hospital provides care in specialized areas of medicine and surgery, obstetrics and paediatric care. The neonatal ward receives babies delivered in the maternity unit of the hospital (Inborns) and sick babies referred from outside the hospital (Outborns). The neonatal ward generally provides level IIIa care and has facilities such as resuscitaires, incubators, LED phototherapy units, improvised/oxygen driven bubble CPAP, syringe pumps, infusion pumps, pulse oximeters, glucometers as well as facilities for KMC. Oxygen is delivered through a piped system. It is divided into the neonatal intensive care unit with seven incubators, special care baby unit inborn with eight cots, special care baby unit out born with seven cots and an isolation ward with five cots. Attached to the neonatal ward is the eight bedded mothers'

room. However, as at the time of this study, there were no facilities for mechanical ventilation, exogenous surfactant administration and total parenteral nutrition. Similarly, the neonatal unit staffing was limited to two paediatricians, one senior registrar, two junior registrars, two medical interns and twenty-three nurses.

Participants and data collection

All the admissions and discharges records in the neonatal ward register for the period January 2013 to December 2017 were reviewed. The hospital notes of all neonates who had died in the neonatal unit of our facility between January 2013 and December 2017 were retrieved and reviewed. Patients who had incomplete records were excluded. Information required from the notes were entered into a proforma pre-designed for the study. This proforma was explained to the neonatal ward residents and interns who then had the responsibility of data entry. Data obtained from the records included the maternal characteristics like age, marital status, employment status, level of education, obstetric data including the parity, ANC attendance and mode of delivery while the neonatal characteristics included postnatal age on admission, sex, birth weight, gestational age, place of birth, major reason for admission, duration of hospitalization and possible causes of death. Approval for the study was obtained from the Ethics and Research Committee of FETHI.

Definition of terms

Our neonatal ward has protocols (based on the widely accepted guidelines and within the limits of available hospital facilities) for diagnosing and managing common neonatal problems. These protocols are regularly reviewed in line with global best practices.

Neonatal sepsis is diagnosed in the presence of maternal or neonatal risk factors for sepsis, laboratory evidence of infection and bacteriological confirmation when available. The gold standard for diagnosing sepsis is blood culture but in the absence of blood cultures, full blood count parameters suggestive of sepsis (presence of leucocytosis [> 30,000/ul], absolute neutrophil count [< 3,5000/mm^3] or reversal of the neutrophil to lymphocyte ratio for age) with or without the presence of risk factors for sepsis was regarded as sepsis.[7]

Perinatal asphyxia is diagnosed using the Apgar scoring system as there are no facilities available for blood gas and pH analysis. For babies that are outborn, the history of failure to initiate spontaneous respiration at birth plus clinical features suggestive of asphyxia were used to make the diagnosis. A diagnosis of Hypoxic Ischaemic Encephalopathy (HIE) was based on the Sarnat-Sarnat grading system which uses neurologic findings to classify the severity of asphyxia[5,6] Preterm birth was defined as babies born before 37 completed weeks of gestation.

Acute bilirubin Encephalopathy was diagnosed in the presence of clinical jaundice plus serum bilirubin greater than the norm on the normogram for the babies' gestational age and weight with signs of encephalopathy.

Deaths which occurred within and after the first seven days of life were classified as early and late neonatal deaths, respectively.[6] Postmortem examinations for the deaths were not routinely carried out due to the strong socio-cultural bias against neonatal postmortems. Consequently, cause of death relied mainly on clinical diagnosis made by a paediatrician and confirmed by a 2nd paediatrician in most of the cases.

Neonatal mortality rate was defined as the number of deaths occurring among the admitted newborns over the period of study expressed as a percentage.

Data analysis and management

Data was analyzed using the statistical package SPSS version 23. The mean, standard deviation and associated percentages were determined where applicable. The Chi square test was used for testing the significance of associations between categorical variables. The level of statistical significance was set at $p < 0.05$. The inborn and outborn babies were compared for age, weight and mortality rate using the Chi square and Student's t-tests. Binary logistic regression was done to determine the predictors of neonatal mortality using selected neonatal characteristics. The corresponding odds ratio and 95% CI are reported.

RESULTS

Neonatal admissions and characteristics of the babies who died.

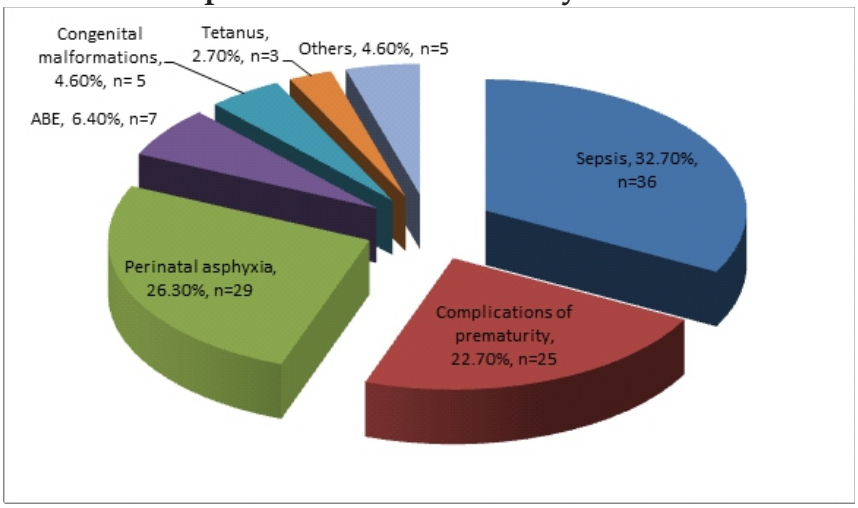
A total of 1236 babies were admitted into the neonatal unit over the 5-year period out of which 110 (8.9%) babies died. Out of the 110 babies that died, 66 (60%) were preterms while 44 (40%) were term babies. The mortality distribution by place of admission was 69 (62.3%) as Outborns while 41 (37.2%) were inborns admissions. Significantly higher proportion of outborn babies died ($p = 0.01$). Out of the 110 patients who died, 65 (59.1%) were males and 45 (40.1%) females, giving a male to female ratio of 1.4:1 The difference between the proportion of deaths between gender was not statistically significant ($p = 0.54$).

Eighty-three (75.5%) babies experienced early neonatal deaths, the mean age at demise was 2.6 ± 1.1 days. Of the 83 babies, 20 (25.0%) died within the first 24 hours of life.

Causes of death and specific neonatal mortality.

In this review, the leading causes of neonatal mortality in our study were sepsis (32.7%), perinatal asphyxia (26.3%), and complications of prematurity (22.7%) and together they accounted for more than 80% of the neonatal deaths. The other causes included acute bilirubin encephalopathy, congenital malformations, tetanus and "Others" which included chromosomal anomalies and few cases of haemorrhagic disease of the newborn that presented very late. This is shown in Figure 1.

Figure 1: Causes of death and specific neonatal mortality.



Association of causes of death with place of birth

The leading causes of deaths for Inborn babies were sepsis (44.4%), complications of prematurity (56.0%) and asphyxia (34.5%) in that order while leading causes of death for the outborn babies were sepsis (55.6%), asphyxia (65.5%) and complications of prematurity (44.0%) in that order. All the deaths from neonatal tetanus and acute bilirubin encephalopathy occurred in outborn babies accounting for 2.7% and 6.4% of overall deaths respectively. This was statistically significant ($p< 0.05$ and 0.01 respectively). However, more Inborns died from complications of prematurity than Outborns but the difference was not statistically significant. This is shown in table 1.

Table 1: Association of Cause of Death with Place of Birth

Diagnosis	Inborns n = 41 (%) +	Outborns n = 69 (%)+	Total (n) (%)	x^2	p Value
Sepsis	16 (44.4)	20 (55.6)	36	0.25	0.62
Asphyxia (HIE)	10 (34.5%)	19 (65.5%	29	1.83	0.18
Complications of Prematurity	14 (56.0)	11 (44.0)	25	1.7	0.19
ABE	0 (0.0)	7 (100.0)	7	15.94	**0.01**
Congenital Malformation	0 (0.0)	5 (100.0)	5	0.44	0.51
Tetanus	0 (0.0)	3 (100.0)	3	3.77	0.05
Others*	1 (20.0)	4 (80.0)	5	0.13	0.72
Total	41 (37.3)	69 (62.7)	110		

ABE- Acute Bilirubin Encephalopathy, HIE - Hypoxic ischemic encephalopathy. + Percentages of total in column. Others*: Chromosomal anomalies, Haemorrhagic disease of newborn, Meconium aspiration syndrome

Timing of mortality and cause specific neonatal mortality.

Table 2 shows the relationship between the time of death and specific diagnosis. Babies who had sepsis, asphyxia and prematurity had early neonatal deaths. For example, 85.7%, 93.1%, and 100.0% of babies who died from acute bilirubin encephalopathy, perinatal asphyxia and complications of prematurity respectively died in the early neonatal period. However, babies with diagnoses of tetanus and sepsis died in late neonatal period.

Table 2: Timing of neonatal mortality and cause specific neonatal mortality.

Primary Diagnosis	No who died during Early Neonatal Period(n)	% of n+	No who died during Late Neonatal Period (n)	% of n+	Total n	% of total deaths
Sepsis	16	44.4	20	55.6	36	32.7
Perinatal asphyxia	27	93.1	2	6.9	29	26.4
Complications of Prematurity	25	100	0	0.0	25	22.7
Acute Bilirubin Encephalopathy	6	85.7	1	14.3	7	6.4
Congenital Malformation	4	80.0	1	20.0	5	4.5
Others	4	80.0	1	20.0	5	4.5
Tetanus	1	33.3	2	66.7	3	2.7
Total	**83**		**27**		**110**	**100**

+ Pecentages of total in the Column

Relationship between baby's sex, selected maternal socio-demographic characteristics and causes of neonatal mortality.

The specific cause of neonatal mortality was compared with the sex of the baby, the place of birth and some socio-demographic characteristics of the mother like educational status of the mother, the level of income for the family and the marital status of the mother. This is depicted in Table 3. Although, all the causes of death were commoner among males than females, the difference was not statistically significant (p= 0.54). The level of income did not appear to be differentiating factor for babies who died from complications of prematurity. The cases of sepsis were higher in mothers with primary (30.8%) and secondary education (42.9%) compared to tertiary education (25.0%). The place of birth i.e., whether the baby was Outborn or Inborn was a statistically significant variable irrespective of the specific cause of death.

Table 3: Relationship between selected maternal sociodemographic characteristics and causes of neonatal mortality.

Variables	Categories	ABE	Prematurity	Sepsis	Congenital Malformation	Tetanus	Asphyxia	Others	P	Total
		n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)		
Babies	Male	3(4.6)	17(26.2)	20(30.8)	3(4.6)	2(3.1)	16(24.6)	4(6.2)	0.54	65
Gender	Female	4(8.9)	8(17.8)	16(35.6)	2(4.4)	1(2.2)	13(28.9)	1(2.2)		45
Maternal	Nil	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1(50.0)	1(50.0)	0(0.0)		2
Educationa	Primary	2(7.7)	5(19.2)	8(30.8)	2(7.7)	1(3.8)	8(30.8)	0(0.0)		26
l Status	Secondary	3(7.1)	7(16.7)	18(42.9)	1(2.4)	1(2.4)	8(19.0)	4(9.5)	0.22	42
	Tertiary	2(5.0)	13(32.5)	10(25.0)	2(5.0)	0(0.0)	12(30.0)	1(2.5)		40
Income	Low	5(9.3)	9(16.7)	18(33.3)	3(5.6)	3(5.6)	13(24.1)	3(5.6)		54
	Medium	2(7.1)	7(25.0)	8(28.6)	2(7.1)	0(0.0)	8(28.6)	1(3.6)		28
	High	0(0.0)	9(32.1)	10(35.7)	0(0.0)	0(0.0)	8(28.6)	1(3.6)	0.35	28
Marital	Married	5(6.0)	19(22.9)	26(31.3)	5(6.0)	2(2.4)	22(26.5)	4(4.8)		83
Status	Others	2(7.4)	6(22.2)	10(37.0)	0(0.0)	1(3.7)	7(25.9)	1(3.7)	0.17	27
Inborn/	Inborn	0(0.0)	14(34.1)	16(39.0)	0(0.0)	0(0.0)	10(24.4)	1(2.4)		41
Outborn	Outborn	7(10.4)	11(16.4)	20(29.0)	5(7.5)	3(4.5)	19(27.5)	4(6.0)	0.01	67

Multivariate analysis of selected neonatal predictors of neonatal mortality

Table 4 shows selected neonatal characteristics were subjected to binary regression analysis at 95% CI as predictors of neonatal mortality. Prematurity (p= 0.0001), low birth weight (p = 0.0001) and age at admission (p = 0.01) were factors associated with neonatal mortality. The gender and the place of birth did not show statistically significant association. This is shown in Table 4.

Table 4: Binary logistic regression analysis of selected neonatal characteristics as predictors of neonatal mortality

Neonatal characteristics	Babies who died (n = 110)	Babies who survived (n= 1065)	Odds ratio	95% CI	p-value
Gestational age	66	331			
< 37 weeks	44	734	3.33	2.22 – 4.98	**< 0.0001**
≥ 37 weeks					
Birthweight					
< 2500g	72	382	3.39	2.24 – 5.12	**<0.0001**
≥2500g	38	683			

Gender*					
Male	65	603	1.1	0.74 – 1.64	0.6412
Female	45	459			
Age on admission (days)					
0 – 7	101	884	2.3	1.14 – 4.63	0.010
8 – 28	9	181			
Place of birth					
Inborn	41	482	0.72	0.48 – 1.08	0.1098
Outborn	69	583			

*3 patients with disorders of sexual differentiation were subtracted from the total of 1065 babies discharged alive CI – Confidence interval

DISCUSSION

The overall neonatal mortality was 9.4% which translates to 94/1,000 and this is remarkably high. However, hospital-based reviews may show high mortality especially at the tertiary health facility because many of the patients (Outborns) were extremely ill babies who could not be managed at the peripheral hospitals. The actual number of neonatal deaths in the developing countries may not be known since most births and deaths occur in the community and are unregistered or unreported. The mortality rate observed in the present study is however lower than the mortality rates ranging from 16.9% to 19.3% in similar retrospective studies reported in older Nigerian studies from Sagamu (2006), Kano (2007) and Calabar (2008).[8-10]The relatively lower rates in the present study compared to previous studies conducted over a decade ago may probably imply that the overall neonatal mortality rate of the country has shown some improvement between about 1990 to 2017.[4]The neonatal mortality rate of 9.4% observed in our study is however higher than the value of 6.3% that was reported from Tigray, Ethiopia.[11]Unlike the present study, the Ethiopian study was a prospective cohort study and the study locations included specialist hospitals and comprehensive newborn health centres where health services were provided free of charge. Healthcare financing in our study setting is however different as cost of care is largely through out-of-pocket expenditure and this may limit prompt care and encourage late presentations and may indirectly be responsible for the higher mortality rate compared to the study from Ethiopia. This is without prejudice to the fact that the level of income was not a statistically significant predictor of mortality from the findings of this present study.

The leading causes of death in the present study are sepsis, perinatal asphyxia, prematurity, and acute bilirubin encephalopathy in descending order. Cases of neonatal sepsis are remarkably high in developing countries including Nigeria because many deliveries are unsupervised and occur in unhygienic environment. Many neonates also die annually in developing

countries from birth asphyxia, Nigeria inclusive. There is a high prevalence of maternal and fetal risk factors that are major predispositions to perinatal asphyxia in developing countries. [1] These include non-attendance and/or high cost of antenatal care, prolonged rupture of membranes, ante partum hemorrhage, pregnancy induced hypertension, ante partum/ intrapartum anemia and fetal risk factors like meconium stained liquor, multiple births, low birth weight infants and malpresentation.[13] which are still predominant in the developing countries. Also, newborn babies especially the low birth weight and preterms have systemic maturation challenges and are physiologically immunocompromised[13] which predispose them to high morbidity and mortality from multisystemic and multiorgan affectation including septicaemia.[13]

The results from the present study also show that neonatal sepsis is overtaking perinatal asphyxia as leading contributor to neonatal mortality. This finding was also reported in Kano in 2007.[9] This could mean improved knowledge of neonatal resuscitation in health facilities especially tertiary centres, resulting in relatively lower deaths from perinatal asphyxia among the inborn babies compared to outborn babies. It is however worthy of note that in our study though the deaths were lower among the inborns, the difference was not statistically significant. A recent review of morbidity and mortality in Enugu in 2018 still showed perinatal asphyxia as the leading cause of admissions and mortality among outborn babies in that study.[14]

Also, recent global and regional reports have suggested that deaths from complications of prematurity range from 30 -39% of neonatal mortality especially in the first week of life.[15] Preterm mortality is however disproportionately high in developing countries, and this may not be unrelated to the fact that neonatal intensive care is limited in many facilities. The exorbitant cost of exogenous surfactants, mechanical ventilation and emergence of antibiotic resistance leads to high mortality from respiratory distress syndrome, and infections for many preterm babies.[2]

Studies have also shown that three-quarters of neonatal deaths happen in the 1st week, the highest risk of death is on the 1st day of life. [3,15] The results from our study are consistent with what has been earlier reported in a study done in Enugu State[14] showing that cumulative deaths in the 1st week of life accounted for approximately 75% of the total neonatal mortality. This is also similar to results from Cameroon which reported 83.3% of deaths occurring in the first week of life reflecting the critical nature of this phase of life which, therefore, warrants close monitoring and follow-up.[2]It has been suggested that neonatal mortality could be reduced by monitoring fetal wellbeing in pregnancy through adequate antenatal care, having skilled attendance at delivery, preventing and treating neonatal infections.[14,16]

Though our study was limited by factors such as the inadequacy of a retrospective hospital-based study at evaluating the true neonatal mortality rates in the community, the dearth of routine postmortem examinations to confirm the cause of death and the unavailability of blood gas analysis for diagnosis of perinatal asphyxia, the results of the study have shown that significant neonatal characteristics that were predictors of neonatal death were the gestational age (< 37weeks), the birth weight (< 2500grams) and the early neonatal period. The GA and the birthweight have traditionally

been linked with neonatal survival,[17] and this has been corroborated by the results from this present study. Unfortunately, different interventions proven to decrease neonatal deaths are not being effectively implemented. These include adequate antenatal care and administration of steroid to mothers with premature labour. Also, there is room for improvement in training and re-training of health workers on helping babies breathe, neonatal resuscitation skills, effective utilization and monitoring of essential newborn care program, management of hypothermia, kangaroo mother care, early breastfeeding, cord care with the use of 4% chlorhexidine gel and eye care with 0.5% eryrthromycin ointment.[18-20]

CONCLUSION

Neonatal mortality rate is still unacceptably high. Neonatal sepsis, perinatal asphyxia and complications of prematurity were the leading causes of neonatal deaths seen during the study period in our hospital. Neonatal characteristics like prematurity, low birth weight and the age on admission were the significant predictors of neonatal mortality. Even though neonatal intensive care is both skill and capital intensive, it is high time tertiary health facilities in developing countries acquired such skills and equipment so they could become the final referral centres for patients especially neonates. This would improve the newborn care available in-the country with the ultimate goal being the reduction of neonatal mortality. In this way healthcare providers can give hope to families and thereby make every baby count!

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