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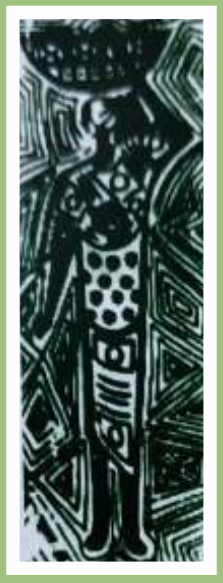

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A Review of Neonatal Morbidity and Mortality in a Tertiary Healthcare Facility in Yenagoa, Nigeria

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Abstract

Background: Audit of facility-based morbidity and mortality patterns helps to improve the quality of care.

Objective: To audit and establish baseline data on neonatal morbidity and mortality patterns in a Tertiary Facility in southern Nigeria.

Methods: This retrospective study was conducted at the Special Care Baby Unit (SCBU) of the Federal Medical Centre, Yenagoa. The hospital records of babies admitted during the three years under review were retrieved for statistical analysis.

Results: Of the 409 records available for review, there were 236 (57.7%) males and 173 (42.3%) females. There were 177 (43.3%) in-born babies and 232 (56.7%) out-born babies, with 239 (58.4%) preterm babies and 156 (38.1%) having≥ 37 completed weeks of gestation. Neonatal sepsis was the commonest morbidity in 104 (25.4%) babies, followed by perinatal asphyxia in 93 (22.7%). Perinatal asphyxia was the commonest cause of mortality, with 48 (32.7%) deaths and 34 (23.1%) in neonatal sepsis. Two hundred and sixty-two babies (64.1%) were discharged home, while 147 (35.9%) died.

Conclusion: The facility-based neonatal mortality rate of 35.9% is unacceptably high. Neonatal sepsis and perinatal asphyxia were the leading causes of morbidity and mortality in this facility. Therefore, the level of preparedness to manage these conditions must be optimised.

Keywords: Low Birth Weight, Neonatal deaths, Neonatal morbidity, Prematurity, Respiratory Distress Syndrome, Sepsis.

Introduction

Worldwide, children face the greatest risk of dying in the neonatal period, defined as the first 28 days of life. In 2022, about 2.3 million children died in the first month of life, with about 6500 newborn deaths every day.[1] Although neonatal deaths have declined globally from 5.0 million in 1990 to 2.3 million in 2022,[1] as reflected in the decline of the average global neonatal mortality rate (NMR) from 37 deaths per 1,000 in 1990 to 17 deaths per 1,000 live births in 2022,[2] there are still large disparities across countries and regions with high NMR persisting in many developing countries. Among the regions, Sub-Saharan Africa has the highest NMR, estimated at 27 deaths per 1,000 live births, followed by South Asia with an estimated rate of 22 deaths per 1,000 live births, with a child born in Southern Asia or sub-Saharan Africa at about 10 times more likely to die in the neonatal period than a child born in a high-income country.[2] In Nigeria, NMR has also fallen gradually over the years, from an average of

57.235 deaths per 1,000 live births in 1977 to 34.324 deaths per 1,000 live births in 2022.[3] This rate is, however, still high and above the global and regional average NMRs of 17 and 27 deaths per thousand life births respectively for 2022.[2]

Neonatal deaths are a major contributor to child mortality and accounted for about 47 per cent of all under-five deaths in 2022.[1] Most neonatal deaths are associated with diseases and conditions related to the quality of care received by a mother during pregnancy and at delivery and by the baby during and after birth, especially in the first few days of life. Reducing neonatal mortality is a global concern and a component of the Sustainable Development Goals (SDGs) set in 2015 by the United Nations General Assembly to achieve a better and more sustainable future for all, with all countries aiming at reducing neonatal mortality to at least 12 per 1,000 live births.[4]

Facility-based morbidity and mortality reviews are important in improving the quality of care provided in healthcare facilities.[5] It helps identify morbidity and mortality patterns and risk factors to enable adequate intervention planning. While it may not be a perfect reflection of the population's NMR since many deliveries and neonatal deaths occur outside the healthcare system, it is a useful evidence-based tool for health systems planning and resource allocation. It must, however, be interpreted with caution because rising rates may not always mean worsening healthcare delivery; rather, it may reflect improvement in medical technology, enabling babies that would have been stillbirths to survive till delivery but die in the neonatal period.

A morbidity and mortality pattern review has been carried out in the neonatal units of many healthcare facilities,[6–11] but none has been done at the Federal Medical Centre, Yenagoa (FMCY). This study was carried out to evaluate the morbidity and mortality patterns of babies admitted into the special care baby unit (SCBU) of the hospital and determine the facility-based neonatal mortality rate to enable evidence-based healthcare planning, interventions and advocacy. It is also a baseline study for the facility against which subsequent review outcomes will be measured.

Methods

Study site

The study was carried out at the Federal Medical Centre, Yenagoa, a tertiary healthcare facility in the Niger Delta region of Nigeria with a Level III SCBU. The unit receives sick or preterm babies delivered in the hospital and serves as a referral centre for those delivered outside the hospital, in Bayelsa state and neighbouring states. To reduce the risk of cross-infection, the unit has two sections, one for inborn babies and the other for outborn babies. The total admission capacity is 26, 10 for the inborn and 16 for out-born sections. The SCBU has paediatricians, residents, nurses, and support staff, including ward orderlies and health attendants, providing care. Both in-born and out-born sections have cots, incubators, phototherapy units, resuscitaire, Continuous Positive Airway Pressure (CPAP) machines, oxygen supply systems and blenders, suction machines, monitors, warmers, pulse oximeters and various resuscitation tools. The SCBU also has a side laboratory.

Access to the unit is open to all sick neonates with medical bills paid through the Health Insurance Scheme or out-of-pocket, the latter being a possible hindrance to healthcare due to financial constraints. To prevent delays in treatment, ill babies may be admitted to the unit on an emergency basis, and payments will be made later.

Study design

This was a retrospective review of the hospital records of babies admitted into the SCBU.

Study population
Neonates were admitted into the SCBU over three years: January 2020 to December 2022.
Inclusion criteria
All babies admitted into the SCBU during the study period whose hospital records were retrieved and contained the desired information.
Exclusion criteria
Babies admitted into the unit during the study period whose hospital records were retrieved but lacked the desired information.

Data collection
The records of babies admitted into the unit during the study period were obtained from the unit registers. These details were used to retrieve the hospital records from the Medical Records Department of the hospital. Data for the study was extracted from the case notes using a proforma. The information obtained included: birth date, age at presentation, sex, birth weight, Apgar score, gestational age (GA), mode and place of delivery, presenting symptoms, diagnosis, length of stay in hospital, and discharge weight. Outcomes of hospitalisation, which could be routine discharge, discharge against medical advice, death, or referral, along with the duration of stay in the unit, were also retrieved. Other data obtained included the mother's medical history, antenatal care, and other relevant details. The patient's diagnosis, made according to the unit's standard procedures, was adopted for use in this study.

Data analysis
Data was cleaned on the Microsoft Excel spreadsheet (2021) and transferred to the Statistical Package for Social Sciences (SPSS) software (version 23) for analysis (IBM SPSS). Analysed data was expressed as frequencies and percentages in tables to depict the clinical, morbidity and mortality data of the cases reviewed.

Ethical Considerations
Ethical approval to conduct this study was obtained from the Ethics Committee of FMCY before the study was commenced. All information obtained from the records was treated as confidential and used only for academic research.

Results

A total of 813 patients were admitted into the unit over the 3-year study period. Of these, 503 case notes were retrieved, but only 409 had information relevant to this study and were reviewed with details in Table I. The variables were analysed based on the number of babies and the appropriate data for each category. There were 236 (57.7%) males and 173 (42.3%) females. Also, 356 (87.0%) were admitted within 24 hours of birth, 177 (43.3%) of the babies were delivered in FMCY, and 232 (56.7%) were out-born. Most babies (64.7%) were delivered by spontaneous vaginal delivery (SVD), about 60% were delivered at less than 37 completed weeks of gestation (preterm babies), and 57.4% had birthweight below 2500gm (low birth weight babies). Two hundred and ninety-one mothers (71.7%) had antenatal care (ANC) for the index baby, out of which 103 (35.4%) received the care in FMCY and others in centres, as shown in Table I.

With regards to the morbidity pattern of the study population, (Table II), neonatal sepsis was the commonest, with the diagnosis made in 104 (25.4%) babies. This was followed closely by perinatal asphyxia (93; 22.7%) and respiratory distress syndrome (RDS) (60; 14.7%); the latter occurred in babies who were all preterm. Respiratory Distress Syndrome and neonatal sepsis were the commonest diagnoses among preterm babies and those delivered beyond 37 completed weeks of gestation, respectively.

Of the 409 cases reviewed, 262 (64.1%) were discharged while 147 (35.9%) died. In-born babies contributed 38.1% of the total neonatal deaths while out-born babies contributed 61.9%; within each group of babies, the mortality rates were 31.6% and 39.2% among in-born and out-born babies, respectively. The

mortality rate was higher among preterm babies than those beyond 37 weeks of gestation, with rates of 81.3% and 18.8%, respectively (Table III). The mortality rate was also higher among babies with a weight below 2,500 compared to those with a weight of 2500gm and beyond, with rates of 82.1% and 17.9%, respectively. About half of the neonates in the preterm and low birth weight categories died. A high gestational age-specific mortality rate of 95.1% was found among babies delivered before 28 weeks, but this decreased with increasing estimated GA to 17.2% among babies up to 37 completed weeks (Table IV). The birthweight-specific mortality rate of 94.4% was obtained in babies less than 1000gm, and these rates decreased with increasing birth weight to 14.7% among babies with a birth weight of up to 2500gm.

Mortality distribution of the study population is shown in Table V. Out of the 147 deaths recorded, perinatal asphyxia was the commonest cause of death (32.7%), followed by neonatal sepsis (23.1%) and prematurity-related RDS (17.7%).

Table I: General demographic and obstetric characteristics of the subjects

Characteristics		**Frequency**	**Percentage**
Sex (n = 409)	Male	236	57.7
	Female	173	42.3
Age of admission (n = 409)	24 hours	356	87.0
	2-7 days	33	8.1
	8-14 days	6	1.5
	15-21 days	4	1.0
	22-28 days	10	2.4
Place of birth (n=409)	FMCY	177	43.3
	Outside FMCY	232	56.7
Mode of delivery (n = 405)	SVD	262	64.7
	CS	143	35.3
Gestational Age (n = 396)	< 37 weeks (preterm babies)	239	60.4
	≥ 37weeks	157	39.6
Birthweight Categories (n-399)	Birth weight < 2500gm	229	57.4
	Birth weight ≥ 2500gm	170	42.6
Mothers' ANC attendance (n = 406)	Yes	291	71.7
	No	115	28.3
Place of ANC (n = 291)			
	FMCY	108	35.4
	Private Hospital/Maternity	46	15.8
	Traditional Birth Home	42	14.4
	Chemist Shop	33	11.3
	Primary Health Centre	29	10.0
	General Hospital	17	5.8
	Home	12	4.1
	Others	9	3.1

FMCY – Federal Medical Centre, Yenagoa; SVD – Spontaneous Vertex Delivery; CS – Caesarean Section; ANC – Antenatal Clinic.

Table II: Distribution of neonatal morbidities according to estimated gestational age

Morbidities	Estimated Gestational age (n = 396)*		Total population
	GA < 37 weeks [n (%)]	GA ≥ 37 weeks [n (%)]	No. of babies [n (%)]
Neonatal Sepsis	41 (17.2)	58 (36.9)	104 (25.4)
Perinatal Asphyxia	37 (15.5)	52 (33.1)	93 (22.7)
Preterm with Respiratory Distress Syndrome	60 (25.1)	0 (0.0)	60 (14.7)
Prematurity only	56 (23.4)	0 (0.0)	56 (13.7)
Neonatal Jaundice	23 (9.6)	28 (17.8)	52 (12.7)
Anaemia	9 (3.8)	2 (1.3)	11 (2.7)
Congenital Malformations	3 (1.3)	4 (2.5)	8 (2.0)
Congenital Heart Disease	3 (1.3)	4 (2.5)	7 (1.7)
Meconium Aspiration Syndrome	0 (0.0)	2 (1.3)	2 (0.5)
Respiratory Distress (unspecified)	0 (0.0)	2 (1.3)	2 (0.5)
Miscellaneous	7 (2.9)	5 (3.2)	14 (3.4)
Total	**239**	**157**	**409**

***EGA was documented in only 396 case notes.**

Table III: Neonatal outcome distributed according to gestational age and birth weight

Variables		No. admitted	No. of deaths (CFR in %)	% of deaths
Gestational Age (n = 396)	<37 weeks	239	117 (49.0)	81.3
	≥37 weeks	157	27 (17.2)	18.7
Birthweight (n = 399)	<2500gm	229	115 (50.2)	82.1
	≥2500gm	170	25 (14.7)	17.9

Table IV: Gestational age- and birthweight-specific mortality rates

Variables		No. admitted	No. of deaths (%)
Gestational Age (weeks)	<28	41	39 (95.1)
	28-$31^{6/7}$	71	38 (53.5)
	32-$33^{6/7}$	69	28 (40.6)
	34-$36^{6/7}$	58	12 (20.7)
	≥$37^{0/7}$	157	27 (17.2)
		396	144
Birth weight (gm)			
	<1000	36	34 (94.4)
	1000-<1500	71	38 (53.5)
	1500-<2500	122	43 (35.2)
	≥2500	170	25 (14.7)
		399	140

Perinatal asphyxia was also the commonest cause of mortality in both the preterm category and babies up to 37 completed weeks of gestation and beyond, with rates of 30.7% and 40.7%, respectively. In the preterm category, this was followed by RDS (22.2%) and neonatal sepsis (20.5%), whereas in babies up to 37 weeks of gestation and beyond, neonatal sepsis (29.6%) and meconium aspiration syndrome (7.4%) were leading. A case fatality rate of

100% was recorded in babies with meconium aspiration syndrome and nonspecific RDS.

Table V: Mortality distribution by morbidity and gestational age

Clinical diagnosis	GA < 37 weeks (n = 239)			GA ≥ 37 weeks (n = 157)			Total population (n = 409)		
	Admitted (N)	Deaths (N)	%	Admitted (N)	Deaths (N)	%	Admitted	Deaths (N)	%
Perinatal Asphyxia	37	36 (97.3)	30.7	52	11 (21.2)	40.7	93	48*	32.7
Neonatal Sepsis	41	24 (58.5)	20.5	58	8 (13.8)	29.6	104	34**	23.1
Preterm with RDS	60	26 (43.3)	22.2	0	0 (0.0)	0.0	60	26	17.7
Prematurity alone	56	16 (28.8)	13.7	0	0 (0.0)	0.0	56	16	10.9
Neonatal Jaundice	23	7 (30.4)	6.0	28	1 (3.6)	3.7	52	8	5.4
Severe Anaemia	9	2 (22.2)	1.7	2	0 (0.0)	0.0	11	2	1.4
Meconium Aspiration Syndrome	0	0 (0.0)	0.0	2	2 (100.0)	7.4	2	2	1.4
Respiratory Distress (unspecified)	0	0 (0.0)	0.0	2	2 (100)	7.4	2	2	1.4
Congenital Heart Disease	3	1 (33.3)	0.9	4	1 (25.0)	3.7	7	2	1.4
Other Congenital Malformations	3	1 (33.3)	0.9	4	1 (25.0)	3.7	8	2	1.4
Miscellaneous	7	4 (57.1)	3.4	5	1 (20)	3.7	14	5	3.4
Total	**239**	**117**	**100**	**157**	**27**	**99.9**	**409**	**147**	**100.2**

***One baby with no documented GA died from perinatal asphyxia; **Two died from neonatal sepsis.**

Discussion

The finding that over 50% of the neonates in this study presented within their first 24 hours of life is similar to the findings in some earlier studies, [11 - 13], but differs from those where most babies presented after the first day of life. [10, 14] Delays in reaching healthcare facilities were found to be the most common cause of delayed healthcare delivery to sick neonates. [15] Early presentation of most neonates in this study may thus reflect easy access to the referral hospital. The observation that 56.7% of the study population were out-born highlights the importance of the study centre as a referral centre for neonatal care in the region. This is similar to the findings reported by Eze *et al.* in Yemen, Mukhtar-Yola and Iliyasu in Nigeria, and Sharma and Gaur in India, where over 50% of the study populations were out-born babies, [12, 16, 17] but differs from the findings of Omoigberale *et al.* in Nigeria, Sackey and Tagoe in Ghana and Al-Momani in Jordan, where less than half were out-born babies. [6, 13, 18] The finding that 60.4% of the study population were preterm babies is similar to admission patterns in many neonatal intensive care settings where preterm babies accounted for over half of the admitted babies, [9, 10, 12, 17, 19] but differ from other reports where preterm babies accounted for less than half of the study population. [7, 11, 20, 21] Preterm birth is an increasing global burden with marked variability in preterm birth rate worldwide, [22, 23] but 4-16% rates were reported across countries by the WHO. [24] Global annual reduction rates of preterm births have been reported. 25 Still, this study's findings suggest a persisting high preterm burden.

On the morbidity pattern of the study population, the finding that neonatal sepsis was the commonest cause of admission is similar to findings in many studies. [8, 10, 11, 20, 26, 27] This highlights the continuing burden of neonatal sepsis and the need for adequate infection prevention and control (IPC) measures at all levels of care, early recognition of sepsis, and proper case management. This finding,

however, differs from reports from studies where other morbidities, such as perinatal asphyxia or RDS, accounted for more admissions than neonatal infection. [17, 21, 28, 29] The difference in morbidity pattern between the preterm population and babies up to 37 weeks and beyond, with respiratory distress syndrome and neonatal sepsis being the commonest in the groups, respectively, is similar to the findings by Tijkia *et al.* [9] Perinatal asphyxia, the second commonest morbidity in the study population, has remained a major threat to newborn survival in many developing countries and among the top three reasons for admission in many neonatal units. [11, 12, 17, 21]

The facility-based neonatal mortality rate of 35.9% found in the present study is higher than rates of between 8-30% reported by many studies. [8, 10, 17, 29, 30] It is, however, comparable with a rate of 34.7% reported by Weddih *et al.* [31] and within the range of 0.2-64.4% reported by Chow *et al.* for Neonatal Intensive Care Units in developing countries. [32] Much lower facility-based neonatal mortality rates of 3.8% and 6.6% have been reported from some units. [33,34] The study facility had huge power supply challenges during the review period, which negatively impacted the functionality of electricity-dependent machines such as incubators and warmers and probably contributed to poor neonatal outcomes.

The finding that out-born babies contributed 61.9% of the deaths in the unit while the inborn babies contributed 38.1% and that the mortality rate in the out-born and in-born categories were 39.2% and 31.6%, respectively, are similar to reports from earlier studies, [6, 12, 35] and those in which risk of death was higher among out-born babies. [11,18,36] This re-emphasises the importance of in-utero transfer as the most effective and safest way of enabling newborn babies to benefit optimally from expert care with improvement in survival. [37-39]

Perinatal asphyxia, the commonest cause of mortality among the babies in this study, accounting for 32.7% of deaths, has also been reported as the most common cause of mortality in many neonatal units. [8, 14, 28, 35, 40] This differs from similar studies in which respiratory distress syndrome was the commonest cause of mortality. [17, 19, 27] Perinatal asphyxia was also the commonest cause of death in both the preterm category and in babies delivered from 37 completed weeks of gestation, highlighting its important contribution to neonatal death. This is similar to the finding by Mokuolu *et al.*, in which it was also the commonest cause of death in both categories, [21] but differs from the finding by Jain *et al.* in which sepsis was the commonest cause of death among preterm babies. [41]

In this study, over 80% of the deaths were underlined by preterm birth, and that may be in keeping with the findings from similar studies where it contributed to over half of the deaths. [9, 12, 42, 43] The high mortality among the preterm and low birth weight babies in this study, which worsened with decreasing gestation and birthweight, with a mortality rate of over 90% among the extremely preterm and extremely LBW babies, is comparable with reports by many authors. [6, 12, 13, 21, 43] The GA-specific mortality rate of 95.1% and 53.5% obtained in the present study for babies delivered at less than 28 and 32 completed weeks, respectively, is in keeping with the WHO report that in low-income countries, half of the babies born at or below 32 weeks die unlike those delivered in high-income countries. [24]

The mortality rates among babies of up to 37 completed weeks of gestation and beyond, as well as those with a birth weight of up to 2500gm of 17.2% and 14.7%, respectively, obtained in this study, are comparable to 10-20% reported in many earlier studies, [6, 11, 13, 19, 21, 43] but higher than rates of below 10% reported by Eze *et al.* [12] and by Al-Momani. [18] However, Leak *et al.* reported higher mortality rates of 25.6% and 22.1% among term babies and those weighing from 2500gm, respectively. [42]

Reducing neonatal mortality is essential not just for reducing neonatal mortality rates but also for the under-five mortality rate to which it is the greatest contributor. [44] There is an urgent need for a critical review of the facility's preparedness to manage the identified causes of morbidity and mortality, especially regarding infrastructure, manpower, and technology. Mahtab *et al.,* while highlighting the complexities underlying neonatal deaths in low- and middle-income countries, noted that 75% of deaths were potentially preventable or treatable. [45] Appropriate measures should thus be implemented to reduce preventable causes and optimise case management significantly. Implementing IPC and clinical guidelines, training and retraining, regular audits and feedback are key. A high antenatal care utilisation rate by over 70% of the mothers should be optimised with health education. While improvement in ANC and deliveries, linkage to tertiary healthcare facilities, IPC practices and timely intervention were identified as key strategies to prevent neonatal deaths in sub-Saharan Africa,[46] there is a need for an in-depth study of factors underlying these morbidities and mortalities peculiar to our setting to enable targeted interventions. This will require strong advocacy, intra- and intersectoral collaborations, and political will since some relevant interventions may be outside the department or healthcare sector.

Conclusion

This study reviewed neonatal morbidity and mortality patterns in a Level III SCBU in a tertiary healthcare facility. Neonatal sepsis was the commonest cause of admission into the unit and among the term neonates, while respiratory distress syndrome was the commonest in the preterm category. Perinatal asphyxia was the commonest cause of death in the unit. The preterm birth burden was high and contributed to over 50% of the admissions and 80% of deaths in the unit. The facility neonatal mortality rate of 35.9% obtained in this study is high.

Urgent action is needed to reduce morbidity and mortality in the unit, with a focus on the major causes identified in this study. An in-depth audit of resources, including infrastructure, manpower, and clinical guidelines, needed to manage these conditions is crucial, and plans should be put in place to close the identified gaps. Ensuring adequate power supply to the unit is critical. Factors peculiar to our setting that underline these major causes of morbidity and mortality should be identified through further research to enable more focused planning and interventions.

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