Original Article

Risk factors and trends in neonatal mortality in NICU in a tertiary care hospital in India

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ABSTRACT

Introduction: The most vulnerable period of human life is neonatal period, which accounts for most of the morbidities and mortalities. Most of them are preventable with adequate health-care facilities. **Objectives:** The aim of the study was to determine the trends of neonatal mortality and identify the risk factors, most of which are preventable and measure the progress of health-care services. **Methods:** A retrospective study was conducted in neonatal intensive care unit (NICU) of Al-Ameen Children Hospital (AMCH) Vijayapura, Karnataka, India. Data were extracted from paper medical records at AMCH of a period of 1 year and digitized. Data obtained included age, sex and birth weight, place of delivery, morbidity profile, mortality profile, diagnosis, and period of stay in NICU. **Results:** A total of 648 neonates were admitted in NICU during the study period of 1-year duration, between January and December 2021. A total of 382 (58.9%) infants were discharged on recovery, 65 (10.3%) were referred due to unavailability of advanced surgical intervention, 39 (6%) were discharged against medical advice, 162 (25%) died due to various reasons. Male neonatal deaths outnumbered female neonates (56.8%). Among the total neonatal deaths, 82 (50.6%) were preterm neonates, 73 (45.1%) were term neonates and 7 (4.3%) were post-term neonates. It was noticed that among neonatal deaths, 87 (54.3%) babies were out-born and 75 (46.2%) babies were inborn. In this study, it was noticed that the mortality percentage of the neonate falling in the category of 1.5–1.9 kg was high compared to other categories. In our study, respiratory distress syndrome was the main cause of mortality accounting for 19.1% (31 cases) of total cases and prematurity was the most common risk factor. **Conclusion:** Improving the standard of antenatal care and encouraging deliveries in institutions having good NICU facility and early identification of risk factors help to reduce the mortality and its complications.

Key words: Mortality, Neonatal, Risk factors, Trends

The neonatal period (first 28 days of life) carries the highest risk of mortality per day than any other period during childhood. The daily risk of mortality in the first 4 weeks of life is 30-fold higher than the post neonatal period, which is from 1 to 59 months of age [1]. Although extensive progress has been done in reducing neonatal mortality over the past 3 decades, increased efforts to improve progress are still needed to achieve the Sustainable Development Goals-2030 target.

Even though neonatal mortality is declining globally, it is doing so at a much slower rate than post-neonatal under-5 mortality [2]. If there are no gains in reducing newborn mortality, it is predicted that between 2018 and 2030, 27.8 million neonates will die [3]. India is responsible for more than a quarter of newborn fatalities and one-fifth of live births worldwide. One of the main global health objectives is to lower newborn mortality rates in underdeveloped nations; however, ineffective registration systems in the area hinder public health initiatives. Within 28 days of birth, nearly half of under-5-year-old children die, and almost all of these deaths take place in underdeveloped nations [4].

Of the 25 million babies born in India every year, 1 million babies die. India alone contributes to 25% of neonatal mortality around the world [5]. As per the report sheet published in the Lancet, the major direct causes of neonatal mortality are: Prematurity (27%), infections (26%), birth asphyxia (23%), congenital-anomalies (7%), others (7%), tetanus (7%), and diarrhea (3%) [6]. Mortality risk is highest on the 1st day of life contributing to 36% of all neonatal deaths [7].

METHODS

The study conducted was a retrospective longitudinal study. A total of 680 deliveries which took place in a period of 1 year from January 1st, 2021, to December 31st, 2021, in Al-Ameen

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Inclusion Criteria

All neonates admitted before 28 days of life were included in the study.

Exclusion Criteria

The following criteria were excluded from the study:

- Neonates who left hospital against medical advice (LAMA)
- Neonates who were referred due to non-availability of complicated surgical intervention.

Data were collected as inborn and out-born (OB), admission, sex, gestational age, birth weight, referral center, age at presentation, indications for admission, duration of stay at hospital, complications encountered, and outcome of hospitalization. Primary disease was considered as final diagnosis even if the baby developed complications of primary disease or having more than one disease. The World Health Organization definitions were used for term, pre-term, low birth weight (LBW), very low birth weight, extremely low birth weight, and congenital malformation. Meconium aspiration syndrome (MAS) in neonates was diagnosed on basis of history, clinical, and radiological findings. Birth asphyxia was diagnosed using Apgar score. Respiratory distress syndrome (RDS) was diagnosed on basis of clinical, radiological, and appropriate laboratory findings. Neonatal jaundice was diagnosed after assessment of serum bilirubin and pathological zones as per American Academy of Paediatrics charts. Sepsis was diagnosed by clinical features and appropriate laboratory screening tests. The data were filled in the EXCEL sheet and categorical variables were tabulated. The significance and relationship of risk factors with neonatal mortality was assessed with the help of "p" value.

RESULTS

A total of 650 neonates were admitted in neonatal intensive care unit (NICU) during the study duration of 1 year between January and December 2021. Male neonates outnumbered female neonates in those that died (56.8%). Three hundred and eighty-two (58%) of the infants were discharged on recovery, 65 (10%) were referred due to unavailability of advanced surgical intervention, 39 (6%) were discharged against medical advice, and 162 (24.9%) died due to various other reasons. Comparisons between neonates on the basis of their outcomes such as death, discharge, and leaving against medical advice indicated that the median age of admission was 2 days for those who died.

In this study, gestation age distribution was 50.6% (82) of pre-term neonates, 45.1% (73) term neonates, and 4.3% (7) post-term neonates among total deaths [Figure 1].

It was noticed that 87 (54.3%) babies were OB, which were born outside this hospital where there was no NICU facility or at home and 75 (46.2%) babies were born in this hospital [Table 1].

In this study, it was noticed that the mortality percentage of the neonate falling in the category of 1.5–1.9 kg was high compared to other categories. As observed, maximum mortality was seen amongst male babies weighing 1.5–1.9 kg. Lowest mortality in male babies was with 1.0–1.4 kg and 3.5 kg. Among female babies, maximum mortality is seen with weight 1.5–1.9 kg and lowest with weight <1.5 kg and 3.0–3.4 kg [Table 2].

Individuals who died were more likely to have diagnosis of RDS were 19.1%, followed by MAS 11.7% and neonatal seizure 11.7%, birth asphyxia – 10.5% and congenital heart diseases 10.5%, pneumonia 9.3%, hypoglycemia 8.6%, and sepsis and septic shock 3.1% followed by various other diagnoses as depicted in the above bar chart [Figure 2].

Risk Factors

In our study, we aimed to identify risk factors for death within 72 h of admission. We determined that 613 neonates were eligible for inclusion in this study population for analysis, after excluding 39 neonates who went LAMA within 72 h of admission. One hundred and sixty-two (24.9%), approximately a quarter of neonates, were considered in this study population died within 72 hrs of admission. Among those who died, 17.3% were premature (PM), 16.7% were PM with low birth weight (PM with LBW), 16.4% were having sepsis, 10.5% had congenital anomalies followed by other various risk factors as depicted in above descriptive study. In our study, prematurity, prematurity with low birth weight, and sepsis are the three common risk factors noted [Table 3].

DISCUSSION

Accurate data on morbidity and mortality profile of neonates are important for the health-care providers and administrators to decide and design interventions for the prevention and treatment to implement and evaluate health-care programs. The present study depicts the morbidity and mortality pattern in our NICU. In this study male to female ratio was 1.3:1. It is due to biological vulnerability of male gender and may be due to preference of male child in the society, which was similar to that study conducted by Bhanupriya *et al*. [8]. The major cause of morbidity was RDS which was similar to that study conducted by Bhanupriya *et al*. [8].

Highest mortalities in neonates were observed with low birth weight and pre-term babies, similar to the study conducted by Fajolu *et al*. [9].

Out of all the diagnoses, highest number of deaths were attributed to RDS that commonly occurs in PM babies due to surfactant deficiency and lack of anatomical development of lungs.

Neonates who died within 48 h of admission were more likely to be male, pre-term, and have diagnosis of perinatal asphyxia as compared to those who survived beyond 48 h of admission. Prematurity, male sex, and perinatal asphyxia were identified as potential risk factors for death within 48 h of admission. Males have worse survival outcome than females when considering

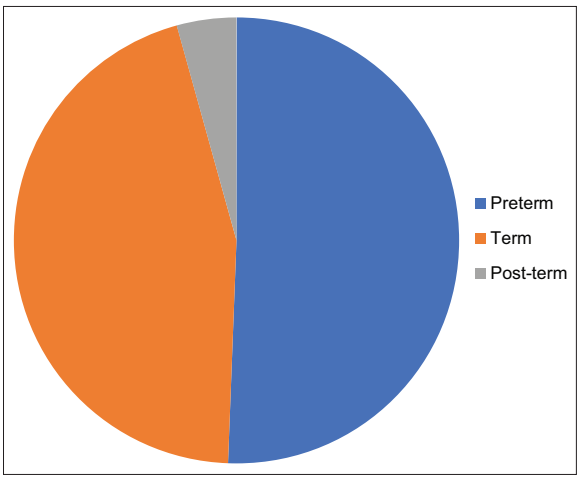

Figure 1: Distribution of neonates based on gestational age

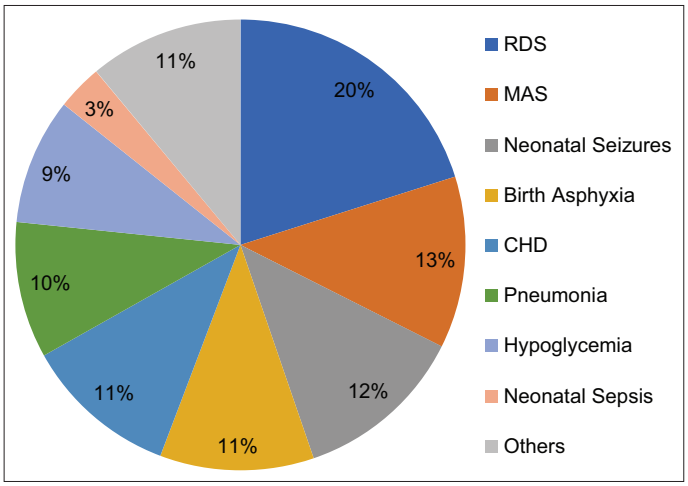

Figure 2: Etiological distribution of mortality

adverse neonatal outcomes such as hemorrhages and congenital malformations. Males are also found to have higher risk for adverse neurological outcome and disability.

This study was conducted to delineate the outcome and factors leading to mortality of neonates admitted to NICU of a tertiary care teaching hospital. In our study, data analysis revealed a large population (24.9%) of neonatal deaths in the unit in 1-year period in 2021 compared to United Nation Children's Education Fund (UNICEF) report.

According to the UNICEF's "The state of world's children's report," 28% of neonates were born with low birth weight in India [10].

While neonatal mortality in high-resource countries is usually due to unpreventable causes, the majority of neonatal deaths in low-resource areas occur from preventable and treatable diseases, including intra-partum-related complications, prematurity, and infections [11, 12]. Further investigations into the factors associated with neonatal mortality are needed to improve the standards of neonatal care units to support neonatal survival and ensure better health outcomes. Evaluation of the services provided at NICU should be conducted, for example: Functioning of the radiant warmers/incubators, practice of aseptic precautions. Provision of resources to address the specific gaps in treatment that are affecting unit-specific neonatal survival.

Table 1: Distribution of neonatal deaths based on place of birth

Parameter	Place of birth		Total
	Inborn	Out born	
Sex			
Male	47	45	92
Female	28	42	70
Total	75	87	162

Table 2: Distribution of neonates based on birth weight (in kg)

Parameter	Birth weight in kg							Total
	<1.0	1.0–1.4	1.5–1.9	2.0–2.4	2.5–2.9	3.0–3.4	>3.5	
Sex								
Male	0	4	34	25	19	6	4	92
Female	2	2	20	19	17	2	8	70
Total	2	6	54	44	36	8	12	162

Table 3: Risk factors for neonatal mortality

Parameter	Neonates that died n=162 (24.9%)	Neonates that were discharged n=382 (58%)	Neonates that left against medical advice n=39 (6%)	p-value
Age at admission (median days)	0 (1)	1 (3)	0 (3)	0.002
Sex				
Males	92 (56.8)	200 (52.3)	21 (53.8)	0.2
Females	70 (43.2)	182 (47.7)	18 (46.2)	
Admission diagnosis				
Prematurity	82 (50.6)	180 (47.1)	20 (51.2)	<0.001
RDS	31 (19.1)	77 (20.3)	8 (20.5)	<0.001
MAS	19 (11.7)	41 (10.7)	4 (10.2)	<0.001
Seizures	19 (11.7)	39 (10.2)	4 (10.2)	<0.001
HIE	17 (10.5)	35 (9.1)	3 (7.6)	0.1
CHD	17 (10.5)	34 (8.9)	4 (10.2)	<0.001
Sepsis	5 (3.1)	11 (2.8)	1 (2.5)	<0.001
Hypoglycemia	13 (8.6)	29 (7.5)	2 (5.0)	<0.001
Birth place				
Inborn	75 (46.2)	176 (46.1)	19 (48.7)	0.07
Out born	87 (54.3)	206 (53.9)	20 (51.3)	
Delivery mode				
Vaginal	98 (61)	225 (59.1)	20 (51.2)	<0.001
LSCS	50 (31)	114 (29.8)	13 (33.3)	
Others	14 (8)	43 (11.1)	6 (15.3)	

RDS: Respiratory distress syndrome, MAS: Meconium aspiration syndrome, CHD: Congenital heart diseases

Since this was a hospital based retrospective, the cause of death was determined by the data available in medical records. Inability to further stratify prematurity into its subcategories such as extremely pre-term (<28 weeks), moderately pre-term (28–32 weeks), and late preterm (32–37 weeks) which in the previous studies have shown different levels of survival. Missing data on certain maternal characteristics which might have established

association with neonatal mortality. Inability to complete the study on those who absconded or left against medical advice. Assumption of survival/death of these babies was not made due to unavailability of data regarding the events which occurred after they left the hospital. Knowing the risk factors and trends in neonatal mortality helped to improvise the standard of health-care services. This study can open the doors for newer inventions in neonatal care. The longitudinal nature of the study offers a benefit over other studies.

CONCLUSION

In spite of many advances in neonatal care, access to skilled health care resources is limited. Majority of the morbidities and mortalities are preventable by improving antenatal care, skilled health-care providers, strong link between communities and health facility, maternal health, timely intervention, referring at appropriate time to tertiary care centers for high risk cases, preventing pre-term deliveries, and care of neonates at centers with facility can reduce neonatal mortality rate. Training sessions and hands on workshop must be given to all heath care providers involved in delivery as the perinatal asphyxia outcome mainly depends on the appropriate timing and manner of interventions.

ETHICAL APPROVAL

Given.

CONTRIBUTION OF AUTHORS

Dr. Nagamani Kulkarni and Dr. Sadashiva B Ukkali designed the project, collected and analyzed the data and drew the conclusions. Dr. Sadashiva B Ukkali wrote the original article with the help and support of Dr. Punitha Badsheshi, Dr. Ravindra Naganoor and Dr. A N Thobbi.

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