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Factors Associated with Mortality of Neonates Admitted to a Tertiary Care Neonatal Unit

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Abstract

Background: The neonatal period is the most susceptible phase of life. In the aim of this study was to assess the causes and factors associated with neonatal mortality.

Methodology: This study was a Retrospective study of medical records for 2 years (Jan. 2020- Dec. 2021). The age, sex, gestational age, and morbidity and mortality profile of all SNCU admissions in 1 year were determined, and the difference between inborn (those born in Hospital) and out born (neonates delivered outside and referred) was calculated.

Results: Of the 1600 neonates admitted, 61.5% neonates were males, 57.4% were Inborn and 42.8% were outborn. Approximately, 33.4% were preterm, and renal cardiovascular (20.4%), Neurological disorder (18.6%), and Respiratory related infection (19.1%) were the chief morbidities. The chief causes of mortality were low birth weight with AOR 1.29 (0.836-2.0120), respiratory support that includes O2 with AOR 5.817 (3.367-10.051), CPAP with AOR 4.902 (2.745-8.754), CMV with AOR 4.251(2.184-8.274) and Level of Care with AOR 4.85 (3.102-11.471). This factor was statistically associated with neonatal mortality.

Conclusion: Low birth weight, respiratory support, neonate size, and degree of care were all found to be associated with newborn mortality in this study. As a result, hospitals ought to emphasize enhancing antenatal, intrapartum, and standardized care for newly admitted infants. A prospective study is what we suggest.

Keyword: Low birth weight; Respiratory support; Neonate size; Degree of care.

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INTRODUCTION

The first 28 days of life the neonatal period is the most vulnerable time for a child's survival. The risk of death in the first four weeks of life is 30 times higher than the risk of death in the post-neonatal period, which lasts from one month to 59 months.[1] During labor or the first 24 hours following birth, over 40% of newborn deaths occur. Prematurity (35%) is the leading cause of newborn fatalities, followed by newborn infections (33%), birth

asphyxia (20%), and congenital deformities (9%).[2]

India is home to roughly of the world's annual childbirths, with 25 million babies born each year. One of those newborns dies every minute. In the year 2020, 2.4 million children will have died in their first month of life around the world.[3] Every day, over 6700 newborns die, accounting for 47 percent of all child mortality under the age of five, up from 40% in 1990.[1,4]

Since 1990, the globe has achieved significant gains in terms of child survival. Neonatal fatalities worldwide have decreased from 5 million in 1990 to 2.4 million in 2020. However, neonatal mortality decreased at a slower rate than post-neonatal under 5 mortality from 1990 to 2020.[4,5]

Various strategies and policies have been explored around the world to minimize neonatal, infant, and under-five mortality. These include the Millennium Development Goals (MDG-4), which were implemented in 2015 to reduce child mortality by three quarters.[6,7] The second one is Goal 3 of the Sustainable Development Goals (SDGs-3) has 13 specific aims for reducing the impact of poverty.[6]

By 2030, newborn mortality will have decreased to 20 to 12 fatalities per 1000 live births. India has seen a decrease in infant mortality over the last decade, but the observed rate has been slower than projected.[8,9] The Indian government identified the need for a 30–50 percent increase in neonatal care centers in 2011. As a result, the Ministry of Health and Family Welfare built 448 new Sick Newborn Care Units (SNCU) with level 2 facilities, totaling 6408 beds, and supporting over 6,00,000 newborns by 2013.[10] In NICU settings, there is still a significant shortage of competent personnel with adequate infrastructure. To keep up with the present volume of preterm newborns, NICUs still require more trained clinical labors.[11]

As a result, the current study was carried out to provide basic data to care givers and health planners to develop treatments to reduce newborn morbidity and mortality. It was also done to measure and analyze the level of newborn care in a tertiary referral center in Karnataka.

METHODS AND MATERIALS

Participants

A retrospective study was conducted to determine the factors associated with neonatal mortality among neonates admitted to NICU in JSS Hospital, Mysuru. This study was conducted to retrieve data over two years, from January 2020 to December 2021. A functional incubator, a ventilator bed, admission beds, 4–6 qualified nurses, and at least one pediatrician are all included in NICU. All live-born neonates admitted to the neonatal intensive care unit (NICU) for whatever cause, whether born in or out of the hospital or referred from another hospital, for less or equal to 28 days, admitted into the neonatal intensive care unit (NICU) for any reason from January 2020 to December 2021 were eligible for this study. Neonates whose discharge summary sheet did not clearly show whether they were alive or dead, neonates >28 days of life admitted in the Neonatal Intensive Care Unit (NICU), and cases of DAMA (discharge against medical advice) were excluded from this study. Because these neonates were difficult to measure their outcomes. Besides, the medical records of the mothers were taken into consideration for medical problems during pregnancy from the medical logbook.

DATA COLLECTION AND PROCESS

The data extraction checklist was adjusted after checking the NICU admission logbook and discharge summary books. The checklist for chart review was created. It is made up of sociodemographic traits (sex, age of neonates, mode of delivery) as well as fetal factors (Birth weight, status at birth, diagnosis of disease, gestational age). The data collectors first looked over the neonates' medical records to see if they met the inclusion requirements.

DATA PROCESSING AND STATISTICAL ANALYSIS

The collected data were coded, checked for completeness, and cleaned for errors. After that, the data was loaded into Microsoft Excel and then exported to SPSS version 23.0 for statistical analysis. The normality assumptions were verified. Texts, tables, frequency, mean, and standard deviation were used to present the results of descriptive statistics.

The bivariable logistic regression analysis was done to identify variables that have a p-value of less than 0.05 to be considered in the multivariable logistic regression analysis model. Thus, we have used the clinical significance of predictor variables, the absence of multi-collinearity between independent variables, and variables with a p-value <0.05, the bivariate analysis and model adequacy to select and enter independent variables into the final model.

Then, a multivariable logistic regression analysis was done to identify factors associated with neonatal mortality. The final model's results were presented as adjusted odds ratios with corresponding 95% confidence intervals. Finally, at a p-value of 0.05, a statistically significant level was announced.

Ethical consideration

Ethical clearance was obtained from the ethical review board (ERB) of JSSAHER (JSS Academy of Higher Education & Research), Mysuru. Finally, the institution provided an official authorization letter to proceed with the data collection. Because the data was acquired through medical chart review, informed permission was not required for this study. Personal identifiers were avoided, and records were kept in a secure way to protect confidentiality.

RESULT

During the study period, 1787 newborns were admitted to the NICU, with 113 neonates leaving against medical advice and 74 neonates having incomplete records and being excluded from the study. For this study, a total of 1600 newborns with results of improved/ death were included.

Sociodemographic characteristics: (Table 1)

According to the findings in Table 1, 985 (61.5%) of the neonates were males, while 615 (38.4%) were females, resulting in a male to female ratio of 1.6:1. 1308(93.4%) neonates were admitted within the first 7 days of their lives, and 292 (6.6%) were admitted within the first 8–28 days of their lives. The highest number of neonatal admissions was recorded in 2020, accounting for more than half (50%) of all neonatal admissions evaluated. Inborn neonates (those born in the same hospital) account for 916 (57.3%) of those admitted to the NICU, while outborn neonates (those referred from another facility) account for 684 (42.8%). Furthermore, mode of delivery is an essential criterion for neonates; in this study, 1107(69.9%) deliveries were done using LSCS and the remaining 493 (30%) were delivered via NVD+AVD.

Table 1: Sociodemographic characteristics of study participants admitted in NICU

Characters	Response	Frequency	Percentage
Sex of neonate	Male	985	61.5%
	Female	615	38.4%
Age of Neonates (in days)	=<7 days	1308	93.4%
	>7 days	292	6.6%
Number of cases admitted and year of admission at NICU	2020	1052	65.75%
	2021	548	34.25%
Source	Inborn	916	57.3%
	Outborn	684	42.8%
Mode of Delivery	AVD+NVD	493	30%
	LSCS	1107	69.9%

Table 2: Fetal health conditions and causes of neonatal admission in NICU

Variable	Category	Frequency	Percentage
Weight (gm)	=<2500 gm	794	49.6%
	>2500 gm	806	50.3%
Gestational age (week)	=<37 weeks (preterm)	877	54.8%
	>37weeks (term)	723	45.2%
Size of Neonates	AGA	1387	86.6%
	LGA+SGA	213	13.3%
Causes of neonatal admission in the NICU	Preterm	535	33.4%
	Renal cardiovascular Condition	329	20.5%
	Neurological condition & infection	297	18.6%
	Respiratory Condition	305	19.1%
	others	134	8.4%

Max respiratory support	O2	480	30%
	CPAP	513	32%
	CMV	98	6.1%
	NONE	509	31.6
Level of care	L2+SPL CARE	425	26.5%
	L3	1175	73.4%

Association of neonatal mortality with low Birth weight (p=0.001), [odds ratio (OR) 1.925 (1.303-2.845)], and Outborn source (p=0.042), [odds ratio (OR) 1.476 (1.014-2.148)] were detected by univariate analysis (Table 3). However, Respiratory Support-CMV with a p-value of 0.00 [odds ratio (OR) 5.623 (3.288-9.616)], Size of neonates (AGA) with p-value 0.004, [Odds ratio (OR) 1.957 (1.234-3.105), were all associated to neonatal death with a lower degree of odds.

Table 3: Univariate regression

Variable	Catagory	Neonatal mortality		COR (95%CI)	p-value
		Yes	No		
Age	=< 7 days	98	1210	1.101 (0.551-1.498)	0.704
	>7 days	20	272	1	
Gestational period	=<37 weeks	73	804	1.361 (0.931-2.011)	0.111
	>37 weeks	45	678	1	
Birth weight	=<2.5kg	76	718	1.925 (1.303-2.845)	0.001
	>2.5kg	42	764	1	
Source	Inborn	57	859	1	0.042
	Outborn	61	623	1.476 (1.014-2.148)	
Gender	Male	80	903	1.400 (0.936-2.094)	0.102
	Female	37	577	1	
Level of care	L2+ Spl care	1	424	1	0.000
	L3	117	1058	46.888 (6.529-336.741)	
Mode of delivery	AVD+NVD	33	457	1	0.496
	LSCS	85	1022	1.156 (0.762-1.753)	
Respiratory support	O2	29	451	0.782 (0.475-1.285)	0.332
	CPAP	39	474	0.448 (0.253-0.795)	0.006
	CMV	31	67	5.623 (3.288-9.616)	0.000
	NONE	17	488	1	
Size of neonates	AGA	92	1295	1.957 (1.234-3.105)	0.004
	LGA+SGA	26	187	1	
Disease	Preterm	38	497	1.062 (0.500-2.254)	0.876
	Renal cardiovascular Condition	17	312	0.757 (0.329-1.743)	0.513
	Neurological condition & infection	26	271	1.333 (0.607-2.927)	0.475
	Respiratory Condition	28	277	1.404(0.643-3.063)	0.394
	others	9	125	1	

In multivariate analysis, only four variables remained significant. All 4 variables (Birth weight, Respiratory support, Size of neonates, and Level of care) have shown an association with neonatal mortality. Birth weight less than or equal to 2.5kg has a significant p-value of 0.025 [adjusted odds ratio 1.297 (0.836-2.012)], Respiratory support has a significant p-value of 0.00 [CPAP AOR- 4.902(2.745-8.754), CMV AOR – 4.251 (2.184-8.274)], Size of neonates (AGA) with p-value 0.011, the adjusted Odds ratio is 0.513 (0.308-0.856) and Level of care with p value 0.00 [adjusted odd ratio 4.85 (3.102-11.471)] was associated with a decreased degree with neonatal mortality. These variables are showing a protective effect (AOR<1) on neonatal mortality.

Table 4: Multivariate regression

Variable	Category	AOR (95% CI)	P-value (significance)
Birth weight	=<2.5kg	1.297 (0.836-2.012)	0.025
	>2.5kg	1	
Source	Inborn	1	0.119
	Out born	1.375(0.954-2.053)	
Respiratory support	O_2	5.817 (3.367-10.051)	0.00
	CPAP	4.902(2.745-8.754)	
	CMV	4.251(2.184-8.274)	
	NONE	1	
Size of neonates	AGA	0.513(0.308-0.856)	0.011
	LGA+SGA	1	
Level of care	L2+SPL CARE	1	0.00
	L3	4.85(3.102-11.471)	

DISCUSSION

The documentation of mortality data is critical and valuable to healthcare providers, investigators, researchers, and decision-makers to devise interventions for prevention and treatment, hence enhancing care quality. The majority of published data studies on neonatal mortality have been undertaken in well-equipped tertiary hospitals' newborn units and at community levels around the world.[12,13]

A total of 1600 neonates were included in our study, with 118 of them reporting fatality.

Multivariate logistic regression found that Low Birth Weight (≦2500 grams), Respiratory support, size of neonates, and Level of care were associated with neonatal mortality.

Any mechanical ventilation or noninvasive respiratory support that provides positive end-expiratory pressure, such as continuous positive airway pressure, biphasic continuous positive airway pressure, high flow of air or oxygen (>1.5 L/min), non-invasive intermittent positive pressure ventilation, and noninvasive high-frequency oscillation, was defined as respiratory support (RS).[14] Newborns with RDS often required respiratory support. This study demonstrates that newborns who were on CPAP and CMV support were more prone to mortality. Stabilizing newborns with RDS on non-invasive respiratory support (NRS) such as continuous positive airway pressure (CPAP) and subsequently initiating surfactant therapy in selected neonates with an increased oxygen need has become standard practice.[15]

The first month is the most crucial period for child survival. Neonatal mortality continues to remain high with little improvement over the years.

These infants when admitted to the neonatal intensive care unit (NICU) need numerous interventions depending upon the severity of sickness and postnatal course like need of mechanical ventilation (MV) or noninvasive ventilation, surfactant administration, placement of central lines, total parenteral nutrition, and numerous medications. The duration of NICU and hospital stay of these high-risk infants varies from a few days to a few weeks to a few months. Long stay in the hospital leads to high hospital bills and increases the cost of neonatal care substantially.

Neonatal ventilation is an integral component of care delivered in the neonatal unit. The aim of any ventilation strategy is to support the neonate's respiratory system during compromise while limiting any long-term damage to the lungs. Understanding the principles behind neonatal ventilation is essential so that health professionals caring for sick neonates and families have the necessary knowledge to understand best practices. Many factors can influence clinical decision making on both an individual level and within the wider perspective of neonatal care.

Despite advancements in technologies and interventions made for improving the life of newborns, neonatal death remains an unfinished agenda as a serious public health concern in developing countries.

Preterm births are those that occur before 37 weeks of pregnancy. In India, about 3.5 million babies are born pre-maturely, 1.7 million have birth abnormalities, and one million newborns are discharged from Special New-born Care Units each year (SNCUs). These infants are still in danger of death, stunting, and developmental delays.[3] Premature deliveries are responsible for 75% of

perinatal death and more than half of long term morbidity.[20] Poor nutrition before and throughout pregnancy is one of the pregnancy related variables linked to premature birth. During pregnancy, avoid smoking and excessive alcohol use. Infections of the urinary tract and amniotic membranes are also associated with preterm birth.[20] Preterm care can reduce the burden of mortality, care includes -Preterm and full-term babies with low birth weights that require extra warmth and feeding support. Kangaroo mother care is a good way of doing this.[21]

CONCLUSION

Low birth weight, Respiratory support, size of neonates, and Level of care were all found to be associated with neonatal mortality in this study. As a result, health care facilities should focus on enhancing antenatal, intrapartum, and standardized care for admitted neonates. A prospective study is suggested.

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