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Survival Status and Cause of Deaths of Neonates admitted to SNCU: A study of district hospital of North India

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ABSTRACT
Special Newborn Care Unit is second level of facility-based care established to provide care for sick newborn. It is an important component of neonatal healthcare, particularly in settings where access to advanced medical care may be limited. The aim of this study is to analyze the survival status and cause of deaths of admitted newborn at Special Care Newborn Units at district hospitals, Siddharthnagar, Uttar Pradesh.The secondary data from hospital authority about admitted newborn of Special Newborn Care unit is obtained for year 2019 and 2020. Information on age, sex, weight, duration of stay, cause of death, outcome of newborn is obtained for 4,752 newborns admitted during this period. Percentage distribution, Kaplan Meier, log rank and cox proportional methods are used to get results. The STATA 14 is used to analyse the data.The early neonatal period is high risk of mortality. Also, Low Birth weight newborns are at higher risk than Normal birth weight newborns. The primary cause of death is HIE/birth asphyxia followed by Sepsis.The results of the present study can be used by hospital administrative authorities for new policy implications to improve the health status of neonatal admitted to the hospital.

Keywords:*SNCU, Neonatal Health, Neonatal Mortality, Cause of deaths, Siddharthnagar*

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I. INTRODUCTION

The Sustainable Development Goals (SDGs) aim for end to preventable deaths of newborns and children under age 5, by target to reduce neonatal mortality rate to 12 or fewer deaths per 1,000 live births and an under-five mortality rate to 25 or fewer deaths per 1,000 live births by 2030. According to recent unicef report, most of countries will not meet the under-five mortality and neonatal mortality SDG target by 2030[1]. The first month is the most crucial period for child survival. With the birth of 25 million children each year India accounts for nearly one fifth of the world's annual child births. Every minute one of those babies dies.

Facilities Based Newborn Care (FBNC) is the term used to describe the 24-hour clinical services offered by qualified staff in healthcare facilities[2, 3]. Facility-Based Newborn Care (FBNC) is an important strategy for reducing neonatal mortality rates and improving neonatal health outcomes in India, which has the highest number of neonatal deaths in the world [4]. The second level of the facility-based newborn care unit is the Special Newborn Care Unit. Special Newborn Care Units (SNCUs) have been established at district hospitals and subdistrict hospitals with an annual delivery load of more than 3000 to provide care for sick newborns. All types of neonatal care are except assisted ventilation and major surgeries. It is a separate unit near the labour room with 12 or more beds and managed by adequately trained doctors, nurses, and support staff to provide 24x7 services. This study is aimed to study the survival status and cause of deaths of admitted newbornof neonates admitted at Special Care Newborn Units at district hospitals, Siddharthnagar, Uttar Pradesh during 2019–2020.

II. METHODS

Hospital-based secondary data is obtained from the Special newborn care unit at District Hospital Siddharthnagar, Uttar Pradesh. This data is about newborn admitted in Special newborn care unit at hospital from January 2019 to December 2020. A total of 4,752 newborns are admitted during this period. It is consisting of information on age, sex, weight, duration of stay, cause of death, outcome (discharge, referral and death) of the newborn.

Univariate and Bivariate analysis is done to show expected basic results.The Kaplan Meier survival curve together with log rank test is fitted to determine the survival time. Variables which had p-value <0.05 in log rank test analysis is considered formultivariable cox regression analysis. Both unadjusted hazard ratio (UHR) and adjusted hazard ratio (AHR) together with the corresponding 95% confidence interval is shown.

Distribution of cause of death for different characteristics is also shown. The STATA version 14 is used to conduct statistical analysis.

III. RESULTS

Sample Characteristics of admitted neonates in ward

Table1 represents sample characteristics of admitted neonates in the ward during 2019-2020. The 4752 neonates involved in the study are shown in this table. Around 87% of newborns are up to 7 days old and almost 13% of neonates 7 days or older are included. Furthermore, of these neonates, around 67 % were male and 33 % were female. Furthermore, about half of the neonates were brought from the public hospital, followed by 41 % from the private hospital, and only approximately 9 percent were brought from home. Additionally, in the case of religion, the majority (78%) of neonates belonged to the Hindu religion, followed by the Muslim religion (22%). Furthermore, 45 percent of neonates had low birth weight (<2500 gm).

Outcome of admitted newborn

Figure 1 shows outcome of newborn admitted in last 2 years in SNCU. From total of 4752 newborn, around 76% newborn successfully discharged from hospital. 4.31% newborn leaved against medical advice, 8.40% newborn referred to higher referral unit and 11.17% of newborn expired.

Percentage of deaths with different characteristics

Table 2 show the percentage of deaths with different characteristics.Therevels that children up to 7 days at time of admission had a higher risk (11.79%) of deaths, whereas those children aged 7 at time of admission and more days found lower deaths (about 7%). Furthermore, female children's deaths were higher (about 12%) than male children's deaths (10.74%). Religion had not shown a difference in the deaths of neonates; for both religions, the deaths were almost the same. In terms of low birth weight (LBW), those children who had LBW were found to have higher mortality (13.82%) than children with no LBW (8.99%).

Survival Probability of neonates admitted in ward

Table 3 represents the overall Kaplan-Meier survival estimate. Out of total admitted newborn, 72 neonatal deaths occurred in the first 24 hours and 429 in the next 2 to 7 days. The cumulative survival rate of neonates at the end of the 28 days is 0.681 (95 % CI: 0.594, 0.754).

Figure 2 The graph shows the proportion of neonates who survived during the hospital stay. During the first seven days, the graph went down gradually, showing a higher proportion of neonates dying and a lower probability of survival. While, over the next 7 days (7 and 14), the proportion of neonates who survived slightly increased and the graph fell slowly up to the third follow-up time (21 days). In the last follow-up period of 23 days the graph became straight.

Category wise comparisonof Neonatal survival

Table 4 shows the result of the log-rank test for neonate's death. The findings of this table showed that age and birth weight are significant factors for neonate deaths. The sex of the newborn, from where they were brought and religion has no impact on neonatal deaths.

Figure 3 shows Kaplan Meier Survival estimates for both age groups (0-7 days and 7+ days). It showed that at the beginning of the stay, the life survival rate for both age groups was almost the same. Later, survival for the 0-7 age group decreases faster than for the 7+ age group.

Figure 4 The Kaplan Meier Survival estimates for low birth weight and normal birth weight showed that children with normal birth weight had higher survival rates than low birth weight. The Kaplan-Meier survival estimate showed that after 10 days survival rate is almost straight for normal birth weight children, whereas the survival rate for the children with low birth weight showed higher deflection in the graph.

Adjusted and unadjusted effect of predictors on neonatal mortality

Table 5 presents the Cox proportional hazard model with predictors of neonatal mortality. The unadjusted and adjusted results show highly statistically significant results for the age of children and low birth weight (LBW). The unadjusted results for age and low birth weight show that children aged 7+ days had a 0.54 times less likely risk of death of neonates than children aged up to 7 days, and children with LBW (2500 gm) were found to have a 1.47 times more likely risk of deaths of neonates than children with no LBW. However, after controlling for other factors, the adjusted results revealed that children aged 7 and up were 0.52 times less likely to die of neonates than their counterparts, and children with LBW were 1.5 times more likely to die of neonates than children without LBW.

Cause of death

Table 6 depicts the cause of death of neonates for different category wise of background factor. HIE/Birth Asphyxia is main cause of death with 57.06%, followed by Sepsis with 37.48% for overall newborn. Similar kind of pattern is seen for category wise cause of death having high proportion of death due to HIE/Birth Asphyxia followed by Sepsis.

Death among Low Birth Weight and Normal Birth Weight newbornby week

Table 7 revealed the weekly deaths among low-birth-weightand normal birth weight children. The findings in this table showed that neonatal deaths in the first week were the highest (17%) of deaths, followed by neonatal deaths in the second week with 2.5% of deaths, and then neonatal deaths in the third week with 1% of deaths. Similarly, the findings also showed that neonatal deaths in the first week were the highest (16%), followed by neonatal deaths in the second week with 1.5% of deaths, and then neonatal deaths in the third week with 0.5% of deaths.

IV. DISCUSSION

The findings of present study reveals that the percentage of death is higher in newborns up to age 7 days than 7 + days. Also, the death percentage is slightly higher in newborns with low birth weight. Among all predictors, only the newborn's age and birth weight are found statistically significantly affect neonatal death.There is a differential in survival probabilities between early and late neonatal groups. The survival curve for early neonatal falls more rapidly than for late early neonatal. It shows that early neonates are at a higher risk of mortality. There is also a difference in survival probability by birth weight. Normal birth weight newborns are at less risk than low birth weight newborns.Overall, HIE/Birth Asphyxia is the major cause of newborn death followed by Sepsis. HIE/birth asphyxia is the major cause of death among low-birth-weightnewborns. Around 17% of newborns died in the first week of life among low-birth-weightnewborns. At the same time, around 15% of newborn dies in the first week of life among normal birth weight.

Literature suggests different factors affecting neonatal mortality. The significant predictors of neonatal mortality included the length of the birth interval, breastfeeding status, higher birth order, non-institutional delivery and low birth weight [5, 6, 7, 8, 9]. The study by Gaiva found neonatal mortality was associated with maternal age of less than 20 years; prematurity; low birth weight; Apgar score of less than seven at 1 and 5 minutes; and congenital anomaly [10]. Lower gestational age, lower birth weight, delivery by cesarean section and birth in the month of May are risk factors for NICU admission [11]. Multiple gestations, preterm premature rupture of membranes, diabetes, abruption placentae, pregnancy-induced hypertension, and preterm labor were independently associated with at least a 3-fold risk of NICU admission [12]. A comparison study done in Northern and Southern regions of India shows that Neonatal mortality is higher in rural, poor households, the house had no toilet facility and a lower Wealth index has a negative association with neonatal mortality [13]. The chances of infant death in the case of a mother aged 20-29 years are 30% lower than that of infants born to younger mothers under 20 years [14]. A study by Ravikumar(2021) found that female children are at higher risk of mortality than male children[15]. Apart from these, Mother's education and household wealth are also strong predictors of child survival. The birth interval is an essential determinant of the risk of death in the first five years of life, repeatedly highlighted in previous studies [16, 17].

The literature review found that Asphyxia, Sepsis, Jaundice, LBW, and respiratory diseases are leading causes of morbidity and mortality in newborn care units. A Retrospective study for three years conducted in the SCNU of the teaching hospital of Assam shows that from the total admitted in the SCNU, the percentage share of the inborn newborn was high compared to outborn. The common morbidities in the study were neonatal sepsis, jaundice, and birth asphyxia. Mortality was much higher in the outborn compared to the inborn unit. 77.5% of deaths were early neonatal deaths. 66.1% of the death cases were LBW. Sepsis (42.6%), birth asphyxia (29.3%) and prematurity-related complications (17.5%) were the common causes of death [18]. A study conducted in the district hospital of Kurnool, Andhra Pradesh, identified LBW (49.72%), birth asphyxia (32.02%), respiratory distress (27.43%), and sepsis (23.41%) as major causes of morbidity [19]. A study conducted in Rohtas District of Bihar shows that the babies born outside the hospital had 2.5 times higher mortality rate than those born in our hospital. Most deaths were associated with LBW, prematurity, sepsis, respiratory distress syndrome (RSD) and intrauterine growth retardation [20]. A study by Pandya & Mehta in Vadodara, Gujarat, found that 54% of total admissions were outborn. Most admission in SNCU were jaundice followed by Sepsis, RDS, Perinatal asphyxia & Congenital anomalies. The most common cause of mortality was sepsis (40%), followed by birth asphyxia (21.4%) and RDS (12.2%)[21]. Uttarakhand's study reported that of newborns admitted to SNCU, 60.80% were inborn and 39.20% were outborn. Major admission causes were jaundice, sepsis, and birth asphyxia, whereas birth asphyxia was the primary cause of mortality, followed by sepsis and prematurity. Mortality was higher in outborn babies, at 14.67%, compared to inborn babies, at 9.80% [22].

V. CONCLUSION

The present study found that the newborn's age and birth weight are predominant factors affecting neonatal mortality of admitted newborns in SNCU. The leading cause of newborn deaths was HIE/Birth Asphyxia followed by Sepsis. The results from the current study are very much crucial for hospital administration. It predicts neonatal mortality and the cause of death of newborn admitted to SNCU of the district hospital of Siddharthnagar, Uttar Pradesh. These results can be used by hospital administrative authorities for new policy implications to improve the health status of neonatal admitted to the hospital. The present study included a smaller number of factors to predict the neonatal mortality due unavailability of data from hospital administration. This may be a severe limitation of this study. There is a scope of new studies with many factors to predict the risk of neonatal mortality in SNCU.

Table 1: Sample Characteristics of admitted neonates in ward

Characteristics	Frequency	Percent
Age		
Up-to 7 days	4,146	87.25
7 + day	606	12.75
Sex		
Male	3176	66.84
Female	1576	33.16
Brought		
Public	2,365	49.77
Private	1,963	41.31
Home	424	8.92
Religion		
Hindu	3,704	78.00
Muslim	1,048	22.00
Low birth Weight		
Yes (<2500g)	2,149	45.00
No (>2500g)	2,603	55.00
Total	4,752	100.00

Figure 1: Outcome of admitted newborn

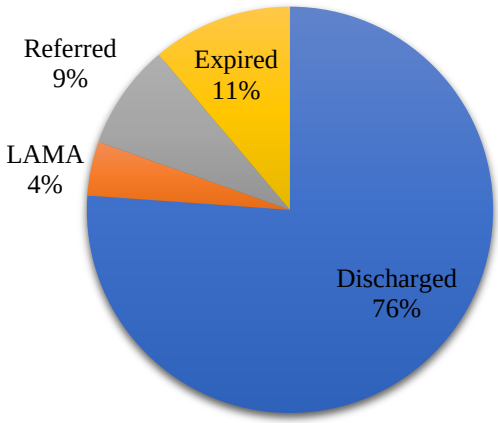

Table 2: Percentage of deaths with different characteristics

Characteristics		percent	frequency	p-value
Age group	upto 7	11.79	489	0.000
	7 +	6.93	42	
Sex	male	10.74	341	0.174
	female	12.06	190	
Brought	Public	10.91	258	0.710
	Private	11.61	228	
	Home	10.61	45	
Religion	Hindu	11.23	416	0.815
	Muslim	10.97	115	
LBW	Yes	13.82	297	0.000
	No	8.99	234	

Table 3: Kaplan Meier Survival Probability of neonates admitted in ward

Time (day)	Total	Death	Lost	Survival Probability	95 % CI	
0-1	4752	72	215	0.984	0.980	0.987
2-7	4465	429	3513	0.828	0.814	0.842
8-14	523	25	411	0.763	0.734	0.789
15-21	87	4	53	0.713	0.654	0.763
22-28	30	1	15	0.681	0.594	0.754

Figure 2: Overall Kaplan Meier Survival Estimate

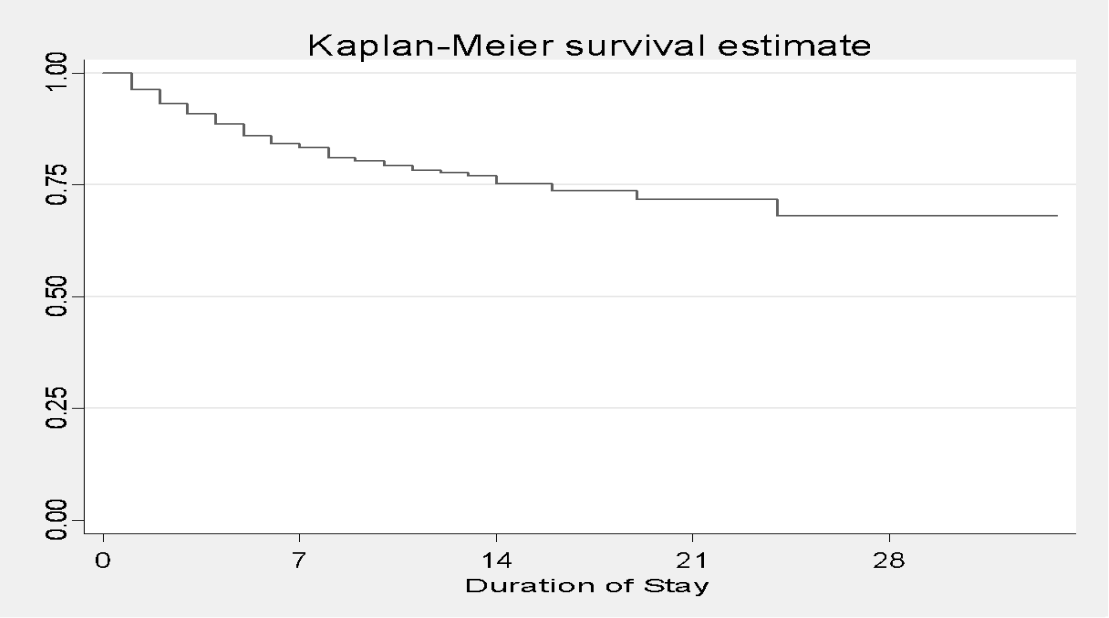

Table 4: Log Rank Test Result for Neonates

Characteristics	Log rank	p-value
Age	11.98	0.000
Sex	2.54	0.110
Brought	0.9	0.637
Religion	0.8	0.371
Low birth weight (LBW)	3.05	0.000

Figure 3: Kaplan Meier Survival Estimate for both age group

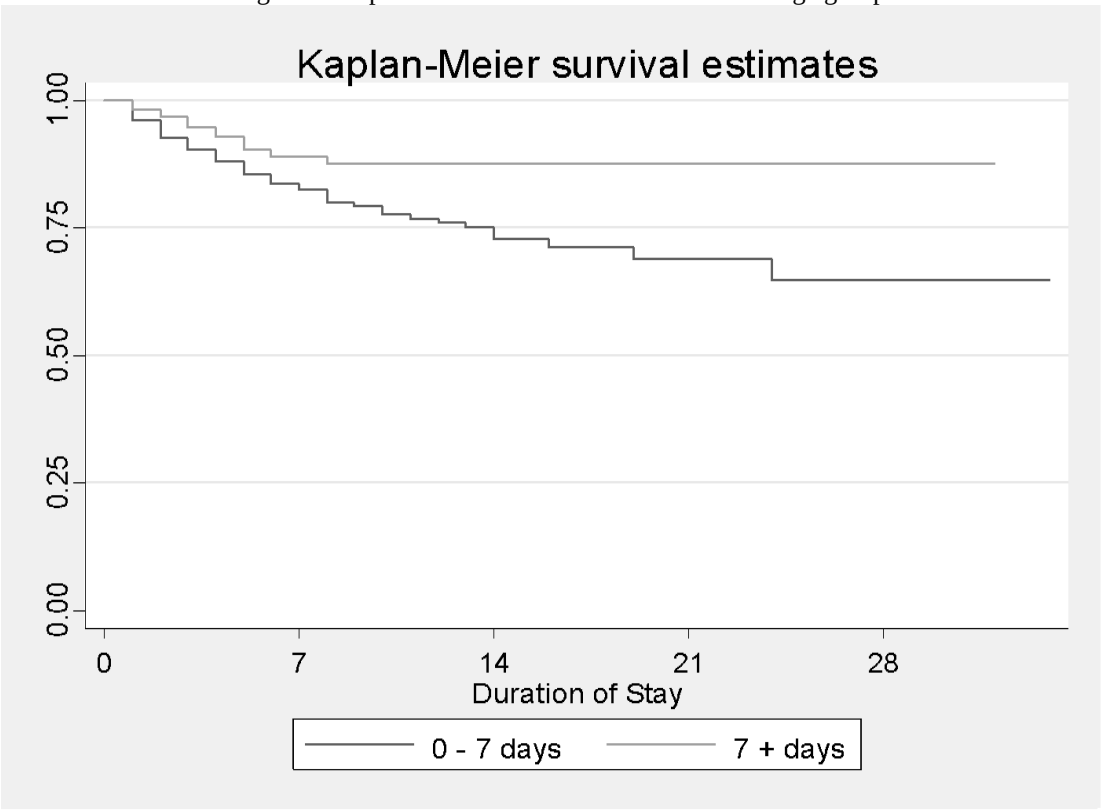

Figure 4: Kaplan Meier Survival Estimate for Low Birth Weight and Normal Birth Weight

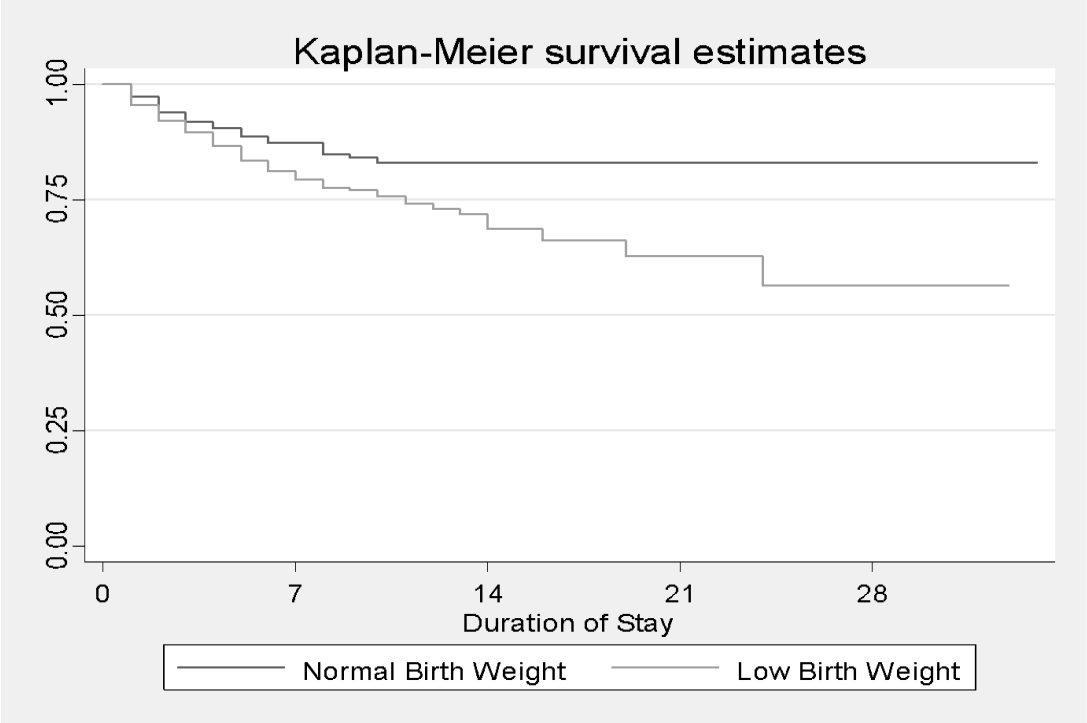

Table 5: Cox-proportional hazard model of predictors of neonatal mortality

Characteristics	Unadjusted HR	95 % CI		p-value	Adjusted HR	95 % CI		p-value
Age								
Up-to 7 days®	1							
7 + day	0.54	0.38	0.76	0.000	0.52	0.37	0.73	0.000

LBW								
No®	1							
Yes	1.47	1.22	1.77	0.000	1.50	1.25	1.80	0.000

Table 6: Cause of death category wise for different background characteristics

		HIE/Birth Asphyxia	Sepsis	Other	Total
Overall	N	303	199	29	531
	%	57.06	37.48	5.46	
Low Birth Weight	N	172	106	19	297
	%	57.91	35.69	6.4	
Normal Birth Weight	N	131	93	10	234
	%	55.98	39.74	4.27	
Early Neonatal	N	280	183	26	489
	%	57.26	37.42	5.32	
Late Neonatal	N	23	16	3	42
	%	54.76	38.1	7.14	
Male	N	189	130	22	341
	%	55.43	38.12	6.46	
Female	N	114	69	7	190
	%	60	36.32	3.68	

Table 7: Death among Low Birth Weight and Normal Birth Weight by week

	Low Birth Weight		Normal Birth Weight	
Characteristics	Death	%	Death	%
Neonatal deaths in 1st week	368	17.12	410	15.75
Neonatal deaths in 2nd week	54	2.51	39	1.49
Neonatal deaths in 3rd week	23	1.07	12	0.46
Neonatal deaths in 4th week	13	0.6	6	0.23

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