

Predictive Factors Affecting Newborn Survival Admitted in Special Newborn Care Units of Tertiary Care Hospitals

Shah Harsh¹, Nagar Shashwat^{2,*}, Thomas Ebbie³, Patel Jay⁴

ABSTRACT

Context: Government efforts are being made for the reduction of child mortality through the facility and community-based strategies. Studies have indicated that several other factors also have an impact on child survival. This calls for researches to be directed efforts and understanding of the local causes and factors associated with it. **Aim:** To analyze the socio-demographic, programmatic and clinical profile of neonates' admitted in SNCUs. **Settings and Design:** A cross sectional study among 43 SNCUs during year 2017-18. **Methods and Materials:** The data was recorded from the pre-defined case record registers and analyzed using simple proportions. **Statistical Analysis used:** Chi-square test and multivariable logistic regression analysis were carried out for finding the association between survival rate of neonates and other variables. **Results:** Out of 48,775 neonates admitted at selected SNCUs across the State, 68.5% were successfully discharged, 6.7% referred to higher centers, 10% left against medical advice and 15.2% died during the study period. Survival Rate was observed to be significantly associated with the Place of Delivery, Mode of Transport, Type of Admission, Maturity of child admitted, weight of a child during admission and Indications of admission.

Key words: SNCU, Child Survival, Regression, NMR, U5MR, Gujarat state.

Key Messages: Several factors influence the new-born survival which must be given attention along with the programme interventions. These factors must be studied more in-depth and may be given due weightage by the programme managers to enhance new-born survival.

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INTRODUCTION

Millions of children die every year because of preventable or treatable causes despite the progress over the last two decades. While concentrated efforts aimed at improving child survival received large reductions in mortality levels among children under 5 years of age in recent years, still, priorities are to be set to address the specific survival needs of children to reduce further deaths. Sustainable Development Goal (SDG) 3, target 3.2 suggests for an end to preventable deaths of new-borns and children under 5 years of age and specifies that all countries should aim to reduce neonatal mortality to at least as low as 12 deaths per 1,000 live births and under-five mortality to at least as low as 25 deaths per 1,000 live births by 2030.¹ During 2000-2017, neonatal mortality (NMR; deaths within the first 28 days of life) declined by 41 per cent and in 2017 alone, 5.4 million children died before reaching their fifth birthday. Globally, an estimated 2.5 million new-borns died in the first month of life in 2017 – approximately 7,000 every day – most of whom died in the first week after birth.²

According to various rounds of the National Family Health Survey (NFHS) data, the under-five mortality rate (U5MR) has declined by a little more than half in the past 23 years, namely, from 109 deaths (per 1000 live births) in c.1990 (five years prior to

the 1992–1993 NFHS) to 50 deaths (per 1000 live births) in c.2013 (five years prior to the 2015–2016 NFHS).³ For the same period, the reduction in the neonatal mortality rate (NMR) was only 19 units (per 1000 live births).^{3,4} Thus, if India makes progress towards a similar decline in the next 12 years, it is very likely to meet the target set by the Sustainable Development Goals (SDGs) for U5MR but unlikely to meet the NMR target. Neonatal mortality rate of Gujarat accounts for 63% of total under five aged children mortality. Gujarat has achieved U5MR of 33 per 1000 live births, IMR of 30 per 1000 live births and 21 per 1000 live births NMR.⁵ Gujarat has achieved considerable progress in maternal and child survival rates with available resources. There are very few studies that provide comprehensive overview of neonatal morbidity and mortality data with factor associated with them.

For a country, to achieve ambitious child survival goal, requires a basic understanding of the local causes for their deaths and factors associated with it. Simple interventions aimed at these main causes have been tested and found to be effective in reducing the neonatal mortality.^{6,7} The existing evidenced based practices can help to reduce more than 70% of neonatal mortality, but is often challenged by an

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uneven distribution of the service coverage in the various geographical areas.⁸ The facility based new-born care is crucial component but there are various programmatic and clinical components which affects the survival of the neonates.

The present study has been carried to analyse the various factors which have an impact on the neonatal survival among the SNCU admitted neonates. The various factors of the admitted neonates have been tested for to analyse their impact over the outcome in terms of neonatal survival. The aim of the study was to develop a regression model which can depict the impact of various contributing factors towards the survival of the admitted neonates. The study was conducted with the objectives to explicate the relationship of the various factors contributing to neonatal mortality and to find out the impact of various factors contributing individually and coherently towards the outcome among SNCU admitted children.

SUBJECTS AND METHODS

A cross sectional study was carried out amongst the 40 SNCUs which includes all Govt. supported Medical college attached hospitals, district hospitals and trust hospitals. These SNCUs are equipped with 15 beds to 100 beds of radiant warmer with all support system as per guidelines of SNCUs. In Gujarat, these SNCUs are supported by State Govt budget and National Health Mission. Study Population: The study subjects were 48,775 Neonates admitted in SNCUs who were delivered in same facility of SNCUs considered as "Inborn" and considered as "Outborn" if born outside. Study Period: The aggregated compiled secondary data was taken from April 2017 to March 2018. Data Collection: The monthly SNCUs reports were the source of data and due efforts were made to conceal identity of hospitals and patients. The primary data has been recorded in pre-defined case record registers of demographic, programmatic information of patients, clinical parameters of neonates and mothers filled up by paediatricians and staff nurses. It also includes information on mode of transport use during the process, place of delivery, duration of stay along with treatment outcome as discharged, expired, LAMA and referred. Inclusion Criteria: All babies who had less than 28 days of life admitted in SNCUs only with indoor registration number. Exclusion Criteria: The babies who had life of more than 28 days and not registered as indoor case. Ethical permission was sought from the concerned authority of State Health and Family Welfare, Govt of Gujarat. Limitation of analysis: The study was done on aggregated data of neonates based on Govt supported or Govt Affiliated SNCU admissions. The private owned SNCUs were not included into study. The follow up on discharged, LAMA and referred neonates were not done during the study. Data analysis: Statistical analysis was done analysing the percentages, proportions, Chi-square and multivariable logistic regression analysis using Statistical Package for the Social Sciences (SPSS) version 17 (SPSS-Inc., Chicago, US).

Multi-variable Logistic Regression Analysis

There was total 48,775 neonates admitted in SNCUs, out of which the outcome of the children who were referred or those who left against medical advice (LAMA) were removed and the multivariable logistic regression was run on the total of 40,806 cases of successfully discharged (33,412) and expired (7,394). A multivariable logistic regression analysis was carried out where the outcome was measured in terms of survived (successfully discharged) and non-survived (expired) among the all the children admitted in the SNCU for the said duration.

Predictors of the survival among children taken as independent variables were several variables like indication of admission, place of delivery, birth weight, maturity of the pregnancy, type of admission and mode of transport to the SNCU. Some of these variables had to be recoded

for developing a significant regression model. 'Place of delivery' (PoD) variable was categorized as FRUs, PHCs, Home Delivery, Private Institutes and Others. Here FRU was taken as comparative standard. 'Mode of Transport' (MoT) variable was categorized into self-arrange (private) and Govt. provided. Here Govt. provided was taken as comparative standard. 'Type of admission' (ToA) was categorized into inborn, out-born (health facility referred) and out-born (community referred by health staff). Here inborn was taken as comparative standard. 'Maturity' was categorized into pre-term, full-term and post-term. Here pre-term was taken as comparative standard. 'Weight' was categorized into normal, low, very low and extremely low. Here Normal was taken as comparative standard. 'Indication of admission' (IoA) was categorized into any other, congenital abnormalities, hypo/hyper-thermia, hypoglycaemia, low birth weight, meconium aspiration, jaundice, prematurity, respiratory distress and birth asphyxia. Here any other was taken as comparative standard.

RESULTS

Neonatal characteristics of SNCU Admission: During the study, 48,775 neonates were admitted at selected SNCUs across the State. Out of which, 27,542 (56.5%) neonates were inborn admission and 21,233 (43.5%) were outborn admission. There were admission of 18 (0.03%) ambiguous, 21347 (43.77%) female and 27410 (56.20%) male neonates admitted in SNCUs.

Outcome of the admitted neonates: The study found the outcome was categorized in 4 sections as successfully discharged, referred to higher centre, leave against medical advice (LAMA) and died. The analysis showed that 33,412 neonates were successfully discharged (68.5%), 3,287 were referred to higher centres (6.7%), 4,682 were left against medical advice (LAMA) (10%) and 7,394 were died during the study period (15.2%). The analysis found that every 2nd neonates was about to discharge successfully during the course of management. The study had not explored the reasons behind the LAMA and referred to higher centres as a limitation.

Multi-variable Logistic Regression Analysis (Above tables)

Dependent Variable: Outcome = Not Survived (coded as 0) and Survived (coded as 1). Hence, the outcome of "Not Survived" was taken as baseline or reference. Independent Variables were taken as below

1. Place of Delivery (PoD) (5)
2. Mode of Transport (MoT) (2)
3. Type of Admission (ToA) (3)
4. Maturity (3)
5. Weight (4)
6. Indication of Admission (IoA) (Categories: 10)

The chi-square test suggests that the independent variables added in this regression model was statistically significant related to dependent variable as $P < 0.001$. The association was found to be statistically significant which indicates that each of these had a relationship with the outcome in terms of survival. Cox and Snell R Square model summary suggests that 18.3 % of the Outcome was explained by these independent variables in this model. Out of 27 categories of all 6 variables, 6 categories were not significant and rest 21 categories were statistically significant in the model. The regression model has also shown the relationship of each of these having a direct impact on neonatal survival with beta exponential values.

Table 1 and 2 shows the male neonates formed the relative majority (56.3%) among all the genders. The regression equation model showed

that survival rate was higher in neonates referred from government institution was 84.8% followed by private institution (72.6%), during commute (70.9%) and home delivery (66.5%). This data revealed the importance timely stabilization and care at the place of delivery. In the equation, the majority of neonates was transferred through Government provided vehicle (53.5%) with a survival rate of 82.8%. The survival rate for the inborn was 87.1% followed by the referral from the community by front line health workers (84.5%) and referral from the other health facility (71.6%). The survival for the neonates referred from other health facility was low as compared to other referrals which may give hypothesis for the correlation between survival of neonates and delays in different mode of transport including supportive referral system.

The survival rate in the full term showed statistically significant (88.1%) as compared to pre-term (70.9%) and post-term (79.4%). The survival rate was significantly high in the normal birth weight of the neonates (89.2%) followed by low birth weight (86.1%), very low birth weight

(57.1%) and extremely low birth weight (12.8%) which was consistent with clinical scenario of new-born survival. The survival rate in neonates admitted at SNCUs with indication from jaundice was high (98.2%) followed by hypo/hyperthermia, hypoglycaemia, meconium aspiration, congenital abnormalities and others. The survival rate is lowest in neonates admitted with indication of prematurity (37.9%).

DISCUSSION

A number of studies have attempted to identify the contextual factors demographic, geographical factors and indirect causes associated with the childhood illnesses.⁹ The majority of high-risk districts for NMR and U5MR belong to the states of Assam, Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Orissa, Rajasthan and Uttar Pradesh. The high-risk districts in NMR terms are also across rich and advanced states like Andhra Pradesh, Gujarat and Telangana.¹⁰ Socio-economic factors such as urbanization, education status and family income; coupled with early

Table 1: Categorical Variable of Neonates admitted in SNCUs (N= 40,804).

Variables	Total No. (%)	Outcome		p-Value	
		Not-Survived	Survived		
Sex	Ambiguous	13 (0.03)	5 (38.5)	8 (61.5)	<0.001
	Female	17807 (43.7)	3011 (16.9)	14796 (83.1)	
	Male	22986 (56.3)	4378 (19.0)	18608 (81.0)	
Place of Delivery	Government Institution	31988 (78.4)	4869 (15.2)	27119 (84.8)	<0.001
	Private Institutions	5061 (12.4)	1386 (27.4)	3675 (72.6)	
	Home Delivery	1045 (2.6)	350 (33.5)	695 (66.5)	
Mode of Transport	During Commute	2712 (6.6)	789 (29.1)	1923 (70.9)	<0.001
	Government Provided	21840 (53.5)	3759 (17.2)	18081 (82.8)	
	Self-Arranged	18966 (46.5)	3635 (19.2)	15331 (80.8)	
Type of Admission	Inborn	23924 (58.6)	3094 (12.9)	20830 (87.1)	<0.001
	Outborn (Health Facility Referred)	13069 (32.0)	3710 (28.4)	9359 (71.6)	
	Outborn (Community Referred)	3813 (9.4)	590 (15.5)	3223 (84.5)	
Maturity	Pre-term	14722 (36.1)	4287 (29.1)	10435 (70.9)	<0.001
	Full-term	25953 (63.6)	3080 (11.9)	22873 (88.1)	
	Post-term	131 (0.3)	27 (20.6)	104 (79.4)	
Weight	Normal	15848 (38.9)	1717 (10.8)	14131 (89.2)	<0.001
	Low	19054 (46.7)	2650 (13.9)	16404 (86.1)	
	Very Low	4791 (11.7)	2057 (42.9)	2734 (57.1)	
	Extremely Low	1113 (2.7)	970 (87.2)	143 (12.8)	
Indication of Admission	Congenital Abnormalities	811 (2.0)	248 (30.6)	563 (69.4)	<0.001
	Hypo/Hyper-thermia	1468 (3.6)	48 (3.3)	1420 (96.7)	
	Hypoglycaemia	255 (0.6)	31 (12.2)	224 (87.8)	
	Low Birth Weight	5714 (14.0)	1408 (24.6)	4306 (75.4)	
	Meconium Aspiration	2249 (5.5)	402 (17.9)	1847 (82.1)	
	Jaundice	8265 (20.3)	151 (1.8)	8114 (98.2)	
	Prematurity	4037 (9.9)	1530 (37.9)	2507 (62.1)	
	Respiratory Distress	6286 (15.4)	1614 (25.7)	4672 (74.3)	
	Birth Asphyxia	5000 (12.3)	1260 (25.2)	3740 (74.8)	
	Any Other [#]	6721 (16.6)	702 (10.4)	6019 (89.6)	

[#]Hemorrhagic disease of newborn, neonatal tetanus, suspected inborn error of metabolism, Tetanus, Unknown

Table 2: Regression Equation Model (6 categories and 27 sub categories).

S.No.		Variables in the Equation					AOR	95% C.I. for AOR	
		B	S.E.	Wald	df	Sig.		Lower	Upper
1.	Category – PoD (FRUs)			53.156	4	.000			
	Category – PoD (PHCs)	.532	.128	17.171	1	.000	1.702	1.324	2.189
	Category – PoD (Home Delivery)	-.402	.081	24.403	1	.000	.669	.571	.785
	Category – PoD (Pvt. Institutions)	.083	.047	3.152	1	.076	1.087	.991	1.192
	Category – PoD (Others)	.006	.052	.012	1	.913	1.006	.908	1.114
2.	Category MoT (Self arranged)	-.128	.029	19.347	1	.000	.879	.830	.931
3.	Category ToA (Inborn)			331.054	2	.000			
	Category ToA (Outborn-Health Facility Referred)	-.587	.036	268.002	1	.000	.556	.518	.596
	Category ToA (Outborn-Community Facility Referred)	-.028	.064	.197	1	.657	.972	.857	1.102
4.	Category Maturity (Full term)			19.278	2	.000			
	Category Maturity (Pre term)	-.155	.039	16.084	1	.000	.856	.794	.924
	Category Maturity (Post term)	-.433	.221	3.823	1	.051	.649	.421	1.001
5.	Category of Weight (Normal)			1945.136	3	.000			
	Category of Weight (Low)	-.191	.038	25.251	1	.000	.826	.767	.890
	Category of Weight (Very Low)	-1.343	.052	656.405	1	.000	.261	.235	.289
	Category of Weight (Extremely Low)	-2.854	.075	1442.699	1	.000	.058	.050	.067
6.	Category of IoA (Any Other)			1377.986	9	.000			
	Category of IoA (Congenital Abnormalities)	-.779	.082	89.611	1	.000	.459	.391	.539
	Category of IoA (Hypo/Hyper-thermia)	.932	.153	37.232	1	.000	2.541	1.883	3.428
	Category of IoA (Hypoglycemia)	-.080	.199	.164	1	.686	.923	.625	1.362
	Category of IoA (Low Birth Weight)	-.039	.057	.466	1	.495	.962	.859	1.076
	Category of IoA (Meconium Aspiration)	-.793	.068	134.050	1	.000	.452	.396	.517
	Category of IoA (Jaundice)	1.521	.092	273.899	1	.000	4.578	3.823	5.482
	Category of IoA (Prematurity)	-.466	.061	58.050	1	.000	.628	.557	.708
	Category of IoA (Respiratory Distress)	-.684	.051	177.194	1	.000	.505	.456	.558
	Category of IoA (Birth Asphyxia)	-1.068	.052	424.102	1	.000	.344	.310	.380
	Constant	2.869	.050	3293.886	1	.000	17.619		

motherhood, poor nutrition, sanitation, safe drinking water, low use of antenatal care and skilled intrapartum care aggravates the chances of deaths.¹¹⁻¹⁶ The child survival efforts also depend upon the program implementation and their level of coverage across the Districts.

The Gujarat State has achieved considerable reduction in neonatal mortality after the introduction of National Health Mission (NHM). The NHM has supported to create infrastructure, provision of logistics and operational cost to execute neonatal care. There are 43 Govt Supported SNCUs across the Gujarat but the survival rate depends upon wide variety of factors surrounds mothers' antenatal to postnatal care and also on facility to community level new-born care. The analysis of demographic profile and type of admission were similar to previous studies of India.¹⁷⁻²⁰ As in this study, six variables- sub variables were analysed mostly on operational programmatic management and their association to neonatal survival suggested that comprehensive package for neonatal care should be in place and monitoring of these variables

would support the positive outcome of overall neonatal survival strategies.

The State has to utilize existing strategies of program implementation framework to accelerate the pace of reduction in neonatal mortality.²¹ The strong program monitoring structure has to be established by linking community-based interventions like home based new born care by ASHA to facility based new-born care (SNCU). The concentrated efforts in these identified areas are required starts from demand generation to facility-based care, a continuum care approach for neonates to under 5 in to have uniform achievement of SDG targets across the State.

CONCLUSION

The survival rate among the neonates depends upon several factors which play significant role in neonatal survival and hence must be given attention along with strengthening of program interventions. The study supports policy makers and program managers to identify the enablers

and barriers in operational management along with highlighting key preventive areas for efforts.

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CONFLICTING INTEREST

The authors declare that there is no conflict of interest.

ABBREVIATIONS

SNCU: Special newborn care units; **U5MR:** Under 5 mortality rate; **NMR:** Neonatal mortality rate; **LAMA:** Left against medical advice; **NHM:** National Health mission.

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