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Paediatrics Section

A Retrospective Study of Predictors of Mortality in Low Birth Weight Neonates in a District Hospital of Lucknow, India

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ABSTRACT

Introduction: Low birth babies account for 10% of neonatal mortality. Survival of these babies depends on gestation, birth weight, presence of associated co-morbidities and quality of neonatal care.

Aim: To evaluate predictors of mortality of low birth weight neonates admitted in Special Newborn Care Unit (SNCU) of a district hospital in Lucknow.

Materials and Methods: A retrospective analysis of case records were done to assess predictors of mortality of low birth weight babies admitted in SNCU of a district hospital in Lucknow from January 2017 to January 2020 was done. Neonatal variables in the form of gender, place of delivery, birth weight, gestation, mode of delivery, need for resuscitation at birth, respiratory distress, need for oxygen, duration of stay in hospital, neonatal outcome in the form of death, discharge, referral or leave against medical advice was assessed. The association between qualitative variables was assessed using Fisher's-exact test. Quantitative variables were analysed using unpaired t-test.

Results: Out of 2227 babies admitted in SNCU of a district hospital, 47.4% (n=1056) babies were low birth weight. Mean age of admission was 3.32±6.35 hours and mean weight on admission was 1.8±0.46 kg. A 53.41% (n=564) were preterm, 46.31% (n=489) were term and only 3 babies (n=0.28%) were post-term babies. A total of 655 (62%) babies were discharged, 85 (8%) referred and 316 (29%) died. Using univariate Odds Ratio (OR) to calculate the risk for mortality and taking p-value <0.05 statistically significant predictors of mortality were prematurity (p-value=0.001, OR 2.223), extremely low birth weight (<0.001), birth asphyxia (p-value=0.024, OR=1.399), place of delivery p-value=0.036, OR=1.290) and duration of stay in the hospital (p-value <0.001).

Conclusion: In the present study, it was seen that gestation less than 28 weeks extremely low birth weight perinatal asphyxia and duration of stay in hospital were the most important predictors of mortality. Timely referral could have saved these babies. Consolidation of the existing infrastructure with better networking among the district and tertiary hospitals is required.

Keywords: Co-morbidities, Gestation, Infant, Premature, Special care newborn unit

INTRODUCTION

Birth weight is an important marker of both maternal and foetal health. World over there has been marked improvement in survival of under five children. United Nations Inter-agency Group for Child Mortality Estimation 2020 report shows that greatest percentage of under five child death is due to neonatal deaths. Low birth weight babies comprised of a large percentage of neonatal deaths. Hence, in order to attain reduction in under five child mortality survival of low birth weight babies has to improve. In order to improve their survival, we need to know the predictors of mortality in them. In 2015, 20.5 million low birth weight babies were born [1]. On an average, nearly 70% of world's low birth weight babies are born in developing countries [2]. India has succeeded in bringing the percentage of low birth weight babies from 22% in 2005-2006 to 18% in the 2015-2016 [3]. Outcome of low birth weight babies is guided by a number of factors like gestation, associated co-morbidities like respiratory distress, sepsis, patent ductus arteriosus, birth asphyxia, hypothermia etc., Level of neonatal care too has a major impact on survival of these children [4,5].

Committee of Foetus and Newborn had defined the levels of neonatal care into level 1, 2 and 3 NICU based on their functional capabilities and regionalised system of perinatal care [6]. They have recommended that low birth weight babies above 32 weeks and weighing more than 1500 gram to be managed in level 2 NICU [6]. India has a very high delivery rate and majority of its population belongs to low income groups. Government run SNCU or level 2 NICU forms the backbone of neonatal care in India [5]. There are some studies on predictors of delivery of low birth weight babies in mothers which were conducted at community level [7,8]. However, these studies have not evaluated the determinants of survival of these babies in hospital setting. One hospital based study was conducted to evaluate the maternal risk factors of low birth weight babies. This study has not evaluated the neonatal variables and their impact on survival [9]. Most of the studies conducted in India have focussed on survival of very low birth weight babies and extremely low birth weight babies [10,11]. Both these studies were conducted nearly a decade ago. With everchanging and evolving newborn care and with the newer government initiatives the predictors of survival have also changed.

A 55% of neonatal deaths in India occur in four states i.e., Uttar Pradesh, Madhya Pradesh, Bihar and Rajasthan. These states also contribute to 15% of global neonatal deaths [12]. Uttar Pradesh is India's most populous state. Its capital city Lucknow is one of the most populous cities in the world with a high birth rate. Uttar Pradesh has high neonatal mortality rate which is higher than the national average. Hence, a study on newborns particularly the vulnerable groups of low birth weight babies would help us to find out the lacunae in the delivery system of healthcare. If we need to decrease the national neonatal mortality rate we need to study the predictors of mortality in babies admitted in the district hospitals of the state. Most of these district hospitals cater to high delivery load and are the epicentre of newborn care. Thus the results of

this study will have a national impact on newborn care delivery in India particularly the low birth weight babies. Hence, this study was conducted with the aim to evaluate the mortality, morbidity and predictors of mortality in low birth weight babies admitted in SNCU of a district hospital of Lucknow, Uttar Pradesh, India.

MATERIALS AND METHODS

A retrospective analysis of case records of all low birth weight babies admitted over the time period from January 2017 to January 2020 at SNCU of Dr Ram Manohar Lohia Combined hospital, Lucknow was done. This SNCU has 24 beds and 2 bubble Continuous Positive Airway Pressure (CPAP). The collected records were analysed in 2020. The admission criterion in NICU is weight less than 1800 grams or gestation more than 28 weeks. Those children requiring ventilation or not meeting the criteria for admission but delivered in the hospital were referred to higher centre after initial stabilisation. This hospital has a large catchment area covering nearby districts of eastern Uttar Pradesh. The hospital caters to rural population of low socio-economic strata with poor access to healthcare providing them treatment free of cost.

Inclusion criteria: Records of all living babies weighing less than 2500 grams admitted in SCNU of the study centre during January 2017 to January 2020, within 24 hours of birth irrespective of their place of delivery were included in the study.

Exclusion criteria: Neonates weighing less than 500 g, gestational age less than 26 weeks, babies with lethal congenital anomalies and still births were excluded from the study.

Definitions

Levels of neonatal care: The National Neonatology Forum of India [12] has classified the neonatal care into three levels with subdivisions as follows:

Level 1: Healthy newborn care and basic resuscitation.

Level 2a: Preterm care of newborns >32 weeks gestational age.

Level 2b: Preterm care of newborns >32 weeks requiring brief period of ventilation <24 hours or Continuous Positive Airway Pressure (CPAP) support.

Level 3a: Extreme preterm care.

Level 3b: Extreme preterm care with High Frequency Oscillatory Ventilation (HFOV), inhaled Nitric Oxide (iNO).

Inborn deliveries: Babies delivered in Dr. Ram Manohar Lohia Combined Hospital.

Outborn deliveries: Babies delivered in other hospitals and referred to Dr. Ram Manohar Lohia Combined Hospital.

Low birth weight babies: Babies weighing less than 2500 grams while babies <1000 g are considered as extremely low birth weight babies [13].

Small for gestational age/Intrauterine Growth Retardation (IUGR): Birth weight of babies less than 10th centile for gestational age based on intrauterine charts [11].

Respiratory distress syndrome: Infants presenting with respiratory distress at birth or within 24 hours of birth with characteristic radiological picture [11].

Neonatal sepsis: It is diagnosed on the basis of clinical picture of letharginess, refusal to feed hypothermia, hypoglycaemia, respiratory distress and seizures along with positive blood culture [9].

Birth asphyxia: Failure to initiate or sustain breathing after birth [11].

Preterm: Babies born less than 37 weeks gestational age [11].

Study protocol: Neonatal information in the form of gender, place of delivery, birth weight, gestation, mode of delivery, need for resuscitation at birth, respiratory distress, need for oxygen, duration of stay in hospital, neonatal outcome in the form of death, discharge, referral or leave against medical advice were retrieved from the prestored electronic data. In addition authors also noted the complications which the newborn developed during their stay in the SNCU like neonatal sepsis, neonatal seizures, jaundice hypoglycaemia and respiratory failure.

STATISTICAL ANALYSIS

The data was summarised in terms of frequency distribution while quantitative variables were expressed as mean±Standard Deviation (SD). The association between qualitative variables was assessed using Fisher's-exact test. Quantitative variables were analysed using unpaired t-test. Univariate OR was calculated to risk factors for mortality. A p-value <0.05 was considered statistically significant. The data was stored in Microsoft (MS) excel spreadsheet and statistical analysis was performed using open source R (Ross Ihaka and Robert Gentleman) programming language. Statistical Package for Social Sciences (SPSS) version 20.0 was used for data analysis.

RESULTS

A total of 2227 babies were admitted in the SNCU during the study period. Out of these, 1056 (47.42%) babies weighed less than 2500 gm, hence categorised as low birth weight babies. Their clinico-demographic profile is mentioned in [Table/Fig-1]. Out of total, 1171 babies weighed more than 2500 grams. The total of 458 of low birth weight babies were delivered by Lower Segment Caesarean Section (LSCS) and 598 babies were delivered vaginally. Clinico-demographic profile of these babies is shown in [Table/Fig-1]. A 655 (62%) of babies were successfully discharged. An 85 (8%) of babies were referred to level 3 NICU for ventilator support. A 316 (30%) of babies could not be saved. The neonatal complications were studied and associated with the outcomes in [Table/Fig-2]

Variables	Number of babies (%)
Total	**2227**
Birth weight	
Number of babies with birth weight >2500 gm	1171 (52.6%)
Number of low birth weight babies (birth weight <2500 gm)	1056 (47.4%)
Gender of LBW babies	
Male	588 (55.68%)
Female	468 (44.31%)
In-hospital/referred cases in LBW neonates	
Intramural deliveries	583 (55.21%)
Outborn hospital referrals	420 (39.77%)
Directly admitted from community	53 (5.02%)
Place of delivery	
Government hospital (delivered)	663 (62.78%)
Private hospital (delivered)	393 (37.22%)
Mode of transport of LBW babies	
Transport (private ambulances)	738 (69.89%)
Government ambulance transport	318 (30.11%)
Preterm babies	564 (53.41%)
Term babies	489 (46.31%)
Post-term babies	3 (0.28%)

[Table/Fig-1]: Clinico-demographic profile of studied participants.

On analysis, the study found that prematurity, extremely low birth weight, neonatal complications during admission (RDS, neonatal sepsis, birth asphyxia, neonatal jaundice) and place of delivery were significantly associated with the outcomes [Table/Fig-2].

For the total sample of low birth weight babies in the present study, mean age of admission 3.32±6.35 hours, mean weight on admission was 1.8±0.46 kg, mean discharge weight was 1.83±0.47 kg and mean duration of stay of babies in SNCU was 8.49±9.93 days. On categorisation and analysis of the data, it was found that, mean weight on admission, mean discharge weight and mean stay of neonates in the hospital was significantly associated with the outcomes of their treatment and survival [Table/Fig-3].

DISCUSSION

The Million Death Study conducted between 2000-2015 to assess cause specific neonatal and under 5 years child mortality had found that neonatal death rates due to prematurity and low birth weight were significantly higher in rural areas and poorer states compared to urban areas and richer states [13]. Special care newborn unit is the initiative taken by Ministry of Health and Family Welfare Government of India to provide all types of sick care other than ventilator care to newborns neonates in district and sub district hospitals. Currently, there are more than 500 SNCU in India with 27 SNCU in Uttar Pradesh and 3 SNCU in Lucknow [14]. Aim of establishing these SNCU's were to decrease the neonatal mortality rate to >5% per year from 2015 onwards to establish 2030 Sustainable Developmental Goals for Child Mortality [13]. Neonatal mortality rate in India in 2013 was 28 per 1000 live births and infant mortality rate was 40 per 1000 live births [14]. Nearly, 70% percent of infants die in the neonatal period. The neonatal mortality rate in 2019 was 22 per 1000 live births and the infant mortality rate is 28 per 1000 live births [15]. Thus, though we have significantly reduced the infant mortality rate from 40% to 28%, 70% of infant's death still occurs in neonatal period. Planning Commission of India appointed a high level expert group to look after

Outcome →	Expired n=316		Discharged n=655		Patient left against medical advice n=85 (%)	p-value*	Odds ratio	95% CI for odds ratio	
Morbidity	**n**	**%**	**n**	**%**				**Lower**	**Upper**
Term of subjects									
Preterm (n=564)	205	64.87%	274	41.83%	85	**0.001**	2.223	1.676	2.949
Post-term	0	0	2	0.3%	0	0.152	-	-	-
Birth weight									
Extremely low birth weight babies (ELBW) (n=57)	32	10.12%	7	1.06%	18	**0.001**	9.536	4.768	19.072
Gestational age									
<28 week gestational age (n=5)	5	1.58%	0	0	0	**0.001**	-	-	-
Neonatal complications									
Respiratory Distress Syndrome (RDS) or Hyaline Membrane Disease (HMD) (n=98)	22	6.96%	73	11.14%	3	**0.007**	0.538	0.329	0.880
Neonatal sepsis (n=170)	40	12.65%	118	18.01%	12	**0.004**	0.589	0.401	0.866
Birth asphyxia (n=199)	75	23.73%	109	16.64%	15	**0.024**	1.399	1.004	1.950
Prematurity (28-37 weeks) (n=162)	60	18.98%	98	14.96%	4	0.160	1.198	0.840	1.708
Transient tachypnoea of new born (n=8)	1	0.31%	7	1.06%	0	0.094	0.268	0.038	1.899
Neonatal jaundice (n=33)	4	1.26%	29	4.42%	0	**0.003**	0.252	0.094	0.670
Neonatal aspiration of meconium (n=15)	4	1.26%	8	1.22%	3	0.464	0.946	0.283	3.167
IUGR (n=5)	0	0	5	0.76%		0.052	-	-	-
Place of delivery									
Inborn (n=583)	165	52.22%	333	50.84%	85	0.159	0.869	0.659	1.145
Outborn (health facility referred) (n=420)	144	45.56%	236	36.03%	40	**0.036**	1.290	0.978	1.701
Outborn (community referred) (n=53)	2	0.63%	20	3.05%	31	**0.005**	0.184	0.050	0.679
Gender									
Male (n=588)	186	58.86%	341	52.06%	61	0.290	1.082	0.818	1.431
Female (n=468)	125	39.55%	248	37.86%	95		0.924	0.699	1.222
Mode of transport									
Govt. provided transport (n=318)	93	29.43%	178	27.17%	47	0.461	0.985	0.730	1.329
Self-arranged transport (n=738)	218	68.99%	411	62.75%	109		1.015	0.752	1.370

[Table/Fig-2]: Factors affecting survival of low birth weight babies.
*Fisher-exact test; IUGR: Intrauterine growth retardation; Govt.: Government; p-value <0.05 considered significant

Outcome →	Expired mean±SD	Discharged mean±SD	p-value^
Duration of stay (days)	3.42±6.69	11.76±9.86	**<0.001**
Discharge weight	1.63±0.53	1.94±0.41	**<0.001**
Age (days)	2.71±6.17	3.41±6.35	0.055
Weight at time of admission	1.63±0.53	1.90±0.39	**<0.001**

[Table/Fig-3]: Effect of age and weight on survival of low birth weight babies.
^Unpaired t-test; p-value <0.05 considered significant

the determinants of neonatal mortality. They found that neonates born to rural poor women or to conventionally demoted and debarred communities had a higher probability of being omitted from the health services [16]. In India, prevalence of low birth weight babies is 16% [17]. Low birth weight babies account for nearly 10% of neonatal mortality. Hence, if the doctors at the healthcare facility provide better care to this group of babies, neonatal mortality rate can be curbed.

In present study, 1056 babies (47.4%) of total SNCU admission comprised of low birth weight babies. The survival rate of low birth weight babies was (655 babies) 62%. Similar survival rate was also seen in another study on low birth weight babies in Southern India [18]. Study population had male preponderance which is similar to other related studies from India and Iran [19,20]. However, gender had no impact on survival of these babies. Mean age of admission was three hours with mean admission weight being 1.8 kg. Duration of stay and birth weight were significant factors affecting the outcome of these babies. Other significant predictors of mortality were gestational age, prematurity, respiratory distress and perinatal asphyxia. These observations were also seen in another study conducted in Northern India [19]. Inborn babies had better chances of survival compared to outborn babies. Those babies admitted from the community had worse outcome. This could be explained as those babies who were admitted from community had community acquired sepsis and there had been a delay in seeking medical attention. Similar observations were made by Downie L et al., [21].

A very recent study from India found out that Intraventricular Haemorrhage, hyperglycaemia and respiratory distress requiring surfactant were found to be most common cause of mortality in very low birth weight babies [22]. Majority of survival studies in recent past have focussed on very low birth weight and extremely low birth weight babies. India still lacks behind in improving its neonatal mortality despite significant initiatives taken. Hence, further prospective studies are required from all parts of country and with greater sample size to formulate recommendations and guidelines on management of low birth babies in India. Strengths of the present study are study sample size and place of study. Study was conducted in one of the busiest district hospital of India's most populous state catering to a very high delivery load. No study has been done in the 21st century on evaluating the predictors of mortality of low birth weight babies, all the studies done so far are nearly a decade old and much has evolved in both treatment and demography of the study population.

Limitation(s)

Being single centre hospital based evaluation and retrospective nature, the present study was limited in the inferences and results drawn.

CONCLUSION(S)

Prevention of preterm deliveries, better antenatal and postnatal care, improvement of existing health infrastructure with proper and timely referral of sick babies is the key to survival of low birth weight babies.

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