A Cohort Study on Survival Predictors of Low Birth Weight Newborns

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ABSTRACT

Introduction: Low Birth Weight (LBW) represent a vulnerable group of newborns associated with high risk of complications thus have a high mortality rate. There are many factors affecting the early survival of LBW neonates. There are limited studies providing the evidence on survival predictors in the newborns in western Indian region.

Aim: To identify the various factors determining the survival of LBW newborns.

Materials and Methods: This was a prospective cohort study conducted in the Neonatal Intensive Care Unit (NICU) of the Department of Paediatrics, Jay Kay Lon Mother and Child Hospital, a neonatal and paediatric tertiary care centre attached to Government Medical College, Kota, India over a period from January 2011 to December 2011. Three hundred and sixty two newborns, admitted to the neonatal intensive care unit with birth weight <2500 gm within 24 hours of birth, were included in the study. Data were interpreted by using Statistical Package for Social Sciences (SPSS) Software for windows version 20.0. Those babies that were transferred and directly discharged to home were pooled as survivors and for the purpose of analysis were compared to babies that died during hospital stay. Associations between categorical variables and survival and death outcome were performed using the Chi-Square test. The p-value less than or equal to 0.05 was considered significant.

Results: This study of total sample of 362 newborns, reported a survival rate of 76.52% (277) and a mortality of 23.48% (85). Single gestation birth had better survival (78.69%) than multiple births (64.91%) (p=0.024). The survival improved as the birth weight increased (p<0.001). The survival in female was better (82.31%) as compared to males (72.56%) (p=0.032). The survival in Appropriate for Gestational Age (AGA) newborns was better (79.85%) than Small for Gestational Age (SGA) (67.68%) (p=0.0149). Neonates delivered to mothers who received antenatal steroids had a survival rate of 76.14% as compared to 68.13% in those who had not received steroids (p<0.02). Main cause of mortality in the study group was Respiratory Distress Syndrome (RDS) (86.36%) followed by Birth Asphyxia (BA) (33.33%) and Necrotising Enterocolitis (NEC) (33.33%).

Conclusion: The BA and RDS were the most common cause of neonatal mortality among various other complications related to prematurity and LBW. However, there are several factors that interplay and it is not possible to single out any particular factor influencing LBW survival. Reducing perinatal mortality requires a multidimensional approach with timely identification and appropriate management of the issues related to potential complications of prematurity as RDS, LBW and BA.

INTRODUCTION

The LBW is defined as birth weight less than 2,500 grams at birth irrespective of period of gestation. In developing countries like India, 30-35% babies are born LBW. However, more than 50 percent of these infants are full term babies mainly due to lack of intrauterine nourishment termed as Intrauterine Growth Retardation (IUGR) [1].

In India alone, 6-8 million babies are born annually. High incidence of LBW babies in India is not due of premature babies rather because of the higher number of babies born with IUGR (small-for-date) [2]. In developing countries like India, LBW infants is estimated to have 2.3 times increased risk of mortality due to infections after considering for all the confounding variables [3,4]. LBW represent a vulnerable group of newborns with a high mortality rate. There are many factors which determine the early survival of LBW neonates. LBW/Prematurity account for more than 80 percent [5] of all neonatal death in India, being contributed largely by maternal factors like early marriage, frequent teenage pregnancies, maternal malnutrition,

anaemia, infections and genital colonisation, illiteracy and also high incidence of pregnancy induced hypertension among malnourished and socio-economically deprived women [6]. When it comes to neonatal deaths in India, preterm birth complications (43.7%) is the major cause of death followed by infections (20.68), intrapartum related (19.2%), congenital malformations (8.1%), others (8.2%) [7].

Despite the attention, time, effort and resources being given for their care, the mortality in LBW newborns is very high. Survival of LBW babies is directly associated with their weight at birth and inversely associated with severity of the neonatal illness and gestation age [5]. But these are not the only factors to impact on the neonatal mortality. The interaction of the severity of the neonatal illness and physiological variations complicate the management strategies, appropriateness of which determines the neonatal outcome [6].

As there are limited studies providing the evidence on survival predictors in the newborns in the western Indian region, this study aimed to generate the evidence on the same. The study aimed to identify the various factors determining the survival of LBW newborns.

MATERIALS AND METHODS
This hospital-based cohort study was conducted in the NICU under Department of Paediatrics, Jay Kay Lon Mother and Child Hospital, from January 2011 to December 2011. The institute is a neonatal and paediatric tertiary care centre attached to Government Medical College, Kota, India. The study was conducted following the declaration of Helsinki and patients were handled with due care while the data were kept anonymised.

Inclusion criteria: Newborns admitted to the neonatal intensive care unit with birth weight <2500 gm within 24 hours of birth, in the selected study centre, were included in the study after obtaining written informed consent from parents.

Exclusion criteria: Neonates weighing less than 500 gm and with gestational age less than 26 weeks, presence of congenital malformations and death in the delivery room or within 12 hours of life were excluded from the study.

Study Procedure
Demographic details were recorded in a preformed proforma along with detailed perinatal history with special emphasis on history of maternal illness like fever/rashes/history of blood transfusion/hypertension, whether steroid was given in case of anticipated preterm delivery, any obstetric complications, age and parity of mother noted, mode of delivery, place of delivery and whether single or multiple birth, were taken.

Thorough clinical examination encompassing history of lethargy, poor feeding, jaundice, excessive, fever, vomiting, fast breathing,

and abdominal distension were taken. Birthweight of every newborn was measured in gram using a pre-tested and precalibrated weighing machines. Newborns were classified according to the birth weight as follows [8-11]:

a) LBW (Low birth weight)-Less than 2500 grams

b) VLBW (Very low birth weight)-Less than 1500 grams

c) ELBW (Extremely low birth weight)-Less than 1000 grams.

Weight for gestational age was estimated using the foetal growth chart [8]. Gestational age was assessed using New Ballard Scoring system [12]. Newborns were classified according to gestational age as follows:

a) Preterm: Less than 37 completed weeks

b) Late preterm: between 34 weeks through 36 weeks of Gestational Age (GA)

c) Term: 37 weeks to 42 weeks

d) Post term: 42 weeks or more

A detailed physical examination and anthropometry of the neonates were recorded according to the proforma. Investigations were advised as per the neonatal condition and treatment protocol in the institution. A detailed history as above, along with complete examination on admission and at the time of discharge was done and the following were noted:

• Progress during hospital stay and outcome.

• Details of morbidities and mortality developed during hospital stay; if any.

The outcome measure was in-hospital death and survival was defined as the discharge of a live infant from the hospital.

STATISTICAL ANALYSIS
Data were collected in excel sheet and interpreted by using SPSS software for windows version 20.0., to identify factors affecting neonatal mortality and morbidity. Those babies that were transferred and directly discharged to home were pooled as survivors and for the purpose of analysis were compared to babies that died during hospital stay. Associations between categorical variables and survival and expired outcome were performed using the Chi-square test. The p-value less than or equal to 0.05 was considered significant.

RESULTS
Of 362 newborns, 277 (76.52%) survived and 85 (23.48%) died [Table/Fig-1]. Majority of the mothers belonged to the age group 18-35 years of age. The survival rate in the newborns of mothers in the age group of <18 years, 18-35 years and >35 years was 75%, 76.66% and 71.43%, respectively (p=0.94). Of the total births, 15.75% were of multiple births and 84.25% were of

Maternal parameters					
		Survived (277) (%)	Died (85) (%)	Total (362) (%)	p-value
Maternal age (in years)	<18	6 (75)	2 (25)	8 (2.21)	0.94
	18-35	266 (76.66)	81 (23.34)	347 (95.86)	
	>35	5 (71.43)	2 (28.57)	7 (1.93)	
ANC visits	Yes	236 (77.12)	70 (22.88)	306 (84.53)	0.526
	No	41 (73.21)	15 (26.79)	56 (15.47)	
Gestation	Single	240 (78.69%)	65 (21.31%)	305 (84.25%)	0.024
	Multiple	37 (64.91%)	20 (35.09%)	57 (15.75%)	
Maternal risk factors	No	191 (81.28)	44 (18.72)	235 (64.92)	0.003
	Yes	86 (67.72)	41 (32.28)	127 (35.08)	
Antenatal steroid (248)	No	109 (68.13)	51 (31.87)	160 (64.52)	0.02
	Yes	67 (76.14)	21 (23.86)	88 (35.48)	
Gravida	Primigravida	240 (78.69)	65 (21.31)	305 (84.25)	0.024
	Multigravida	37 (64.91)	20 (35.09)	57 (15.75)	
Mode of delivery	Vaginal	210 (74.47)	72 (22.53)	282 (77.90)	0.084
	LSCS	67 (83.75)	13 (16.25)	80 (22.1)	
Neonatal parameters					
Sex	Male	156 (72.56)	59 (27.44)	215 (59.39)	0.032
	Female	121 (82.31)	26 (17.69)	147 (40.61)	
Birth weight	ELBW	3 (17.65)	14 (82.35)	17 (4.70)	<0.001
	VLBW	60 (59.41)	41 (40.59)	101 (27.90)	
	LBW	214 (87.70)	30 (12.30)	244 (67.40)	
Maturity	Preterm (<37 weeks)	233 (73.97)	82 (26.03)	315 (87.02)	0.003
	Term (>37 weeks)	44 (93.62)	3 (6.38)	47 (12.98)	
Weight for Gestation	AGA	210 (79.85)	53 (20.15)	263 (72.6)	0.0149
	SGA	67 (67.68)	32 (32.32%)	99 (27.35)	

[Table/Fig-1]: Maternal and neonatal parameters affecting the neonatal outcome.
ANC: Antenatal care; LSCS: Lower segment caesarean section; AGA: Appropriate for gestational age; SGA: Small for gestational age; In 248 cases there was an indication for steroid administration, hence n=248 in that particular category

single gestation. Single gestation birth showed better survival (78.69%) than multiple births (64.91%) (p=0.024).

In this study, primigravida constituted 84.25% and had a better survival rate 78.69% compared to 64.91% in multipara mothers (p=0.024). Maternal risk factors association with neonatal outcome was statistically significant (p=0.003). The survival among AGA babies was better (79.85%) than SGA (67.68%) (p-value=0.0149). In the study group, 67.40% babies were LBW. The ELBW babies showed the lowest survival rate (3 out of 17 i.e., 17.65%) and LBW babies had highest survival rate of (214 out of 244 i.e., 87.70%). Males were more in number (59.39%) than females (40.61%); but the survival in female was better (82.31%) (p=0.032).

Out of the 362 neonates, preterm neonates constituted 315 (87.02%) and their survival rate was 73.97%, whereas among the 47 (12.98%) term neonates, the survival rate was 44 (93.62%) (p=0.003). Those neonates whose mothers received antenatal steroids had a survival rate of 76.14% as compared to 68.13% in those who had not received steroids (p<0.02).

The common causes of mortality in the study group were RDS (86.36%) followed by BA and NEC (33.33%). These association were found to be statistically significant (p<0.001) [Table/Fig-2]. Maternal risk factors' association with neonatal outcome was statistically significant (p=0.003) [Table/Fig-1,3].

Diagnosis	No. of cases	Survived n (%)	Died n (%)
Neonatal sepsis	181	162 (89.50)	19 (10.50)
Neonatal jaundice	93	77 (82.80)	16 (17.20)
Respiratory distress syndrome	66	9 (13.64)	57 (86.36)
Birth asphyxia	66	44 (66.67)	22 (33.33)
Prematurity	40	29 (72.50)	11 (27.5)
Congenital pneumonia	4	4 (100)	0
TTNB	5	5 (100)	0
Haemorrhagic disease of newborn	4	3 (75)	1(25)
Necrotising enterocolitis	3	2 (66.67)	1 (33.33)
BPD	1	0 (0)	1 (100)
Intracranial haemorrhage	2	1 (50)	1 (50)

[Table/Fig-2]: Outcome according to neonatal clinical condition.
TTNB: Transient tachypnoea of newborn; BPD: Bronchopulmonary pulmonary dysplasia

Maternal risk factors	Number of cases	Neonatal survival n (%)	Neonatal mortality n (%)
Anaemia	24	18 (75)	6 (25)
Hepatitis	7	7 (100)	0
Fever	10	7 (70)	3 (30)
Hypothyroidism	1	1 (100)	0
Tuberculosis	1	1 (100)	0

MSL	12	10 (83.33)	2 (16.66)
Oligohydramnios	6	6 (100)	0
APH	48	29 (60.41)	19 (39.59)
PIH	26	20 (76.92)	6 (23.08)
PROM	71	48 (67.60)	23 (32.40)

[Table/Fig-3]: Distribution as per maternal risk factors.
MSL: Meconium-stained liquor; APH: Antepartum haemorrhage;
PIH: Pregnancy induced hypertension; PROM: Premature rupture of membranes

DISCUSSION

In the present study, the Neonatal Mortality Rate (NMR) for LBW babies was found to be 234.8 per 1000 live births, which is in accordance to the studies conducted in India by D'Sa S et al., which showed NMR for LBW babies in number of 254, however it was more than NMR of 124.7 from India, 133 from Bangladesh and 110 from Ethiopia for 1000 live babies born [13-16].

In the present study the males constituted 59.39% (215) and females 40.61% (147) which were similar to study conducted in India by D'Sa S et al., where males constituted 56.6% and females 43.4% [13]. The overall survival in females (82.31%) was better than males (72.56%) which correlate with study by Aghai ZH et al., where survival in females was 72.6% and males was 66.8%, and a study from Iran which showed survival in females (82%) was better than males (74%) [17,18]. Better survival in females can be explained by body-fat hypothesis which states than females have more body fat and low metabolic rate which make them better survivors [19].

Births from multiple gestations (twins, triplets, quadruplets) constituted 15.75% and single gestation was 84.25% with mortality of 35.09% and 21.31%, respectively. A similar trend was seen in the multi-country studies involving India (along with 29 other countries) and Vogel JP et al., (along with 22 other countries) showed multiple gestation have 2-3 times more mortality rates than singleton gestation [20,21].

In the current study, survival rates in ELBW, VLBW and LBW babies were 17.65%, 59.41% and 87.70%, respectively. A study conducted in India showed survival increases with birth weight (ELBW-38.4% and VLBW-73.6%) and similar results (ELBW-10.3%, VLBW-46.5% and LBW-89.2%) were found by Velaphi SC et al., in a study from South Africa [22,23]. Therefore, it can be concluded that as the birth weight increases the survival rate also improves.

Maternal medical conditions adversely affect the outcome of their offspring. In the present study also, those mothers with risk factor had poor neonatal outcome. Of the total cases, 64.92% were without risk factors out of which 81.28% survived and 35.08% had various risk factors most common being premature rupture of membrane out of them 67.72% survived (p=0.003).

A study from Kerala, showed 79.81% mothers with risk factors delivered LBW babies and a study from Maharashtra showed LBW babies were more common in mothers with risk factors [24,25]. Both studies also showed that LBW was the significant risk factor for perinatal mortality. Similarly, the studies by Hedderson MM et al., Moore MI and Zaccaro DJ showed prematurity being most common with mothers with various medical conditions [26,27].

In the present study, the survival rate in preterm and term neonates were 73.97% and 93.62%, respectively. This means that survival is not only influenced by birth weight but also by the gestational age. We also observed that as the gestation age increased so as the chance of survival. These findings were comparable with similar other studies [28-30].

The survival rate in the neonates whose mothers received antenatal steroids was better than who did not receive it. The above findings were in accordance with studies done by Basu S et al., Varghese GM et al., Locatelli A et al., where failure to administer steroid was an independent predictor of mortality [9,31,32]. In the newborns steroid when given antenatally helps in lung maturity [33]. The present study considered the neonates of mothers with diverse risk factors in a tertiary care hospital.

Limitation(s)

The study was conducted in a single centre and cannot be generalised.

CONCLUSION(S)

Most cases of neonatal mortality were related to BA, RDS and complications related to prematurity and LBW. There are several factors at interplay and it is not possible to single out any particular factor influencing LBW. Reducing perinatal mortality requires a multi-dimensional approach with timely identification and appropriate management of the issues related to potential complications of prematurity as RDS, LBW and BA.

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