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PREDICTORS OF MORTALITY IN VERY LOW BIRTH WEIGHT AND EXTREMELY LOW BIRTH WEIGHT NEONATES IN JAIPUR

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Abstract:
In low- and middle-income countries, the majority of neonatal deaths occur without a clear cause of death (i.e., pre-maturity). Due to the paucity of data for Neonatal mortality & associated factors in our geographical area, this study has been planned to determine the predictors of mortality in very low birth weight babies (VLBW) and extremely low birth weight babies (ELBW).

Materials & Methods: This observational descriptive study was conducted in the Neonatal ICU, National Institute of Medical Sciences and Research, Jaipur, Rajasthan. All neonates with very low birth weight (VLBW) & extremely low birth weight (ELBW) admitted to NICU were included. Univariate analysis and logistic regression analysis were done to determine the predictors of short-term outcomes & mortality.

Results: 174 neonates were studied. 104 (59.77%) were male children and 70 (40.23%) were female. Mortality was seen among 6.15% VLBW babies & 45.5% ELBW babies. Febrile illness during pregnancy, Birth weight, Gestational age, need for resuscitation after birth, elevated CRP, Low RBS, and SAS Score less than 7 were found statistically significant and were independent predictors of mortality.

Conclusions: The incidence of early neonatal mortality in low-birth-weight newborns and incredibly higher in Extremely low weight. There is an urgent need for dedicated special care for ELBW & VLBW neonates by primary health care providers and other stakeholders on the first day of admission.

Keywords: Mortality, Very Low Birth Weight Babies (VLBW), Extremely Low Birth Weight Babies (ELBW), Neonates

INTRODUCTION:

Neonatal mortality is a public health problem worldwide primarily in low- and middle-income countries. Although extensive progress has been witnessed in reducing neonatal mortality over the last three decades, increased efforts to improve progress are still needed to achieve the 2030 SDG (Sustainable Development Goals) target. **[1]** Even though there is a global decrease in neonatal

mortality, the rate of decrement is considerably lower than that of the post-neonatal under-five mortalities.**[2]**

Globally, it is estimated that 15–20% of all births, or >20 million newborns annually, are low birth weight infants and the prevalence of LBW in India is 16.4 % in NFHS (National Family Health Survey)-4, 20.9% in NHFS-3, 22.9% in NFHS-2 and 25.2% in NHFS-1 respectively[3]. The Incidence of VLBW babies is less than 2 % of births globally. In India, VLBW babies constitute 4 % to 7 % of live births and approximately 30 % of Neonatal deaths. The VLBW rate is an accurate predictor of the infant mortality rate. VLBW infants account for more than 50% of neonatal death. **[3-4]**

In India in 2017, 79·5% of neonatal deaths were in the early neonatal period of 0–6 days, and this varied from 69·6% to 84·9% between the states. The NMR is not uniform across the country.[13] Although Kerala and Tamil Nadu have low NMRs (20 per 1000 live births), Odisha, Madhya Pradesh and Uttar Pradesh have very high NMRs (35 or more per 1000 live births), Four states—Uttar Pradesh, Madhya Pradesh, Bihar and Rajasthan—alone contribute to ~ 55% of total neonatal deaths in India, ~15% of global neonatal deaths that occur every year. **[5]**

In low- and middle-income countries, the majority of neonatal deaths occur without a clear cause of death (i.e., pre-maturity). It is difficult to confirm the cause because there are many factors that could be linked to the exact underlying cause of neonatal mortality; however, literature has categorized causes into those related to maternal or foetal conditions. **[6,7]** Neonatal deaths often occur due to an illness presenting as an emergency, either soon after birth or later, due to infections such as tetanus or community-acquired infections. **[8]**

Due to paucity of data for neonatal mortality and associating factors in our geographic area this study was planned to determine short term outcome and predictors of mortality. Our center is a tertiary care center catering approximately 800 neonatal admissions per year, out of these almost 20-30% babies are preterm. This study is aimed to determine the short-term outcomes in very low birth weight babies (VLBW) and extremely low birth weight babies (ELBW) and also to identify predictors of mortality.

MATERIALS AND METHODS:

Study area

This observational descriptive study was carried out by the Department of Paediatrics in Neonatal ICU, National Institute of Medical Sciences and Research, Jaipur, Rajasthan.

Study design & Duration

An observational descriptive study was carried out over the period from July 2022 to December 2023.

Study Population

All neonates with very low birth weight (VLBW) & extremely low birth weight (ELBW) admitted to NICU during the study period were included in the study.

Inclusion Criteria

Neonates with birth weight of <1500 grams admitted in NICU were included

Exclusion Criteria

1) Neonates with birth weight <500 grams or >1500 grams and/or gestational age less than 25 weeks.
2) Neonates whose attendants were not gave consent

Methodology

After obtaining the permission of the Scientific and institutional ethical committee on the basis of inclusion & exclusion criteria, consent was taken by the parents or guardians of the neonates. Neonates with very low birth weight (VLBW) & extremely low birth weight (ELBW) admitted to NICU were enrolled in the study. Gestational age has been ascertained by the last menstrual period or Modified Ballard Score or antenatal ultrasound.

Relevant antenatal, intrapartum history of the mother and various risk factors and short-term outcomes (up to 28 days of life) were recorded in predesigned proforma.

Risk factors:

In this section the maternal details like the mother's age, parity, pregnancy-related complications (like hypertensive disorder of pregnancy, gestational diabetes, febrile illness, pre-eclampsia, toxaemia), regular antenatal checkups, antenatal steroids administration were recorded.

The relevant perinatal history was also taken in terms of evidence of foetal distress, APGAR score at 1 and 5 minutes, SAS score, need of resuscitation, need of surfactant, birth weight, anthropometry, type of delivery were recorded.

All neonates were managed as per standard NICU protocol and followed up till discharge or death, whichever is earlier.

All collected data was entered in the MS EXCEL spreadsheet and for analysis Statistical Package for Social Sciences (SPSS) version 23.0. was used. Categorical variables have presented in number and percentage (%) and continuous variables are presented as mean ± SD and median. Univariate analysis and logistic regression analysis were done to determine the predictors of short-term outcomes & mortality.

RESULTS:

In our study, 174 neonates were studied. 104 (59.77%) were male child and 70 (40.23%) were female. Most of the newborn of age group (in days) 0-30 days (65.52%) followed by 31-60 days (32.18%) and above 60 days were 4(2.30%). The mean of Age± S.D. was 26.49 ± 17.53 days. **[Table 1]**

Table 1: Frequency distribution of age (in days) of newborn

Age Interval (in days)	n = 174	In %
0 - 10	41	23.56%
11 - 20	38	21.84%
21 - 30	35	20.11%
31 - 40	11	6.32%
41 - 50	29	16.67%
51 - 60	16	9.20%
61 - 70	4	2.30%

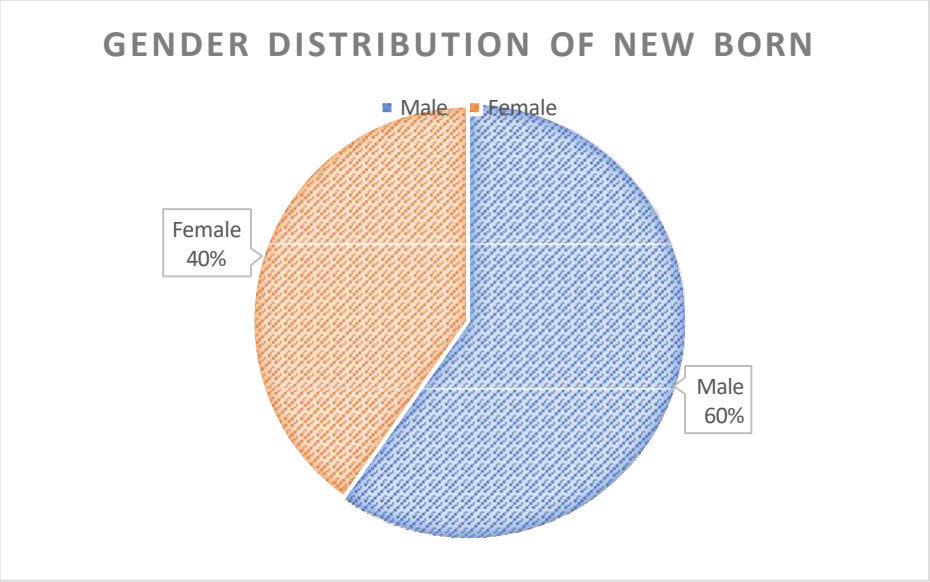

Figure 1: Frequency distribution of gender of newborn

On observing the birth weight of newborn, have weight in 1201-1300 gm (18.39%) followed by 1401-1500 gm(17.82%) and 1301-1500 gm(17.24%). In present study, 130 (74.71 %) neonates admitted to

neonatal ICU were very low birth weight and around one fourth of studied newborns (25.29%) were extremely low birth weight. The mean of weight± S.D. was 1178± 243.6 gm. **[Table 2, Figure 2]**

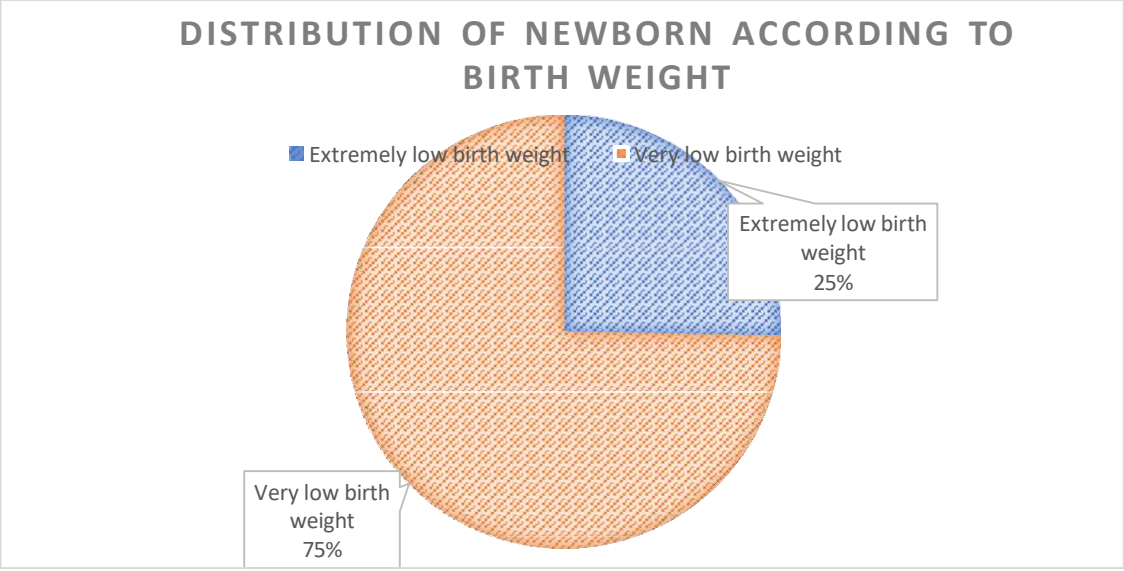

Figure 2: Frequency distribution of newborn according to birth weight

Table 2: Frequency distribution of newborn according to birth weight

Category	n = 174	In %
Extremely low birth weight	44	25.29%
Very low birth weight	130	74.71%

Mortality was seen among 8 out of 130 (6.15%) VLBW babies & 20 out of 44 (45.5%) ELBW babies. It was observed that mortality was more common among ELBW babies than very low birth weight babies and was found highly statistically significant (p=0.00001). [Table 3]

Table 3: Comparing mortality between extremely low & very low birth weight

Variables	Extremely low birth weight	Very low birth weight	Chi-Square test	P - Value	Significance
Live	24	122	37.604	0.00001	**Significant**
Death	20	8			

On observing contributory maternal factors among VLBW & ELBW babies there was history of irregular antenatal checkup (27.01%), positive febrile illness (13.22%), Toxaemia & PIH (13.22%), Need of Prenatal steroid administration (52.30%), PV leak & PV bleeding (48.28%), Oligohydramnios (8.62%), Polyhydramnios (4.02%) and antepartum hemorrhage (5.17%).

On observing contributory perinatal factors among VLBW & ELBW babies, small for gestational age neonates were (13.79%), type of delivery LSCS (33.91%), not cried after birth(35.06%), need of resuscitation after birth at least with bag & mask (24.71%). Other observed parameters among newborn were tachycardia (>160 beats/minutes) in 22.41%, tachycardia (>60breaths/minutes) in 76.44%, anemia in 10.35%, leukocytosis (3.45%) and leukopenia (4.02%), grunting during admission (37.93%), acrocyanosis (20.11%), retraction or indrawing (69.54%) and at 1-min APGAR Score was seen. [Table 4, 5, 6 & 7]

On applying t-statistics on various contributory maternal factors, Birth weight of newborn (p=0.00001), febrile illness during pregnancy (p=0.0076) found statistically significant. Other maternal factors like mother age and new born age was found statistically insignificant.

On applying chi-square test on various contributory perinatal factors among VLBW & ELBW babies, small for gestational age neonates (p=0.01035), need of resuscitation after birth at least with bag & mask (p=0.00004), elevated CRP (P=0.00001) and Low RBS (P=0.00001) found statistically

significant. Other perinatal factors like mother age and new born age was found statistically insignificant.

Table 4: Maternal and newborn parameters between extremely low and low birth weight

Characteristics	Extremely low birth weight	Very low birth weight	t - test	P - Value	Significance
Mother Age (In Yrs.)	25.47 ± 3.48	26.56 ± 3.78	-1.603	0.11141	Not Significant
New Born Age (In Days)	29.26 ± 22.22	23.65 ± 15.4	1.687	0.0941	
Weight of New Born (In Grams)	824.26 ± 116.6	1292.8 ± 139.6	-19.024	0.00001	**Significant**

On applying the chi-square test on various contributory perinatal factors among VLBW & ELBW babies, small for gestational age neonates (p=0.01035), the need of resuscitation after birth at least with bag & mask (p=0.00004), elevated CRP (P=0.00001) and Low RBS (P=0.00001) found statistically significant. Other perinatal factors like mother age and newborn age were found statistically insignificant.

Table 5: Maternal and newborn parameters between extremely low and low birth weight

Variables		Extremely low birth weight	Very low birth weight	Chi-Square test	P - Value	Significance
Regular antenatal check-up	**Yes**	30	97	0.69	0.40611	Not Significant
	No	14	33			
Febrile illness during pregnancy	**Yes**	11	12	7.126	0.0076	**Significant**
	No	33	118			
toxemia & PIH	**Yes**	4	19	0.875	0.34968	Not Significant
	No	40	111			
Prenatal Steroid	**Yes**	28	63	3.034	0.81517	
	No	16	67			
PV leak & PV bleeding	**Yes**	25	59	1.721	0.18956	
	No	19	71			
Oligohydramnios / polyhydramnios	**Yes**	2	13	1.242	0.26517	
	No	42	117			
TT	**Yes**	43	126	0.076	0.78255	
	No	1	4			
Antepartum hemorrhage	**Yes**	0	9	-	-	-
	No	44	121			

Table 6: Perinatal factors between extremely low and low birth

Variables		Extremely low birth weight	Very low birth weight	Chi-Square test	P - Value	Significance
Fetal growth	**AGA**	43	107	6.573	0.01035	**Significant**
	SGA	1	23			
Type of delivery	**LSCS**	10	49	3.285	0.06991	Not Significant
	NVD	34	81			
Cried soon after birth	**Yes**	24	89	2.796	0.09449	
	No	10	41			
Resuscitation	**Yes**	21	22	16.766	0.00004	**Significant**
	No	23	108			

Table 7: APGAR score between extremely low and low birth weight

APGAR Score	Extremely low birth weight	Very low birth weight	t - test	P - Value	Significance
At 1 Min	4 ± 1.27	4.3 ± 1.66	-1.056	0.29273	Both are not significant
At 5 Min	6 ± 1.31	6.28 ± 1.57	-1.016	0.31142	

Table 8: SAS score between extremely low and low birth weight

Variables	Extremely low birth weight	Very low birth weight	t - test	P - Value	Significance
SAS Score	7.27 ± 1.14	4.90 ± 1.23	10.69	0.00001	**Significant**

In our study the mean Apgar score at 1 and 5 minutes was 4 ± 1.27 & 6 ± 1.31 for Extremely low birth weight. While4.3 ± 1.66 & 6.28 ± 1.57 at 1 and 5 minutes for Very low birth weight respectively. Low birth weight neonates with an Apgar score <7 at 5 minutes were 4 times more likely to die compared to those with an Apgar score ≥7.
The mean SAS Score of Extremely low birth weight newborns was 7.27 ± 1.14 and for Very low birth weight neonates were 4.90 ± 1.23 and this difference was statistically significant (p=0.00001). [Table 7 & 8]

DISCUSSION:

This observational study among 174 newborns admitted in the Neonatal ICU, National Institute of Medical Sciences and Research, Jaipur, Rajasthan. In this study our primary aim to determine the predictors for mortality in very low birth weight babies (VLBW) and extremely low birth weight babies (ELBW).
In present study total 130 (74.71 %) neonates admitted to neonatal ICU were very low birth weight and around one fourth of studied newborns (25.29%) were extremely low birth weight. Mortality was seen among 8 out of 130 (6.15%) VLBW babies & 20 out of 44 (45.5%) ELBW babies. It was observed that mortality was more common among ELBW babies than very low birth weight babies and found highly statistically significant (p=0.00001). Mortality was highest among neonates delivered before 30 weeks of gestation (28.6%), those with birth weight <1500g (18.5%), and discharge weight <1200g (20.6%). Most of the deaths occurred at home and were due to possible neonatal sepsis.
The post-discharge mortality we observed at the referral hospital was lower than what was previously reported in two other similar settings. In Bangladesh, a study by **Yasmin et al, 2001** found a mortality of 13.3%. **[9]** while in **Malawi, Blencove et al, 2009** found a mortality of 12.4%. **[10]** The discrepancies may be explained by the differences in engagements between the healthcare facilities and the caregiver's post-discharge.
The level of mortality was however comparable to what **Vazirinejad et al, 2012** found (5.4%) in Iran [**11]** and what **Kibona et al** found in Tanzania. [12] In our study, 13 in 44 LBW neonates who died had possible neonatal sepsis. It is not surprising because neonatal sepsis accounts for about 1 in 5 neonatal deaths in Uganda [13] and it is a significant contributor to neonatal deaths in most low and middle-income countries. [14] Studies have shown that low birth weight is a risk factor for neonatal sepsis. [15-17]
Disease progression is fast and deaths occur rapidly. Indeed, our study found that the majority of deaths occurred at home before parents had taken action to save their infants. These findings are similar to what was found in Malawi. **[12]**
Significant Predictors of mortality in this study during the antenatal period were fetal growth (p=0.01035) and febrile illness during pregnancy (0.0076). During birth, babies with low birth weight needed resuscitation (p=00004) and values of CRP, RBS and RDS were higher than normal-weight babies and this difference is statistically significant. 1 & 5-minute Apgar score <7, and a diagnosis of neonatal sepsis during admission. Low birth weight neonates with discharge weight <1200g were 23 times more likely to die compared to heavier neonates. These results are comparable to what **Abdallah et al, and Blencowe et al. [12, 14]** that the risk of post-discharge mortality increases with decreasing weight at discharge.
In our study the mean Apgar score at 1 & 5-minute was 4 ± 1.27 & 6 ± 1.31 for Extremely low birth weight. While4.3 ± 1.66 & 6.28 ± 1.57 at 1 & 5-minute for Very low birth weight respectively. Low birth weight neonates with an Apgar score <7 at 5 minutes were 4 times more likely to die compared to those with an Apgar score ≥7. These results are in keeping with what **Abdullah et al. [12]** found in Bangladesh, what a systematic review by **Ehrestein, and Cnattingius et al.** found in Sweden; that an Apgar score of <7 at 5 minutes was associated with an increased risk of mortality among LBW neonates. **[18,19]**

So it is concluded that the Low birth weight continues to be a major public health problem in developing and under developed countries and one of the important predictors of survival. Febrile illness during pregnancy, Birth weight, Gestational age, need for resuscitation after birth, elevated CRP, Low RBS, and SAS Score less than 7 were found statistically significant and were independent predictors of mortality. As the strength of the study, this was the first study in Rajasthan to assess mortality and its predictors among VLBW & ELBW.

This study will be used to establish a temporal association between mortality and its predictors. The study was carried out at a tertiary care facility that receives many referrals. This may have caused selection bias. We relied on clinical symptoms identified and reported to ascertain the possible causes of death. However, it has limitations as the study was a single-center cross-sectional design and further studies would be recommended for temporal association among the predictors of mortality.

CONCLUSION:

In conclusion, the incidence of early neonatal mortality in low-birth-weight newborns and incredibly higher in Extremely low weight. There is an urgent need for dedicated special care for ELBW & VLBW neonates by primary health care providers and other stakeholders on the first day of admission.

Furthermore, healthcare providers shall give appropriate ANC and PNC care and they shall educate the mother and should give advice to the caregivers to perform KMC and breastfeed exclusively. A longitudinal prospective study in each low-birth-weight category will be better to address important variables that are missed in a retrospective study and to address the true effect of predictor variables.

Conflict of interest: Not declared

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