

Prevalence and determinants of early neonatal morbidity among neonates born in a rural tertiary care hospital, West Bengal



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ABSTRACT

Background: The first 7 days of life, known as the early neonatal period, is a crucial period where there is increased vulnerability to neonatal complications. Most (75%) of the neonatal deaths occur during the early neonatal period. About 1 million neonates die within the first 24 h of life worldwide. The leading causes of neonatal morbidity and mortality include premature births, low birth weight (LBW), birth complications, such as asphyxia, trauma, neonatal sepsis, and congenital anomalies. **Aims and Objectives:** The present study was conducted from July 2024, to December 2024, to estimate the prevalence of early neonatal morbidity of neonates born in Bankura Sammilani Medical College and to analyze the significance of the risk factors of early neonatal morbidity. **Materials and Methods:** An institution-based, observational study was conducted among 300 neonates born in Bankura Sammilani Medical College within the first 7 days. Mothers were interviewed face to face on the basis of a pre-designed, pre-tested, structured questionnaire, and all medical records were reviewed. Bivariate logistic regression analysis was performed to ascertain adjusted odds ratios of sociodemographic, maternal, and neonatal variables on early neonatal morbidities. **Results:** Early neonatal morbidity was evident among 21.3% of newborns born in Bankura Sammilani Medical College. Common morbidities found were respiratory distress (6.0%), asphyxia (5.0%), sepsis and jaundice (4.7%). LBW babies had 2.92 times higher odds ($P < 0.001$) and babies who did not cry at birth had 22.61 times higher odds of early neonatal morbidities. **Conclusion:** Early neonatal morbidity is high in our setting, with LBW and absent cry being significant predictors. This study extensively assessed the role of various predictors affecting neonatal morbidity, including socio-demographic characteristics, maternal and neonatal factors. These variables need to be explored further in future studies or meta-analysis so that, right efforts are directed toward reducing early neonatal morbidities utilizing optimum resources.

Key words: Early neonate; Morbidity; Prevalence; Risk factor; West Bengal

INTRODUCTION

The neonatal period is the first 4 weeks of life, which is also the most vulnerable phase of life. Neonatal morbidity is defined as any medical condition leading to neonatal inpatient hospital readmission or observational stay. Most of the neonatal deaths, that is, 75% occur during the early neonatal period, defined as the first 7 days of age.

About 1 million neonates die within the first 24 h of life worldwide.^{1,2} The leading causes of neonatal morbidity and mortality include pre-mature births, low birth weight (LBW), birth complications, such as asphyxia, trauma, neonatal sepsis, and congenital anomalies.³ Teenage mother, preeclampsia, hypertension disorder of pregnancy, eclampsia, antepartum hemorrhage, pre-mature rupture of membrane, and multiple gestations are some of the

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important maternal risk factors. LBW, intra uterine growth retardation, neonatal sepsis, neonatal asphyxia, congenital abnormality etc., are neonatal risk factors for neonatal morbidity and mortality.^{4,5}

In India, the neonatal mortality rate (per 1000 live births) has improved by 68 deaths per 1000 live births from 85 [78 - 93] in 1969 to 17 [15 - 20] in 2023.⁶ In a birth cohort of 59056 live births in China, the neonatal mortality rate was 3.6% and 13.5% were hospitalized for any complication.⁷ However, in assisted vaginal delivery, 29.86% suffered from neonatal jaundice, 41.23% from caput succedaneum, 16.59% from cephalhematoma, and 8.06% from subgaleal hematoma. It was also found that neonatal jaundice, birth asphyxia, caput succedaneum, cephalhematoma, and subgaleal hematoma all were more common in primigravida women compared to multigravida ones in a study from Thailand.⁸ Pre-maturity was found to be the most common risk factor of birth asphyxia. It was observed that gestational age <37 weeks was a significant predictor of birth asphyxia in a study from Northwest Ethiopia.⁹

Near-miss events occur three to eight times more often than neonatal deaths.^{10,11} Thus, neonatal near-miss evaluations can provide abundant evidence of the causal pathways responsible for neonatal deaths.¹² A recent study from Nepal found that the prevalence of neonatal near miss was 79/1000 live births. Severe maternal morbidity and no formal education had a positive association, but multiparity and cesarean section had a negative association with neonatal near miss.¹³ As a fact, it was concluded that neonatal morbidities occurred 10–20 times more common than neonatal mortality.¹ A study in Cameroon observed that 75.4% of neonates were admitted from the maternity ward and out of which 64.3% were admitted within 24 h in a district hospital.¹⁴ A cohort study conducted in a tertiary care hospital of Hyderabad concluded that late pre-term babies were significantly at higher risk of neonatal morbidity, compared to their term counterparts (70.8% and 29.1%).¹⁵

There were notable interstate inequalities in neonatal mortalities and morbidities, with some states even reporting stagnation or worsening of situations between 2016 and 2021, as depicted in the study done by Subramanian *et al.*¹⁶ Furthermore, they recommended the need for context-specific policies and interventions.¹⁶

Aims and objectives

The present study was conducted with the objective to ascertain the prevalence of early neonatal morbidity of neonates born in Bankura Sammilani Medical College and Hospital and to evaluate the risk factors of early neonatal morbidity.

MATERIALS AND METHODS

An institution-based, observational study was conducted in the post-natal ward and special newborn care unit of Bankura Sammilani Medical College, Bankura, West Bengal, over 6 months (July 2024–December 2024). This institution is a rural based teaching cum referral government hospital, catering almost exclusively to the under privileged rural pregnant women of Bankura, as well as neighboring three to four districts, with total annual delivery of 23,000 approximately.¹⁷ Early neonates, that is, neonates of 0–7 days of age, born in Bankura Sammilani Medical College, were considered as the study population. Taking the prevalence of neonatal morbidity in a tertiary care hospital as 75.4%,¹¹ allowable error of 10%, non-response rate of 10% and design effect of 2, the minimum sample size calculated was 293. Thus, the final sample size of 300 was considered. A pre-designed, pre-tested, structured questionnaire, and mother-child protection card, and other medical records were used for data collection. Mothers were interviewed face-to-face, and all medical records were reviewed. Data were collected after obtaining written informed consent from the participating mother of the newborn. Permission was obtained from the Institutional Ethics Committee vide No. BSMC/IEC/Aca 139 dated February 20, 2024. The data were entered in MS Excel spreadsheet and analyzed with the help of Epi Info version 7.2.6. To test the association between categorical variables, the Chi-square test was used. Those variables with a $P < 0.2$ in bivariate analysis were considered for Binary logistic regression (LR) analysis with the occurrence of early neonatal morbidities as the dependent variable. Hosmer–Lemeshow Test was used to assess the goodness of fit for the LR model. For all statistical purposes, $P < 0.05$ were considered statistically significant. Anonymity and confidentiality were maintained throughout the study.

RESULTS

The present study found that 5.7% (17) mothers of newborns were teenage mothers and 16.3% were illiterate. It was also observed that 10.7% of fathers of neonates were illiterate, 9.7% (29) belonged to the lower class, and 94.7% (284) were from rural area.

Late registration of pregnancy was found among 7.3% (22) of mothers and 16.0% (48) had inadequate antenatal visits. 1.3% (4) of mothers had Rh-negative blood group. Normal hemoglobin level was increased to 46.7% in 3rd trimester from 14.3% in 1st trimester. Inadequate weight gain was found among 45.3% (136) mothers, whereas 17.0% (51) consumed iron-folic acid tablets less than the recommended ones.

Pre-term birth was found among 27.3% (82) of newborns, 27.0% (81) were of LBW, 2.0% (6) were of very LBW, and 36% (108) babies were delivered by cesarean section.

Present research work observed that 21.3% (64) of early neonates suffered from at least one type of morbidity (Figure 1).

It can be depicted from Figure 2 that 6.7% (20) suffered from respiratory distress, 6.0% (18) from asphyxia, 5.0% (15) from sepsis, and 4.7% from jaundice.

Integrated Management of Neonatal and Childhood Illnesses danger signs were noticed among 19.0% (57) neonates, 14.33% (43) were unable to breastfeed and 13.0% (39) were either lethargic or unconscious.

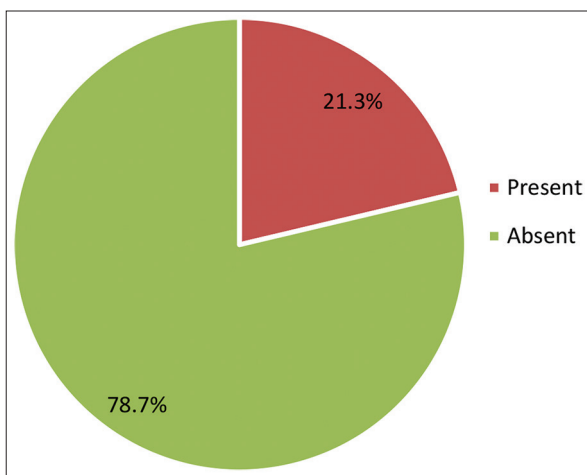


Figure 1: Pie diagram showing percentage of early neonatal morbidity (n=300)

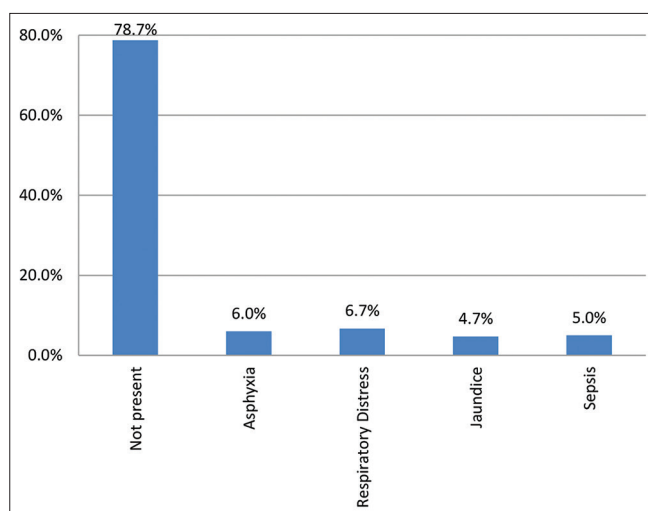


Figure 2: Bar diagram showing distribution of early neonatal morbidity (n=300)

Early neonatal morbidity was significantly higher in mothers and fathers educated up to primary level or below, compared to those parents who were educated above primary level (Table 1).

Early neonatal morbidity was significantly higher in mothers who had inadequate antenatal visits and were anemic (Table 2).

Neonates who did not cry at birth and had LBW were found to have significantly higher early neonatal morbidity. These were statistically significant ($P < 0.001$) (Table 3).

The predictor variables with $P < 0.2$ in bivariate analysis were selected for LR. A binary LR analysis was performed to ascertain effects of significant parental socioeconomic, maternal obstetric and neonatal attributes, such as mother's education, father's education, antenatal visits, maternal weight gain during pregnancy, type of delivery, and birth weight of neonate and whether baby cried at birth, on the likelihood of early neonatal morbidities. All the assumptions of LR were met. The LR model was statistically significant, $\chi^2(7) = 50.1$, $P < 0.001$. The model explained 23.8% (Nagelkerke R^2) of the variance in early neonatal morbidities and correctly classified 82.0% of cases. Hosmer Lemeshow test showed that model has a good fit ($\chi^2(7) = 9.28$, $P = 0.23$).

Table 1: Distribution of study subjects according to Parental sociodemographic variables (n=300)

Parental sociodemographic variables	Early neonatal morbidity		Total
	Present	Absent	
Maternal age	No. (%)	No. (%)	No. (%)
<20 years	3 (17.6)	14 (82.4)	17 (100)
≥20 years	61 (21.6)	222 (78.4)	283 (100)
$\chi^2 = 0.14$ $P = 0.70$			
Education of the mother			
Primary or below	46 (26.4)	128 (73.6)	174 (100)
Above primary	18 (14.3)	108 (85.7)	126 (100)
$\chi^2 = 6.43$ $P = 0.01$			
Education of the father			
Primary or below	39 (28.1)	100 (71.9)	139 (100)
Above primary	25 (15.5)	136 (84.5)	161 (100)
$\chi^2 = 6.98$ $P = 0.01$			
Socioeconomic class			
Upper	1 (50)	1 (50)	2 (100)
Middle	57 (21.2)	212 (78.8)	269 (100)
Lower	6 (20.7)	23 (79.3)	29 (100)
$\chi^2 = 0.98$ $P = 0.60$			
Residence			
Rural	61 (21.5)	223 (78.5)	284 (100)
Urban	3 (18.8)	13 (81.3)	16 (100)
$\chi^2 = 0.06$ $P = 0.79$			

Bold P values indicate statistically significant ($P < 0.05$)

Table 2: Distribution of study subjects according to maternal obstetric variables (n=300)

Maternal obstetric variables	Early neonatal morbidity		Total
	Present	Absent	
Antenatal visits	No. (%)	No. (%)	No. (%)
Adequate	50 (19.8)	202 (80.2)	252 (100)
Inadequate	14 (29.2)	34 (70.8)	48 (100)
$\chi^2=2.08$ P=0.15			
Maternal anemia			
None	26 (18.6)	114 (81.4)	140 (100)
Mild	35 (24.6)	107 (75.4)	142 (100)
Moderate to severe	3 (16.7)	15 (83.3)	18 (100)
$\chi^2=1.79$ P=0.40			
Iron Folic acid tablet consumption			
Adequate	54 (21.7)	195 (78.3)	249 (100)
Inadequate	10 (19.6)	41 (80.4)	51 (100)
$\chi^2=0.10$ P=0.74			
Maternal weight gain			
Adequate	43 (24.7)	131 (75.3)	174 (100)
Inadequate	21 (16.7)	105 (83.3)	126 (100)
$\chi^2=2.81$ P=0.09			

Table 3: Distribution of study subjects according to neonatal variables (n=300)

Neonatal variables	Early neonatal morbidity		Total
	Present	Absent	
Gestational age	No. (%)	No. (%)	No. (%)
Preterm	21 (25.6)	61 (74.4)	82 (100)
Full term	43 (20.2)	174 (79.8)	218 (100)
$\chi^2=1.18$ P=0.27			
Cried at birth			
Yes	52 (18.2)	234 (81.8)	286 (100)
No	12 (85.7)	2 (14.3)	14 (100)
Fisher's Exact test P<0.001			
Birth weight			
Low birth weight	32 (36.8)	55 (63.2)	87 (100)
Normal	32 (15.0)	181 (85.0)	213 (100)
$\chi^2=17.42$ P<0.001			
Type of delivery			
Normal	46 (24.0)	146 (76.0)	192 (100)
Cesarean	18 (16.7)	90 (83.3)	108 (100)
$\chi^2=2.19$ P=0.13			

Bold P value indicates statistically significant (P<0.05)

It was found that the babies with LBW had 2.92 times higher odds of early neonatal morbidities than normal birth weight babies (P<0.001). Similarly, babies who did not cry at birth had 22.61 times higher odds of early neonatal morbidities than those who cried at birth (P<0.001) (Table 4).

DISCUSSION

The present study explored the prevalence and the determinants associated with neonatal morbidities among the neonates born within 7 days of age in Bankura Sammilani Medical College during the study period. Pre-term birth was found among 27.3% of newborns and 29%

Table 4: Predictors of early neonatal morbidities using binary logistic regression model (n=300)

Attributes	AOR (95%CI)	P-value
Mother's education (Primary or below)	1.31 (0.59–2.93)	0.51
Father's education (Primary or below)	1.82 (0.88–3.78)	0.11
Antenatal visits (Inadequate)	1.00 (0.43–2.340)	0.99
Maternal weight gain (Inadequate)	0.64 (0.34–1.23)	0.18
Type of delivery (Cesarean)	0.69 (0.34–1.40)	0.30
Birth weight baby (Low birth weight)	2.92 (1.54–5.53)	<0.001
Baby cried at birth (No)	22.61 (4.56–112.11)	<0.001
Constant	0.13	<0.001

AOR: Adjusted odds ratio, CI: Confidence interval

of early neonate had LBW. Similar findings were obtained by Pal *et al.*¹⁸ which revealed that 21.5% of infants were born LBW and 15% were born pre-term in West Bengal. Another study done by Singh *et al.* based on the National Family Health Survey (NFHS-5) found that the prevalence of LBW infants among the most recent deliveries in healthcare facilities in West Bengal and in India was 18.4% and 17.1%, respectively.¹⁹ However, Jana reported in their study that approximately 12% of children were born pre-term, and 18% had LBW in India during 2019–21 based on NFHS-5.²⁰ The differences could be because of differences in the study population and analysis. In the present study, 36% of babies were delivered by cesarean section. Similarly, births (in the 5 years before the survey) in a public health facility that were delivered by cesarean section in urban areas of West Bengal were 31.7% based on NFHS-5.²¹

It was observed that 21.3% of early neonates suffered from any one of the morbidities. The morbidity pattern in the present study revealed that 6.7% of the early neonates suffered from respiratory distress, 6.0% from asphyxia, 5.0% from sepsis, and 4.7% from jaundice. Similar study by Sasmal *et al.*,²² found that respiratory distress syndrome, perinatal asphyxia, and sepsis were present in 10.6%, 8.1% and 2.6%, respectively. They also found that neonatal hyperbilirubinemia was present among 19.3% of the neonates admitted at a tertiary care center. This difference could be due to the inclusion of all outborn babies in the study, apart from the inborn babies. Bidari *et al.*, also found that birth asphyxia, pre-maturity, jaundice, neonatal sepsis, and respiratory issues significantly contributed to neonatal mortality and morbidity.²³

The educational level of the mother and father is associated with the occurrence of early neonatal complications, as evidenced from the present study. This study found that neonatal morbidities were higher in mothers with primary

or lower level of education (26.4%) compared to mothers educated above primary level (14.3%). Similarly, fathers with primary or lower level of education (28.1%) had higher neonatal morbidities compared to fathers educated above primary level (15.5%). Both were statistically significant in bivariate analysis ($P=0.01$). This was consistent with the study by Cantarutti *et al.*, where it was revealed that compared with low-level educated mothers, those with high education had reduced odds of pre-term birth (odds ratio [OR]=0.81, 95% confidence interval [CI] 0.77–0.85), LBW (OR=0.78, 95% CI 0.70–0.81), small for gestational age (OR=0.82, 95% CI 0.79–0.85), and respiratory distress (OR=0.84, 95% CI 0.80–0.88).²⁴ Similar findings were obtained from another study by Amoah and Asamoah.²⁵ Lower educational level of fathers was associated with higher odds of neonatal morbidity and mortality.^{26,27} Balaj *et al.* revealed that both increased maternal and paternal education showed a dose–response relationship linked to reduced under-5 mortality, with maternal education emerging as a stronger predictor.²⁷

Binary LR model revealed that birth weight and whether cried at birth were significant predictors of neonatal morbidity. Neonates with LBW had 2.92 times higher odds of having neonatal morbidities compared to normal weight neonates in this study. This was consistent with other studies. Triggs *et al.* revealed that most adverse outcomes occurred in infants with birth weights between 10 and 90th centile.²⁸ Furthermore, Pabbati *et al.* found that morbidity and mortality in LBW babies were inversely related to birth weight and gestational age.²⁹ Dhivar *et al.* also found that LBW infants experienced significant morbidities, mortality, and long-term growth and developmental effects.³⁰

A total of 14 early neonates did not cry at birth in this study, with 22.6 times higher odds of having neonatal morbidities among babies who did not cry at birth compared to those who cried at birth. Similarly, Jain *et al.* revealed that among babies who did not cry after birth ($n=12$), 25% had developed Hypoxic ischemic encephalopathy (HIE) stage 1, 50% had HIE stage 2, and 25% HIE stage 3.³¹

The strength of the study being the study extensively assessed the role of various predictors affecting neonatal morbidity, including socio-demographic characteristics, maternal and newborn factors. The study findings could be generalized to similar type of settings like other peripheral Medical Colleges of West Bengal, India.

Other attributes, such as adequacy of antenatal visits, weight gain during pregnancy, and type of delivery, were not found to be associated with the occurrence of neonatal

morbidities in the present study. These variables need to be explored further in future studies or meta-analysis so that, right efforts may be put in the right direction for reducing early neonatal morbidities utilizing optimum resources.

Limitations of the study

Despite best efforts, some of the neonatal morbidities, such as neonatal surgical morbidities and other causes, could not be explored because the study was restricted to the post-natal ward and Special newborn care unit of the institution. Further studies are recommended in the Neonatal Intensive Care Unit to get the entire spectrum of neonatal morbidity. Second, prospective studies could be done in the future with survival analysis of early neonatal morbidities, which was beyond the scope of the present study.

CONCLUSION

The study emphasized on high prevalence of early neonatal morbidity in this peripheral institute and identified its risk factors like low birth weight and no cry at birth or birth asphyxia. There is a need to address both maternal and neonatal factors causing the increased likelihood of early neonatal morbidities.

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