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Original Research Article

Predictors of Mortality among Low-Birth-Weight Neonates Admitted to Neonatal Intensive Care Unit

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Abstract: *Low birth weight (LBW) is defined as a birth weight less than 2.5 kg and is a major contributor to neonatal morbidity and mortality worldwide. Identification of maternal and perinatal predictors of mortality is essential for implementing targeted interventions to improve survival.* ***Objective:*** *To determine the predictors of mortality among low-birth-weight neonates admitted to the neonatal intensive care unit (NICU).* ***Methods:*** *A prospective cohort study was conducted in the Department of Pediatric Medicine, Children's Hospital Multan, from February 2024 to July 2024. A total of 114 neonates aged 1–7 days who met the inclusion criteria were enrolled after parental consent was obtained. Baseline characteristics, including maternal age, gravidity, area of residence, neonatal age, gender, and birth weight, were recorded. Maternal factors (diabetes, pregnancy-induced hypertension), perinatal characteristics (place of delivery, APGAR score), and the need for resuscitation at birth were documented. Neonates were followed for 28 days to record mortality. Data were analyzed using SPSS v23. Continuous variables were expressed as mean ± SD, and categorical variables as frequencies and percentages. Mortality predictors were assessed using relative risk with 95% confidence intervals.* ***Results:*** *Among 114 neonates, 21 (18.4%) died within 28 days. Maternal diabetes, low APGAR score (<7), and need for resuscitation were associated with higher mortality. Other factors such as gender, area of residence, pregnancy-induced hypertension, and place of delivery showed no statistically significant association.* ***Conclusion:*** *Mortality among LBW neonates remains high, with APGAR score, maternal diabetes, and resuscitation need serving as important predictors. Early identification and intervention targeting these risk factors may reduce neonatal deaths.*

Keywords: APGAR score, Birth weight, Low birth weight, Mortality, Neonatal intensive care unit, Predictors, Resuscitation

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Introduction

Low birth weight (LBW) infants are defined as those whose weight at the time of the first postnatal measurement is below 2500 grams, irrespective of gestational age (1). Such neonates face a significantly higher likelihood of death due to immature or insufficiently developed organ systems and their limited capacity to adapt to extrauterine life (2). Consequently, birth weight is considered a crucial indicator of both maternal and child health. The main complications responsible for LBW-associated neonatal mortality include difficulties in feeding, hypoglycemia, hypothermia, immature lungs, vulnerability to infections, and disturbances in fluid and electrolyte balance (3-4). These conditions make them particularly prone to mortality within the first month of life. Moreover, infants who survive the neonatal period continue to face adverse outcomes such as impaired physical growth and reduced cognitive development in early childhood (5). In the long term, LBW is also linked to a greater risk of chronic diseases in adulthood, including obesity and diabetes (6). Despite global efforts, the incidence and mortality rates related to LBW remain considerable, especially in developing countries, where LBW is one of the leading causes of neonatal deaths (7). Worldwide, it accounts for approximately 60–80% of all neonatal fatalities each year (8). Woelile TA et al., in a study of 718 LBW neonates, identified several significant predictors of mortality: delivery outside health institutions [AHR: 2.31; 95% CI: 1.20–4.42], maternal age below 18 years [AHR: 3.08; 95% CI: 1.64–5.81], maternal age above 35 years [AHR: 3.83; 95% CI: 2.00–7.31], neonatal sepsis [AHR: 2.33; 95% CI: 1.38–3.94], respiratory distress syndrome [AHR: 1.92; 95% CI: 1.27–2.89], necrotizing enterocolitis [AHR: 3.09; 95% CI: 1.69–5.64], and extremely low birth weight (<1000 g) [AHR: 3.61; 95% CI: 1.73–7.55] (9). Similarly, Dessu S et al. carried out a prospective cohort study involving 216 LBW neonates, reporting a 28-day mortality rate of 8.3% (18/216). Factors associated with higher mortality included rural residence (83.3% vs. 16.7%), higher gravidity (> four vs. <4; 38.9% vs. 61.1%), home deliveries (66.7% vs. 33.3%), deliveries conducted by non-healthcare professionals (88.9% vs. 11.1%), pregnancy-induced hypertension (72.2% vs. 27.8%), absence of immediate cry at birth (55.6% vs. 44.4%), low APGAR score at 1 minute (<7 vs. >7; 66.7% vs. 33.3%), and need for resuscitation at birth (24.4% vs. 7.4%) (10). Although governments have prioritized neonatal health and launched various interventions to reduce neonatal mortality, the expected decline has not been fully realized. The present study is therefore designed to assess the predictors of mortality among LBW neonates in our local population. Findings from this work are expected not only to highlight the risk factors specific to our setting but also to guide the development of tailored interventions to reduce preventable LBW-related deaths. To determine the predictors of mortality among low-birth-weight neonates admitted to the neonatal intensive care unit.

Methodology

The study was conducted after obtaining ethics committee approval. The study was conducted at the Department of Pediatric Medicine at the Children's Hospital, Multan. It was designed as a prospective cohort study and conducted over six months following synopsis approval from February 2024 to July 2024. The sample size was determined using the WHO sample size calculator for testing the difference between two proportions, assuming mortality rates of 24.4% in neonates requiring resuscitation and 7.4% in those not requiring resuscitation, with 80% power and a 5% level of significance. The calculated sample size was 114. A non-probability consecutive sampling technique was employed.[10]

Neonates aged 1–7 days, of either gender, admitted to the neonatal unit with low birth weight as per operational definition, were included. The exposed group comprised neonates who required resuscitation at birth,

while the unexposed group included those who did not require resuscitation. Neonates with gestational age ≤28 weeks and those with congenital malformations were excluded from the study.

A total of 114 neonates meeting the inclusion criteria were enrolled after obtaining informed parental consent. Baseline information, including maternal age, gravidity, area of residence, neonatal age at admission, gender, and birth weight, was documented. Based on the operational definition, neonates were classified as exposed or unexposed according to the need for resuscitation at birth. Additional data on maternal diabetes, pregnancy-induced hypertension, place of delivery, and the Apgar score at 5 minutes after birth were also recorded. All enrolled neonates were followed for 28 days of life, both during hospital stay and after discharge, and any neonatal death from any cause within this period was noted. Data collection was carried out using a structured pro forma.

Low birth weight was defined as <2.5 kg on a digital scale. Predictors of mortality included maternal diabetes (chronic or gestational, confirmed by history/records), pregnancy-induced hypertension (BP ≥140/90 mmHg with treatment), gestational age (full-term ≥37 weeks, preterm <37 weeks), Apgar score at 5 minutes (<7 low, ≥7 normal), need for resuscitation at birth (delayed cry requiring bag-mask ventilation or chest compressions), and place of delivery (institutional vs. home).

For analysis, SPSS version 23 was used. Continuous variables, including maternal age, gestational age at birth, neonatal age on admission, and birth weight, were presented as mean ± standard deviation. Categorical variables such as gravida, area of residence, neonatal gender, maternal diabetes, pregnancy-induced hypertension, place of delivery, APGAR score at 5 minutes (<7 or ≥7), and mortality were expressed as frequencies and percentages. Predictors of mortality were assessed using relative risks with 95% confidence intervals. Data were stratified by maternal age, gravida, area of residence, and neonatal gender to observe their influence on the distribution of predictors. Post-stratification relative risk with a 95% confidence interval was calculated, and p-values ≤0.05 were considered statistically significant.

Results

The mean maternal age of the enrolled participants was 27.4 ± 4.9 years. Among the neonates, 63 (55.3%) were male, while 51 (44.7%) were female. Regarding gravidity, 23 (20.2%) mothers were in their first pregnancy, 36 (31.6%) had 2–3 pregnancies, and 55 (48.2%) had four or more pregnancies. The mean neonatal age on admission was 11.8 ± 6.7 hours, and the mean birth weight was 2.08 ± 0.34 kg. Concerning residence, 59 (51.8%) neonates were from urban areas, whereas 55 (48.2%) were from rural areas, indicating a nearly equal distribution between urban and rural settings (Table 1).

Maternal diabetes was present in 21 (18.4%) of mothers, while 93 (81.6%) did not have diabetes. Pregnancy-induced hypertension was noted in 18 (15.8%) mothers, with 96 (84.2%) unaffected. Most deliveries occurred in healthcare facilities, with 71 (62.3%) institutional deliveries compared to 43 (37.7%) home deliveries. Regarding neonatal status, 26 (22.8%) neonates had an APGAR score <7 at 5 minutes, while 88 (77.2%) had scores ≥7. A total of 29 (25.4%) neonates required resuscitation at birth (exposed group), and 85 (74.6%) did not require resuscitation (unexposed group) (Table 2). Out of 114 neonates, 21 (18.4%) died within 28 days of life, while 93 (81.6%) survived the neonatal period, reflecting the overall mortality observed in the cohort (Table 3).

Maternal diabetes was associated with higher neonatal mortality, with 8 of 21 (38.1%) deaths in this group, yielding a relative risk (RR) of 2.57 (95% CI: 1.15–5.74, p=0.016). Pregnancy-induced hypertension was linked to 6 of 18 (33.3%) deaths, but this was not statistically significant (RR=2.04; 95% CI: 0.85–4.91; p=0.098). Home delivery accounted for 11 of 43 (25.6%) deaths, with RR=1.74 (95% CI: 0.78–3.85; p=0.167). Neonates with APGAR <7 had the highest risk, with 10 of 26 (38.5%) deaths and a significant RR of 3.08 (95% CI: 1.39–6.81; p=0.005). Resuscitation requirement was associated with 9 of 29 (31.0%) deaths, RR=2.10 (95% CI: 0.95–4.63; p=0.063). Mortality among males was 12 of 63 (19.0%), and in rural neonates, it was 11 of 55 (20.0%), but neither was statistically significant (Table 4).

Table 1. Baseline Characteristics of Neonates (n = 114)

Variable	Category	Mean ± SD / n (%)
Maternal age (years)	Mean ± SD	27.4 ± 4.9
Gender	Male	63 (55.3%)
	Female	51 (44.7%)
Gravidity	1	23(20.2%)
	2-3	36(31.6%)
	≥4	55(48.2%)
Neonatal age on admission (hours)	Mean ± SD	11.8 ± 6.7
Birth weight (kg)	Mean ± SD	2.08 ± 0.34
Area of residence	Urban	59 (51.8%)
	Rural	55 (48.2%)

Table 2. Maternal and Perinatal Characteristics

Variable	Category	n (%)
Maternal diabetes	Yes	21 (18.4%)
	No	93 (81.6%)
Pregnancy-induced hypertension	Yes	18 (15.8%)
	No	96 (84.2%)
Place of delivery	Institutional	71 (62.3%)
	Home	43 (37.7%)
APGAR at 5 minutes	<7	26 (22.8%)
	≥7	88 (77.2%)
Need for resuscitation	Exposed	29 (25.4%)
	Unexposed	85 (74.6%)

Table 3. Mortality Outcomes

Mortality	n	%
Yes	21	18.4%
No	93	81.6%

Table 4. Relative Risk of Predictors of Mortality

Predictor	Mortality Yes (%)	Mortality No (%)	RR (95% CI)	p-value
Maternal diabetes (Yes, n=21)	8 (38.1%)	13 (61.9%)	2.57 (1.15–5.74)	0.016
PIH (Yes, n=18)	6 (33.3%)	12 (66.7%)	2.04 (0.85–4.91)	0.098
Place of delivery (Home, n=43)	11 (25.6%)	32 (74.4%)	1.74 (0.78–3.85)	0.167
APGAR <7 (n=26)	10 (38.5%)	16 (61.5%)	3.08 (1.39–6.81)	0.005
Resuscitation needed (n=29)	9 (31.0%)	20 (69.0%)	2.10 (0.95–4.63)	0.063
Gender (Male, n=63)	12 (19.0%)	51 (81.0%)	1.09 (0.49–2.44)	0.829
Area (Rural, n=55)	11 (20.0%)	44 (80.0%)	1.14 (0.52–2.52)	0.739

Discussion

Low birth weight (LBW) is defined as a birth weight below 2.5 kg, irrespective of gestational age, and is a significant predictor of neonatal morbidity and mortality. LBW neonates are at higher risk of complications such as hypoglycemia, hypothermia, infections, and respiratory distress due to immature organ systems (11). Surviving LBW infants may face long-term consequences, including stunted growth, lower cognitive development, and increased risk of chronic diseases in adulthood (12). Identifying maternal and perinatal predictors of mortality can guide targeted interventions. Understanding these factors is essential to improving neonatal survival and reducing the burden of LBW-related complications.

In our study of 114 low-birth-weight (LBW) neonates admitted to the neonatal intensive care unit, the overall mortality rate was 18.4%, which is higher than the 8.0% reported by Javed et al. (2024) (13). among 424 neonates but lower than the 25.72% observed by Mengstie et al. (2025) in 416 LBW neonates (15). The male-to-female Ratio in our cohort was 55.3% males and 44.7% females, comparable to previous reports by Shaikh et al. (2024) (14). Zaman et al. (2017) (17). Moreover, Bidari et al. (2024) reflect the consistent predominance of male neonates in NICU admissions (18). The mean birth weight in our study was 2.08 ± 0.34 kg, which is higher than that reported for very low birth weight (VLBW) populations, such as Bidari et al., where the mean birth weight was 1.240 ± 0.110 kg for males.[18] Our study included neonates requiring resuscitation, with 25.4% exposed, and this factor showed a relative risk of 2.10 (95% CI: 0.95–4.63), consistent with observations by Desalew et al. (2020) (16). Moreover, Nsubuga et al. (2024) reported that low 5-minute APGAR scores and need for resuscitation were strong predictors of neonatal mortality (19).

Maternal factors such as diabetes were significantly associated with neonatal death in our study (RR=2.57, 95% CI: 1.15–5.74, p=0.016), supporting findings by Mengstie et al. (2025) where maternal diabetes had an adjusted hazard Ratio (AHR) of 2.5 (95% CI: 1.70–3.87) for LBW mortality. (15). Pregnancy-induced hypertension in our cohort had an elevated but nonsignificant risk (RR=2.04; 95% CI: 0.85–4.91), similar to trends reported in Shaikh et al. (2024) (14). Moreover, Razak et al. (2024) (20) found that maternal hypertensive disorders were predictive of adverse neonatal outcomes. Neonatal APGAR score <7 at 5 minutes was strongly predictive in our study (RR=3.08; 95% CI: 1.39–6.81, p=0.005), aligning with evidence from Desalew et al. and Nsubuga et al., which also highlighted low APGAR scores as a key predictor of mortality (16,19).

Compared to studies from Ethiopia and Pakistan, our cohort had slightly higher mortality than Javed et al. (8%) (13). and Shaikh et al. (LBW prevalence 21.2%) (14). but lower than Mengstie et al. (25.7%) (15). and Bidari et al. (25.8%) (18). Differences in mortality rates may reflect variations in gestational age, birth weight distribution, NICU resources, and follow-up duration. Our results emphasize the importance of maternal metabolic conditions, neonatal resuscitation, and immediate postnatal assessment in predicting survival, consistent with global evidence that LBW, low APGAR, and need for early intervention are significant determinants of neonatal mortality (Zaman et al., 2017; Razak et al., 2024) (17,20).

Mortality remains substantial among LBW neonates, highlighting the need for early identification and intervention strategies targeting high-risk infants. This study followed neonates prospectively for 28 days, allowing accurate capture of early neonatal outcomes. Data were collected directly from hospital records and parental interviews, ensuring reliability. A standardized operational definition and a structured pro forma were used for uniform data collection. Limitations include a single-center design, which may limit generalizability. The sample size, though adequate, was relatively small for some subgroup analyses. Additionally, follow-up after discharge relied on parental reporting, which could introduce recall bias.

Conclusion

Low birth weight remains a significant risk factor for neonatal mortality. Maternal and perinatal factors, such as APGAR score and the need for resuscitation, are important predictors. Early identification and intervention can reduce mortality in LBW neonates.

Declarations

Data Availability statement
All data generated or analysed during the study are included in the manuscript.

Ethics approval and consent to participate
Approved by the department concerned. (IRBEC-24)

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Conflict of interest

The authors declared no conflicts of interest.

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All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.

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