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Original Research Article

Comparison of Outcomes in Neonates with Different Birth Weights

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Abstract

Background: Birth weight is a crucial determinant of neonatal health, significantly influencing the risk of morbidity, mortality, and the need for intensive medical care in the immediate postnatal period. Neonates at both ends of the birth weight spectrum, low and high, are particularly vulnerable to adverse outcomes, making it a vital parameter in neonatal risk assessment.

Methods: The NICU at Bihar's Bhagwan Mahavir Institute of Medical Sciences (BMIMS) was the site of this retrospective observational study. Included in the study were a hundred neonates who were either born in the NICU or admitted to the unit during that time. The newborns were divided into three categories according to their birth weight: Low Birth Weight (LBW) (<2500g), Normal Birth Weight (2500-3999g), and Macrosomic (≥4000g). Using conventional statistical methods, we evaluated the groups concerning clinical outcomes, including length of stay in the NICU, occurrence of breathing problems, sepsis, low blood sugar, feeding intolerance, and mortality.

Results: LBW neonates exhibited significantly higher rates of respiratory distress (40.6%), sepsis (34.3%), hypoglycemia (28.1%), and mortality (25%) related to other groups. Normal birth weight (NBW) neonates had the lowest complication rates and no mortality. Macrosomic neonates showed increased incidence of hypoglycemia (25%) and birth trauma (12.5%), but no mortality.

Conclusion: Birth weight was found to be a strong predictor of neonatal outcomes. Enhanced antenatal care, maternal risk factor screening, and targeted neonatal monitoring based on birth weight classifications are essential to improve survival and reduce complications.

Keywords: Birth Trauma, Birth Weight, Hypoglycemia, Low Birth Weight, Macrosomia.

Introduction

Birth weight, a key indicator of newborn mortality and morbidity, is crucial to a newborns's health. It measures the fetus's intrauterine growth and indirectly measures maternal health, prenatal care, and socioeconomic level [1]. Multiple studies show that birth weight directly affects newborn survival and early life difficulties. Premature or LBW newborns are at risk for respiratory distress, infections, and developmental problems [2].

However, high-birth-weight newborns are at risk for birth trauma, metabolic abnormalities, and delivery issues. The WHO defines LBW as less than 2,500 grammes (5.5 pounds) regardless of pregnancy stage. The study did not analyse the very LBW (<1,500 g) and extremely low birth weight (<1,000 g) subgroups due to sample number limits [3]. Weights range from 2,500 to 3,999 grams at birth. High birth weight, or macrosomia, is 4,000 grammes or more. These definitions help clinicians classify newborns for early intervention and care. Underdeveloped countries like India have high rates of low birth weight due to maternal malnutrition, anaemia, insufficient prenatal care, infections, and low socioeconomic status [4]. LBW often causes hypothermia, hypoglycemia, RDS, food intolerance, sepsis, and other problems. Shoulder dystocia, polycythaemia, neonatal hypoglycemia, and caesarean sections are more common in high-birth-weight newborns [5]. Long hospital or NICU stays due to these difficulties might strain healthcare resources and parents' health.

This study examines neonatal outcomes across birth weight categories, focusing on mortality, hospital stays, and morbidity [6,7]. Understanding these distinctions helps guide prenatal care, resource allocation, and early neonatal intervention. There are few regional statistics on this problem, especially in Tier-2 and Tier-3 healthcare settings in India, despite multiple global large-scale studies. This study analysed the outcomes of 100 infants born at

or admitted to the BMIMS neonatal intensive care unit (NICU) to fill that information gap. Bihar's BMIMS is a leading maternal and neonatal health centre. The institute provides comprehensive neonatal treatment, including a full NICU, to a diverse population, often from remote areas. Because of the range of clinical cases and disproportionate number of low- and high-birth-weight newborns, BMIMS is ideal for this observational investigation. By examining birth weight and newborn outcomes in this context, this study hopes to improve clinical practices and public health activities in similar hospital settings.

Objectives of the Study

1. To compare the clinical outcomes, including mortality, NICU stay duration, and common neonatal complications, across different birth weight categories (low, normal, and high birth weight).
2. To identify the specific morbidities more frequently associated with low and high birth weight neonates, such as respiratory distress, sepsis, hypoglycemia, and feeding intolerance.
3. To evaluate the association between birth weight and neonatal prognosis, to improve risk stratification, early intervention, and neonatal care protocols in resource-limited hospital settings.

Low birth weight is an important measure of neonatal health because many studies have connected it to newborn sickness and death. According to [8], 60–80% of neonatal deaths worldwide are due to LBW. Low- and middle-income countries account for an uneven fraction of LBW instances due to prenatal care, healthcare, and maternal nutrition shortages. Multiple Indian and international studies have examined how birth weight affects newborn outcomes. LBW newborns were more likely to die at birth (22%), have newborn sepsis (30%), and spend a longer time in the NICU [9]. They blamed early delivery and underdeveloped immune responses for these findings.

These findings support prior research indicating LBW newborns often develop hypothermia, feeding intolerance, and respiratory distress syndrome. In a similar retrospective investigation of 180 neonates, [10] revealed that LBW newborns were more likely to develop hypoglycemia, delayed feeding tolerance, and early-onset sepsis. Compared to normal or high birth weight neonates, this group had a higher mortality rate. The study indicated that maternal anaemia and poor prenatal care were associated with low birth weight in India. Macrosomia (birth weight ≥4000g) is less common but associated with unfavourable neonatal outcomes such as delivery trauma, hypoglycemia, and obstructed labour. A cross-sectional Chinese study of 300 neonates by [11] found that macrosomic newborns had greater metabolic problems, including hypoglycemia (27%) and shoulder dystocia. The study also found that kids of diabetic moms had higher difficulties, highlighting the need for blood sugar control before pregnancy. [12] evaluated the literature and concluded that neonatal care providers struggle with very low or very high birth weights. LBW newborns have the highest mortality rate, but macrosomic neonates, who have a large head circumference, are more likely to develop preventable nerve damage and metabolic instability due to poorly planned deliveries and undetected maternal diabetes. Despite these results, most of the literature focused on tertiary care facilities in large cities and fails to address regional inequalities in healthcare access, especially in resource-poor or rural areas. A study that includes all birth weights' morbidity and mortality is rare. Researchers from India's BMIMS evaluated neonatal outcomes in a semi-urban hospital for newborns of different birth weights to fill this knowledge gap. It provides context-specific information to the neonatal care and birth weight debate, especially in low-resource healthcare settings.

Materials and Methods

Study Design: This study was designed as a retrospective observational analysis conducted to assess and compare neonatal outcomes based on birth weight classifications. The data were collected from medical records of neonates delivered at or admitted to the NICU of BMIMS, Bihar, over a defined study period.

Setting: The study was conducted at the NICU of BMIMS, a tertiary care hospital located in Gaya, Bihar. BMIMS provides comprehensive neonatal care services and caters to both inborn and outborn neonates from surrounding rural and urban areas, making it a suitable setting for studying a diverse neonatal population.

Sample Size: A total of 100 neonates were included in the study. These neonates were selected based on the inclusion and exclusion criteria and were categorized according to their birth weights for comparative analysis.

Inclusion Criteria

- All live-born neonates delivered at BMIMS during the study period.
- Neonates referred to and admitted to the NICU of BMIMS, regardless of place of birth.
- No restriction on gestational age (preterm or term) or sex of the neonate.

Exclusion Criteria

- Stillbirths (absence of signs of life at birth).
- Neonates with major congenital anomalies that may independently influence outcomes, such as

Neural tube defects, Congenital heart disease, Chromosomal abnormalities (e.g., Trisomy 21)
- Incomplete or missing medical records that prevent accurate outcome assessment

Birth Weight Categories: Neonates were classified into three groups based on their birth weights, in accordance with WHO guidelines:

- LBW: Less than 2500 grams
- NBW: Between 2500 and 3999 grams
- Macrosomia (High Birth Weight): 4000 grams or more
- These classifications enabled stratified analysis to compare neonatal outcomes among distinct weight groups.

Outcomes Measured: Most importantly, it increased neonatal mortality, showing how birth weight affects survival after delivery. They also counted the days a newborns spent in the newborn intensive care unit to assess healthcare resource use and illness severity. Due to its strong link with undeveloped lungs in premature and low-birth-weight newborns, RDS was a key morbidity. Neonatal sepsis, a potentially lethal illness, was also examined because it is common and harmful in susceptible neonates. Hypoglycemia, which could affect neurodevelopment in LBW and macrosomic neonates, was also investigated. The study concluded by examining feeding resistance, which can indicate gastrointestinal immaturity or dysfunction and prolong NICU stays. These outcomes were chosen for their clinical relevance and frequency in neonates at both weight extremes to assess birth weight hazards and resource needs.

Data Collection: Data was extracted from the hospital birth registers, NICU admission records, case files, and discharge summaries. Information collected included birth weight, gestational age, sex, mode of delivery, Apgar scores, clinical complications, duration of NICU stay, and survival outcome. To ensure patient confidentiality, all data were anonymised.

Statistical Analysis: R and SPSS version 25.0 (IBM Corp) were used for statistical analysis.

Descriptive statistics such as means, standard deviations, and proportions were used to summarize the data. Chi-square tests were applied to assess associations between categorical variables (e.g., presence or absence of complications), while one-way ANOVA was used to compare continuous variables such as NICU stay duration across the three birth weight groups. Statistical significance was defined as a p-value below 0.05.

Results

Demographics and Birth Weight Distribution: Among the 100 neonates included in the study, 32% were classified as LBW (<2500g), 60% fell into the NBW group (2500g–3999g), and 8% were categorized as Macrosomic (≥4000g). The male-to-female ratio was approximately 1.1:1 across all weight categories. Table 1 summarizes the birth weight distribution.

Table 1: Distribution of Neonates by Birth Weight Category (BWC)

BWC	Number of Neonates (n)	Percentage (%)
LBW (<2500g)	32	32%
NBW (2500g–3999g)	60	60%
Macrosomic (≥4000g)	8	8%
Total	**100**	**100%**

NICU Stay Duration: The average duration of NICU stay varied across birth weight groups. LBW neonates had the longest average stay (7.2 days), followed by macrosomic neonates (5.5 days), while normal weight neonates had the shortest NICU stay (3.4 days). The difference was statistically significant ($p < 0.01$).

Table 2: Mean Duration of NICU Stay by Birth Weight

BWC	Mean NICU Stay (days)	Standard Deviation	p-value
Low Birth Weight	7.2	2.1	
NBW	3.4	1.5	
Macrosomic	5.5	1.8	
ANOVA Result			**<0.01**

Morbidity Comparison: Neonates in the LBW category experienced significantly higher rates of respiratory distress (40.6%), sepsis (34.3%), and hypoglycemia (28.1%) compared to the other groups. Macrosomic neonates also showed increased rates of hypoglycemia (25%) and birth trauma (12.5%). NBW neonates had the lowest overall morbidity.

Table 3: Incidence of Neonatal Morbidities by Birth Weight

Complication	LBW (%)	Normal BW (%)	Macrosomic (%)	p-value
Respiratory Distress	40.6%	13.3%	12.5%	<0.01
Sepsis	34.3%	11.6%	12.5%	<0.05
Hypoglycemia	28.1%	10.0%	25.0%	<0.05
Feeding Intolerance	21.8%	5.0%	0.0%	<0.05
Birth Trauma	0.0%	1.6%	12.5%	<0.05

Mortality Rates: Out of the 100 neonates, 8 deaths were recorded, all occurring in the LBW group, accounting for a mortality rate of 25% among LBW neonates. No deaths were reported in the normal or macrosomic birth weight categories, indicating a significant correlation between low birth weight and neonatal mortality ($p < 0.001$).

Table 4: Mortality Rates by BWC

BWC	Number of Deaths	Mortality Rate (%)	p-value
Low Birth Weight	8	25.0%	
Normal Birth Weight	0	0.0%	
Macrosomic	0	0.0%	
Total	**8**	**8.0%**	**<0.001**

Statistical Significance Summary: Statistical analysis showed that the differences in NICU stay duration, incidence of complications, and mortality rates among the birth weight groups were all statistically significant (p-values < 0.05). These findings suggest that birth weight is a critical determinant of neonatal outcome, especially for predicting length of hospital stay, likelihood of complications, and survival.

Discussion

The results of LBW (<2500g), normal birth weight (2500-3999g), and macrosomia (≥4000g) were compared in the study. Neonatal mortality, which shows the long-term effect of birth weight on survival in the first few days following delivery, was the major result.

They also counted the days a newborns spent in the newborn intensive care unit to assess healthcare resource use and illness severity. Due to its strong link with undeveloped lungs in premature and low-birth-weight newborns, respiratory distress syndrome (RDS) was a key morbidity. Neonatal sepsis, a potentially lethal illness, was also examined because it is common and harmful in susceptible neonates. Hypoglycemia, which could affect neurodevelopment in LBW and macrosomic neonates, was also investigated. The study concluded by examining feeding resistance, which can indicate gastrointestinal immaturity or dysfunction and prolong NICU stays. These outcomes were chosen for their clinical relevance and frequency in neonates at both weight extremes to assess birth weight hazards and resource needs.

Comparison with Previous Studies: Our findings support a significant body of data that birth weight affects newborn death and morbidity. Study 1 found that LBW neonates had longer NICU stays and more complications than normal-weight neonates. Study 2 reported that newborns ≥4000g had a nearly threefold higher risk of metabolic disorders, particularly in early postnatal periods, supporting our observation of increased hypoglycemia risk in macrosomic neonates. We discovered that birth trauma is prevalent in macrosomia newborns, supporting the Study 3 recommendation for careful delivery preparation. Our findings are consistent with those from better-equipped institutions, suggesting birth weight's clinical effects are comparable across healthcare settings. However, most research is from metropolitan tertiary centres.

Table 5: Comparison of Present Study with Existing Literature on Birth Weight and Neonatal Outcomes

Study	Study Type	Sample Size	Findings
Present Study (2025)	Retrospective Observational	100	LBW neonates had higher rates of respiratory distress (40.6%), sepsis (34.3%), hypoglycemia (28.1%), and 25% mortality. Macrosomic neonates showed increased hypoglycemia (25%) and birth trauma (12.5%).
Study 1 [13]	Prospective Cohort	250	LBW neonates had prolonged NICU stays, higher sepsis (30%) and mortality (22%). Normal weight neonates had significantly fewer complications.
Study 2 [14]	Retrospective Study	180	Neonatal mortality was highest among LBW infants (20%). Hypoglycemia and feeding intolerance were common among both LBW and macrosomic neonates.
Study 3 [15]	Cross-sectional Study	300	Macrosomic neonates had higher risk of hypoglycemia (27%), shoulder dystocia, and NICU admission. LBW infants showed increased infection rates and longer hospital stays.

Limitations of the Study

This study illuminates the relationship between birth weight and newborn health, although it has many limitations. First, subgroup analyses are weaker because the sample size is 100 neonates, especially when there are only 8 macrosomic newborns. This makes it tougher to draw solid conclusions, especially when dealing with rare results or issues. Second, because the study was a single-center study at BMIMS, the results may not apply to other hospitals or places with different demographics, healthcare practices, or resource availability. Thirdly, the study used manual records, which may have errors, omissions, or discrepancies. These data accuracy concerns may affect clinical correlations. Finally, socioeconomic status, gestational age, and maternal health concerns like hypertension and diabetes were not fully controlled for in the study. Even after correcting for birth weight, these factors can affect neonatal outcomes. These potential confounders may have altered the observed associations; therefore, their absence fills a significant gap in the analysis.

Future research should employ multivariate statistical models to adjust for confounders and prospective, multicenter designs with larger, more diverse samples to overcome these limits.

Recommendations for Future Practice and Research: The study suggests several improvements to newborns care, including community-level prenatal screening programs for malnutrition, anemia, and gestational diabetes, standardization of antenatal education and monitoring programs, weight-specific newborn care in NICUs, comparative research with additional Indian centers, and state and district health record integration and data digitisation. These systemic improvements are crucial for enhancing newborn healthcare outcomes and ensuring research-based therapies.

Conclusion

This study shows that LBW neonates are at risk of respiratory distress, sepsis, hypoglycemia, feeding intolerance, prolonged NICU stays, and increased mortality. Macrosomic newborns had higher hypoglycemia and delivery trauma but no higher death, suggesting that both birth weights are therapeutically significant. According to these findings, birth weight is a good predictor of newborn problems and death. These findings demonstrate the need for better prenatal care programs that address maternal nutrition, detect gestational illnesses early, and refer pregnant women to the correct healthcare institutions. Newborns must be closely monitored, especially those at higher risk due to birth weight. Early detection and focused therapy improve results, reduce neonatal death, and relieve critical care resource pressure. Including birth weight in neonatal risk assessment models can improve neonatal health outcomes, especially in low-resource settings like Bhagwan Mahavir Institute of Medical Sciences.

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