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Low Birth Weight and Adverse Neonatal Outcomes: A Retrospective Cohort Study

Ayu Lestari *1, Maya Prameswari*2, Rizka Amalia*3

1 ITSK RS dr. Soepraon Malang
2 ITSK RS dr. Soepraon Malang
3 Poltekkes Kemenkes Malang

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ABSTRACT

Background: Low birth weight (LBW) remains an important predictor of neonatal morbidity and mortality. Infants born with LBW are more vulnerable to respiratory, metabolic, infectious, and survival-related complications during the neonatal period.
Objective: This study aimed to examine the association between LBW and adverse neonatal outcomes.
Methods: This retrospective cohort study included 1,250 live-born singleton neonates delivered between January and December 2025. The study population consisted of all eligible neonates with complete records of birth weight and neonatal outcomes. Neonates were classified into LBW (<2,500 g) and non-LBW (≥2,500 g) groups. The primary outcome was a composite of adverse neonatal outcomes, including NICU admission, respiratory distress, neonatal hypoglycemia, neonatal sepsis, phototherapy-requiring jaundice, low fifth-minute Apgar score, and neonatal death. Risk ratios were estimated using multivariable regression analysis.
Results: Of 1,250 neonates, 180 (14.4%) had LBW. Adverse neonatal outcomes were more frequent among LBW infants than among non-LBW infants (48.9% vs. 16.8%). After adjustment for maternal and obstetric factors, LBW was significantly associated with a higher risk of adverse neonatal outcomes (adjusted RR = 2.31; 95% CI: 1.78–2.99).
Conclusion: LBW was independently associated with an increased risk of adverse neonatal outcomes. Early identification of high-risk pregnancies and strengthened neonatal care are essential to improve outcomes among LBW infants.

Corresponding Author:
Ayu Lestari
ITSK RS dr. Soepraon; lestariayu@gmail.com

INTRODUCTION

Low birth weight (LBW) remains a major public health concern and an important indicator of maternal, fetal, and neonatal health. The World Health Organization defines LBW as a birth weight of less than 2,500 g, regardless of gestational age, with birth weight ideally measured within the first hour after delivery before substantial postnatal weight loss occurs [1]. Globally, LBW continues to contribute to neonatal morbidity and mortality, reflecting the combined influence of maternal nutritional status, pregnancy complications, fetal growth restriction, preterm birth, and access to quality antenatal and perinatal care [2].

The clinical importance of LBW lies in its strong relationship with newborn vulnerability during the early neonatal period. Infants born with LBW often have limited physiological reserves and immature adaptive mechanisms, making them more susceptible to respiratory, metabolic, infectious, and survival-related complications. These complications may include respiratory distress, hypoglycemia, hypothermia, neonatal sepsis, hyperbilirubinemia requiring phototherapy, low Apgar scores, admission to the neonatal intensive care unit, and neonatal death [3][4]. Although LBW is frequently associated with prematurity, it may also occur among term infants with impaired intrauterine growth, indicating that LBW represents a heterogeneous but clinically high-risk condition [5].

Several maternal and obstetric factors are known to influence both birth weight and neonatal outcomes. Inadequate antenatal care, maternal anemia, hypertensive disorders of pregnancy, poor maternal nutritional status, young or advanced maternal age, and preterm delivery may increase the likelihood of LBW and subsequent neonatal complications [6]. These factors may also confound the association between LBW and neonatal outcomes. Therefore, evaluating the independent association between LBW and adverse neonatal outcomes requires adjustment for relevant maternal and obstetric characteristics [7].

Although previous studies have reported an association between LBW and poor neonatal outcomes, important evidence gaps remain. First, many studies have focused on single outcomes, such as neonatal death or NICU admission, rather than evaluating a broader composite outcome that reflects the overall burden of early neonatal morbidity [7]. Second, some studies have not adequately distinguished between crude associations and associations adjusted for key maternal and obstetric factors, particularly prematurity, hypertensive disorders, anemia, and antenatal care adequacy [8]. Third, evidence derived from routinely collected clinical data remains limited in many real-world care settings, where referral patterns, delivery characteristics, and neonatal management may differ from those reported in large population-based datasets [9]. These gaps limit the ability of clinicians and health systems to estimate the actual risk profile of LBW infants and to prioritize early neonatal monitoring based on locally relevant evidence.

To address these gaps, this study examined the association between LBW and adverse neonatal outcomes among live-born singleton neonates using a retrospective cohort design. The primary outcome was a composite measure of adverse neonatal outcomes, including neonatal intensive care unit admission, respiratory distress, neonatal hypoglycemia, neonatal sepsis, phototherapy-requiring jaundice, low fifth-minute Apgar score, and neonatal death. This study further assessed whether LBW remained independently associated with adverse neonatal outcomes after adjustment for maternal and obstetric factors.

METHOD

Study Design

This study used a retrospective cohort design to examine the association between low birth weight (LBW) and adverse neonatal outcomes. The exposure status was determined based on birth weight recorded at delivery, and neonatal outcomes were assessed retrospectively from medical records. This design was selected because it allowed the evaluation of temporal relationships between birth weight status and subsequent neonatal outcomes using routinely collected clinical data.

Study Setting and Period

The study was conducted using medical record data from selected hospitals that provide maternal and neonatal care. Data were collected from deliveries that occurred between January 1 and December 31, 2025. The study setting included facilities with obstetric, neonatal, and referral services, allowing the inclusion of neonates with varying levels of clinical risk and neonatal care needs.

Study Population

The source population consisted of all live-born neonates delivered during the study period. The target population was live-born singleton neonates with complete information on birth weight and neonatal outcomes. The study population comprised neonates who met the eligibility criteria and had sufficient medical record documentation to classify exposures, assess covariates, and evaluate outcomes.

Sample Size and Sampling Technique

A total of 1,250 live-born singleton neonates were included in the final analysis. The sample was obtained using total sampling, in which all eligible neonates delivered during the study period were reviewed and included if they met the inclusion criteria. Neonates with incomplete key data or conditions that could substantially affect the interpretation of outcomes were excluded per the predefined exclusion criteria.

Eligibility Criteria

Neonates were included if they were live-born singleton infants delivered during the study period, had recorded birth weight data, had documented gestational age, and had available neonatal outcome information until discharge, death, or completion of the early neonatal observation period.

Neonates were excluded if they were stillbirths, multiple births, had major congenital anomalies, had missing data on birth weight or primary neonatal outcomes, or were transferred to another facility within 24 hours after birth without available follow-up information. These exclusion criteria were applied to reduce misclassification and improve the validity of outcome assessment.

Exposure Variable

The primary exposure was low birth weight. LBW was defined as a birth weight of less than 2,500 g, regardless of gestational age. Neonates were classified into two groups: the LBW group, consisting of neonates with birth weight below 2,500 g, and the non-LBW group, consisting of neonates with birth weight of 2,500 g or higher. Birth weight was obtained from delivery or neonatal records and was recorded in grams.

Outcome Variables

The primary outcome was a composite measure of adverse neonatal outcomes. A neonate was classified as having an adverse neonatal outcome if at least one of the following events was documented: admission to the neonatal intensive care unit, respiratory distress, neonatal hypoglycemia, neonatal sepsis, jaundice requiring phototherapy, fifth-minute Apgar score below 7, or neonatal death.

Secondary outcomes included each component of the composite outcome analyzed separately. These outcomes were selected because they represent clinically relevant early neonatal complications commonly associated with impaired fetal growth, prematurity, and poor neonatal adaptation.

Data Sources and Data Collection Procedure

Data were obtained from maternal medical records, delivery registers, neonatal medical records, and neonatal care unit registers. A structured data extraction form was used to ensure consistency in data collection. Extracted information included maternal demographic characteristics, obstetric history, antenatal care history, pregnancy complications, delivery characteristics, neonatal characteristics at birth, and neonatal outcomes.

Trained reviewers conducted data extraction. To reduce abstraction error, a subset of records was checked for consistency by a second reviewer. Any discrepancy was resolved through discussion and rechecking of the original medical record.

Statistical Analysis

Data were analyzed using statistical software. Descriptive statistics were used to summarize maternal, obstetric, and neonatal characteristics. Categorical variables were presented as frequencies and percentages, while continuous variables were presented as means and standard deviations or medians and interquartile ranges, depending on data distribution.

Baseline characteristics were compared between the LBW and non-LBW groups. The chi-square test or Fisher's exact test was used for categorical variables, while the independent t-test or Mann–Whitney U test was used for continuous variables, as appropriate.

The association between LBW and adverse neonatal outcomes was first assessed using crude risk ratios. Multivariable regression analysis was then performed to estimate adjusted risk ratios and 95% confidence intervals after controlling for potential confounders, including maternal age, parity, adequacy of antenatal care, maternal anemia, hypertensive disorders of pregnancy, gestational age, and mode of delivery.

A two-sided p-value of less than 0.05 was considered statistically significant. The primary analysis evaluated the association between LBW and the composite adverse neonatal outcome. Secondary analyses examined the association between LBW and each neonatal outcome.

RESULT AND DISCUSSION

Result

A total of 1,382 delivery records were screened during the study period. Of these, 132 records were excluded because they did not meet the eligibility criteria, including stillbirths, multiple pregnancies, major congenital anomalies, incomplete key variables, or transfer to another facility within 24 hours after birth without available follow-up information. The final analytic sample consisted of 1,250 live-born singleton neonates.

Among the 1,250 neonates included in the analysis, 180 (14.4%) were classified as having low birth weight (LBW), whereas 1,070 (85.6%) were classified as non-LBW. The distribution of the study population is summarized in Table 1.

Table 1. Flow of Study Population

Selection stage	**n**	**%**
Delivery records screened	1,382	100.0
Excluded records	132	9.6
Stillbirths	28	2.0
Multiple births	34	2.5
Major congenital anomalies	18	1.3
Incomplete key variables	37	2.7
Transferred within 24 hours without follow-up information	15	1.1
Final analytic sample	1,250	90.4
Low birth weight	180	14.4
Non-low birth weight	1,070	85.6

Maternal and obstetric characteristics according to birth weight status are presented in Table 2. Overall, most mothers were 20 to 34 years of age. Advanced maternal age was more frequent among mothers of LBW neonates, with 42 (23.3%) in the LBW group compared with 178 (16.6%) in the non-LBW group. Mothers younger than 20 years were also slightly more common in the LBW group, occurring in 18 (10.0%) compared with 72 (6.7%) in the non-LBW group.

Primiparity was observed in 477 (38.2%) mothers. The proportion of primiparous mothers was slightly higher in the LBW group than in the non-LBW group, with 76 (42.2%) and 401 (37.5%), respectively. Maternal educational level differed between groups: senior high school or lower was reported in 119 (66.1%) mothers of LBW neonates and 593 (55.4%) mothers of non-LBW neonates.

Antenatal and pregnancy-related risk indicators were consistently more common in the LBW group. Inadequate antenatal care was documented in 61 (33.9%) mothers in the LBW group compared with 202 (18.9%) in the non-LBW group. Maternal anemia was present in 70 (38.9%) pregnancies in the LBW group and 219 (20.5%) in the non-LBW group. Hypertensive disorders of pregnancy were also more frequent among LBW births, occurring in 34 (18.9%) compared with 71 (6.6%) among non-LBW births. Preterm birth showed the largest difference between groups. A total of 76 (42.2%) LBW neonates were born before 37 completed weeks of gestation, compared with 96 (9.0%) non-LBW neonates. This finding indicates that prematurity was an important characteristic of the LBW group, although more than half of LBW neonates were not preterm.

Table 2. Maternal, Obstetric, and Neonatal Characteristics by Birth Weight Status

Characteristic	**Total (N = 1,250) n (%)**	**LBW (n = 180) n (%)**	**Non-LBW (n = 1,070) n (%)**	**p value**
Maternal age, years				
<20	90 (7.2)	18 (10.0)	72 (6.7)	
20-34	940 (75.2)	120 (66.7)	820 (76.6)	0.007
>=35	220 (17.6)	42 (23.3)	178 (16.6)	
Primiparity	477 (38.2)	76 (42.2)	401 (37.5)	0.229
Education <= senior high school	712 (57.0)	119 (66.1)	593 (55.4)	0.008
Inadequate antenatal care (<4 visits)	263 (21.0)	61 (33.9)	202 (18.9)	<0.001
Maternal anemia	289 (23.1)	70 (38.9)	219 (20.5)	<0.001
Hypertensive disorders of pregnancy	105 (8.4)	34 (18.9)	71 (6.6)	<0.001
Gestational diabetes mellitus	57 (4.6)	9 (5.0)	48 (4.5)	0.756
Cesarean delivery	412 (33.0)	64 (35.6)	348 (32.5)	0.419
Preterm birth (<37 weeks)	172 (13.8)	76 (42.2)	96 (9.0)	<0.001
Male neonate	646 (51.7)	94 (52.2)	552 (51.6)	0.881
Birth weight, g, mean (SD)	2,983 (495)	2,132 (286)	3,126 (371)	<0.001
Gestational age, weeks, mean (SD)	37.9 (2.0)	35.7 (2.8)	38.3 (1.5)	<0.001

Neonatal outcomes according to birth weight status are shown in Table 3. Overall, 268 (21.4%) neonates experienced at least one adverse neonatal outcome. The proportion of adverse neonatal outcomes was substantially higher among LBW neonates than among non-LBW neonates, occurring in 88 (48.9%) and 180 (16.8%) neonates, respectively. The crude risk ratio was 2.91, indicating that LBW neonates had nearly a threefold higher risk of adverse neonatal outcomes before adjustment for potential confounders. Admission to the neonatal intensive care unit (NICU) was reported in 206 (16.5%) neonates. NICU admission was more frequent in the LBW group, occurring in 72 (40.0%) neonates, compared with 134 (12.5%) neonates in the non-LBW group. Respiratory distress occurred in 152 (12.2%) neonates overall and was more common among LBW neonates, with 54 (30.0%) affected neonates compared with 98 (9.2%) among non-LBW neonates.

Neonatal hypoglycemia was documented in 99 (7.9%) neonates. The condition was observed in 38 (21.1%) LBW and 61 (5.7%) non-LBW neonates, indicating substantially greater metabolic vulnerability in LBW infants. Neonatal sepsis was recorded in 82 (6.6%) neonates, including 24 (13.3%) in the LBW group and 58 (5.4%) in the non-LBW group. Jaundice requiring phototherapy was documented in 244 (19.5%) neonates. Although this outcome was more frequent among LBW neonates, with 46 (25.6%) cases compared with 198 (18.5%) among non-LBW neonates, the magnitude of difference was smaller than that observed for NICU admission, respiratory distress, and hypoglycemia. A fifth-minute Apgar score below 7 occurred in 57 (4.6%) neonates, including 20 (11.1%) LBW neonates and 37 (3.5%) non-LBW neonates. Neonatal death occurred in 28 (2.2%) neonates, with a higher proportion among LBW neonates than non-LBW neonates, 12 (6.7%) versus 16 (1.5%), respectively.

Table 3. Neonatal Outcomes by Birth Weight Status

Outcome	**Total (N = 1,250) n (%)**	**LBW (n = 180) n (%)**	**Non-LBW (n = 1,070) n (%)**	**Crude RR (95% CI)**	**p value**
Composite adverse neonatal outcome	268 (21.4)	88 (48.9)	180 (16.8)	2.91 (2.38-3.55)	<0.001
NICU admission	206 (16.5)	72 (40.0)	134 (12.5)	3.19 (2.52-4.03)	<0.001
Respiratory distress	152 (12.2)	54 (30.0)	98 (9.2)	3.27 (2.48-4.31)	<0.001
Neonatal hypoglycemia	99 (7.9)	38 (21.1)	61 (5.7)	3.70 (2.55-5.37)	<0.001
Neonatal sepsis	82 (6.6)	24 (13.3)	58 (5.4)	2.46 (1.58-3.82)	<0.001
Jaundice requiring phototherapy	244 (19.5)	46 (25.6)	198 (18.5)	1.38 (1.04-1.84)	0.026
Fifth-minute Apgar score <7	57 (4.6)	20 (11.1)	37 (3.5)	3.21 (1.92-5.36)	<0.001
Neonatal death	28 (2.2)	12 (6.7)	16 (1.5)	4.46 (2.17-9.16)	<0.001

The crude and adjusted associations between selected maternal, obstetric, and neonatal factors and the composite adverse neonatal outcome are presented in Table 4. In the crude analysis, LBW was associated with a markedly increased risk of adverse neonatal outcomes. After adjustment for maternal age, parity, antenatal care adequacy, maternal anemia, hypertensive disorders of pregnancy, gestational age, and mode of delivery, LBW remained independently associated with adverse neonatal outcomes.

The adjusted risk ratio for the association between LBW and the composite adverse neonatal outcome was 2.31 (95% CI: 1.78-2.99; $p < 0.001$). This indicates that LBW neonates had more than twice the risk of adverse neonatal outcomes compared with non-LBW neonates after accounting for relevant maternal and obstetric factors.

Several covariates were also independently associated with adverse neonatal outcomes. Inadequate antenatal care was associated with a higher risk of adverse outcomes, with an adjusted risk ratio of 1.42 (95% CI: 1.13-1.78; $p = 0.003$). Maternal anemia was associated with an adjusted risk ratio of 1.36 (95% CI: 1.08-1.72; $p = 0.009$), while hypertensive disorders of pregnancy were associated with an adjusted risk ratio of 1.59 (95% CI: 1.19-2.12; $p = 0.002$). Preterm birth showed a strong independent association with adverse neonatal outcomes, with an adjusted risk ratio of 2.14 (95% CI: 1.66-2.76; $p < 0.001$).

Table 4. Multivariable Analysis of Factors Associated With Composite Adverse Neonatal Outcomes

Variable	Crude RR	Adjusted RR	95% CI	p value
Low birth weight	2.91	2.31	1.78-2.99	<0.001
Maternal age >=35 years	1.32	1.11	0.86-1.43	0.421
Primiparity	1.18	1.09	0.88-1.35	0.438
Inadequate antenatal care (<4 visits)	1.74	1.42	1.13-1.78	0.003
Maternal anemia	1.61	1.36	1.08-1.72	0.009
Hypertensive disorders of pregnancy	2.08	1.59	1.19-2.12	0.002
Preterm birth (<37 weeks)	3.02	2.14	1.66-2.76	<0.001
Cesarean delivery	1.21	1.08	0.87-1.34	0.486

A summary of individual outcome patterns is presented in Table 5. The highest relative differences between LBW and non-LBW neonates were observed for neonatal death, neonatal hypoglycemia, respiratory distress, low fifth-minute Apgar score, and NICU admission. These findings suggest that the association between LBW and adverse neonatal outcomes was not limited to a single clinical domain but encompassed survival-related, metabolic, respiratory, and early adaptation outcomes.

Overall, the results indicate that LBW was associated with both a higher overall burden of adverse neonatal outcomes and higher proportions of specific neonatal complications. The persistence of this association after adjustment for important maternal and obstetric covariates supports LBW as an independent marker of neonatal vulnerability.

Table 5. Difference in Outcome Proportions Between LBW and Non-LBW Neonates

Outcome	**LBW n (%)**	**Non-LBW n (%)**	**Absolute difference, percentage points**	**Direction of association**
Composite adverse neonatal outcome	88 (48.9)	180 (16.8)	+32.1	Higher in the LBW group
NICU admission	72 (40.0)	134 (12.5)	+27.5	Higher in the LBW group
Respiratory distress	54 (30.0)	98 (9.2)	+20.8	Higher in the LBW group
Neonatal hypoglycemia	38 (21.1)	61 (5.7)	+15.4	Higher in the LBW group
Neonatal sepsis	24 (13.3)	58 (5.4)	+7.9	Higher in the LBW group
Jaundice requiring phototherapy	46 (25.6)	198 (18.5)	+7.1	Higher in the LBW group
Fifth-minute Apgar score <7	20 (11.1)	37 (3.5)	+7.6	Higher in the LBW group
Neonatal death	12 (6.7)	16 (1.5)	+5.2	Higher in the LBW group

Discussion

This retrospective cohort study demonstrated that low birth weight (LBW) was significantly associated with an increased risk of adverse neonatal outcomes among live-born singleton neonates. Of 1,250 neonates included in the analysis, 180 (14.4%) were classified as LBW and 1,070 (85.6%) were classified as non-LBW. Adverse neonatal outcomes occurred more frequently among LBW neonates than among non-LBW neonates, with 88 (48.9%) versus 180 (16.8%), respectively. After adjustment for maternal age, parity, adequacy of antenatal care, maternal anemia, hypertensive disorders of pregnancy, gestational age, and mode of delivery, LBW remained independently associated with adverse neonatal outcomes, with an adjusted risk ratio of 2.31 (95% CI: 1.78–2.99). This finding indicates that LBW neonates had more than twice the risk of experiencing adverse neonatal outcomes compared with non-LBW neonates, even after accounting for relevant maternal and obstetric factors [10].

The association between LBW and adverse neonatal outcomes is clinically and biologically plausible. LBW reflects impaired fetal growth, preterm birth, or a combination of both, each of which may compromise neonatal adaptation after delivery [11][12]. Infants with LBW often have limited energy reserves, lower glycogen stores, reduced subcutaneous fat, immature thermoregulation, and less developed organ function [13]. These physiological limitations may increase susceptibility to respiratory instability, metabolic disturbances, infection, and early neonatal death. Therefore, LBW should be interpreted not only as an anthropometric classification but also as a marker of increased neonatal vulnerability [14].

The findings of this study are consistent with established neonatal health theory and previous research showing that LBW is closely related to poor short-term neonatal outcomes [15]. The World Health Organization recognizes LBW as an important public health indicator associated with neonatal morbidity and mortality. Previous cohort and hospital-based studies have also reported that infants born with lower birth weight have a higher risk of respiratory distress, hypoglycemia, sepsis, intensive care admission, and neonatal death [16]. The present study strengthens this evidence by demonstrating that the association persisted after adjustment for several maternal and obstetric confounders [17]. This is important because the relationship between LBW and neonatal outcomes may be influenced by prematurity, inadequate antenatal care, maternal anemia, and hypertensive disorders of pregnancy [18]. The persistence of the association after adjustment suggests that LBW itself remains an important independent marker of adverse neonatal risk.

NICU admission was substantially more common among LBW neonates, occurring in 72 (40.0%) LBW neonates compared with 134 (12.5%) non-LBW neonates. This finding suggests that LBW infants were more likely to require intensive monitoring and specialized neonatal care. The increased need for NICU admission may be explained by respiratory instability, feeding difficulties, metabolic disturbances, suspected infection, or complications related to prematurity [19][20]. From a clinical perspective, the high proportion of NICU admissions among LBW neonates supports the importance of early risk identification at birth. Birth weight is an easily available clinical measurement and can be used immediately to determine the level of neonatal observation and intervention required [21].

Respiratory distress was also more frequent among LBW neonates, with 54 (30.0%) cases compared with 98 (9.2%) among non-LBW neonates. This finding is consistent with the biological vulnerability of LBW infants, particularly those born preterm. Pulmonary immaturity, surfactant deficiency, weak respiratory effort, and delayed cardiopulmonary transition may contribute to the increased occurrence of respiratory distress in this group [22]. Even among term LBW infants, intrauterine growth restriction and chronic fetal compromise may reduce respiratory reserve and increase the risk of postnatal respiratory problems [23]. These findings highlight the need for adequate delivery-room preparedness, early respiratory assessment, oxygen saturation monitoring, and timely escalation of care for LBW neonates [24].

Neonatal hypoglycemia occurred in 38 (21.1%) LBW neonates and 61 (5.7%) non-LBW neonates. This difference indicates a higher metabolic vulnerability among LBW infants. After birth, neonates must maintain glucose homeostasis independently following the interruption of maternal glucose supply [25]. LBW infants may have limited glycogen stores, reduced adipose tissue, immature gluconeogenesis, and increased energy expenditure, especially when accompanied by hypothermia, respiratory distress, or delayed feeding [26]. Because neonatal hypoglycemia may be asymptomatic, routine glucose monitoring in LBW infants is important to prevent delayed recognition and potential neurological complications [25].

The proportion of neonatal sepsis was higher in the LBW group than in the non-LBW group, with 24 (13.3%) versus 58 (5.4%), respectively. This finding is consistent with previous evidence that LBW infants are more susceptible to infection due to immune immaturity, fragile skin and mucosal barriers, prolonged hospitalization, and greater exposure to invasive procedures. In addition, maternal conditions associated with LBW, such as inadequate antenatal care, anemia, and pregnancy complications, may increase the risk of neonatal infection [27][28]. This result underscores the importance of infection prevention measures, early recognition of clinical deterioration, rational antibiotic use, and strict adherence to aseptic procedures in the care of LBW infants.

Jaundice requiring phototherapy occurred in 46 (25.6%) LBW neonates and 198 (18.5%) non-LBW neonates. Although the difference was less pronounced than for respiratory distress or hypoglycemia, the higher occurrence among LBW neonates remains clinically relevant. LBW infants may have immature hepatic bilirubin metabolism, reduced feeding effectiveness, increased enterohepatic circulation, and a higher likelihood of prematurity-related hyperbilirubinemia [29]. These factors may increase the need for bilirubin monitoring and timely phototherapy. The findings suggest that jaundice surveillance should remain an important component of routine care for LBW infants, particularly during the first days of life and before discharge [30].

Low fifth-minute Apgar score and neonatal death were also more frequent among LBW neonates. A fifth-minute Apgar score below 7 occurred in 20 (11.1%) LBW neonates compared with 37 (3.5%) non-LBW neonates, while neonatal death occurred in 12 (6.7%) LBW neonates compared with 16 (1.5%) non-LBW neonates. These findings indicate that LBW was associated not only with nonfatal morbidity but also with poorer immediate neonatal adaptation and survival [31]. Low Apgar scores may reflect impaired cardiorespiratory transition, birth asphyxia, prematurity, or fetal compromise before delivery. The higher mortality among LBW neonates may be related to the combined effects of respiratory distress, infection, hypoglycemia, prematurity, and limited physiological reserve [32].

Maternal and obstetric factors also contributed to adverse neonatal outcomes. Inadequate antenatal care, maternal anemia, hypertensive disorders of pregnancy, and preterm birth were more common among LBW neonates and were associated with poorer neonatal outcomes [33]. These findings support the concept that neonatal health is strongly influenced by maternal health and pregnancy conditions. Inadequate antenatal care may reduce opportunities for early detection and management of fetal growth restriction, anemia, hypertension, infection, and risk of preterm birth [31]. Maternal anemia may impair oxygen delivery to the fetus and contribute to restricted fetal growth. Hypertensive disorders of pregnancy may reduce uteroplacental perfusion, increase the risk of placental insufficiency, and lead to medically indicated preterm delivery. These pathways may explain why LBW often occurs together with other high-risk maternal and obstetric conditions [33].

The persistence of the association between LBW and adverse neonatal outcomes after multivariable adjustment suggests that LBW captures residual neonatal vulnerability beyond measured maternal and obstetric factors. However, the role of these covariates also indicates that prevention of adverse neonatal outcomes should begin before delivery [5]. Strengthening antenatal care, improving maternal nutritional status, screening and treating anemia, monitoring fetal growth, managing hypertensive disorders of pregnancy, and ensuring timely referral for high-risk pregnancies may reduce the burden of LBW and its associated complications [7].

The clinical implications of these findings are important. LBW should be used as a practical and immediate risk stratification marker at birth. Neonates with LBW require careful assessment of respiratory status, thermal stability, feeding adequacy, blood glucose levels, infection risk, bilirubin levels, and overall clinical condition. Standardized protocols for LBW care may help reduce delays in diagnosis and treatment. Such protocols should include early breastfeeding or appropriate feeding support, prevention of hypothermia, glucose monitoring, respiratory monitoring, infection prevention, and timely referral to higher levels of neonatal care when needed.

CONCLUSION

LBW was independently associated with an increased risk of adverse neonatal outcomes. LBW neonates had higher proportions of NICU admission, respiratory distress, neonatal hypoglycemia, neonatal sepsis, low fifth-minute Apgar score, and neonatal death compared with non-LBW neonates. These findings support the use of LBW as an early clinical marker of neonatal vulnerability and emphasize the need for strengthened antenatal care, early risk identification, and structured neonatal monitoring to reduce morbidity and mortality among infants born with LBW.

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