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ORIGINAL ARTICLE

Association Between Birth Weight and Neonatal Respiratory Morbidity: A Cohort Study of Full-Term Infants

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ABSTRACT

Background: Birth weight serves as a vital indicator of neonatal well-being and a key determinant of postnatal adaptation. Both low and high birth weights are associated with increased risk of respiratory complications, even in full-term neonates.

Objective: To determine the association between birth weight and neonatal respiratory morbidity among full-term infants.

Methodology: This was a prospective cohort study conducted at The Children's Hospital, Lahore from December 2022 to May 2023. A total of 195 full-term neonates were enrolled using non-probability consecutive sampling. Birth weight was recorded immediately after delivery and categorized as low (<2.5 kg), normal (2.5–4.0 kg), or high (>4.0 kg). All neonates were clinically observed for the first 72 hours for signs of respiratory distress, including tachypnea, grunting, nasal flaring, and retractions. Respiratory morbidity such as transient tachypnea of the newborn (TTN), respiratory distress syndrome (RDS), meconium aspiration syndrome (MAS), and persistent pulmonary hypertension of the newborn (PPHN) was diagnosed using clinical and radiological criteria.

Results: Out of 195 neonates, 102 (52.3%) were males and 93 (47.7%) were females, with a mean gestational age of 38.6 ± 1.2 weeks and mean birth weight of 3.1 ± 0.5 kg. Low birth weight was observed in 38 (19.5%) infants, normal weight in 134 (68.7%), and high weight in 23 (11.8%). Respiratory morbidity occurred in 47 (24.1%) neonates. The most common conditions were TTN (10.3%) and RDS (7.2%). A significant association was found between low birth weight and respiratory morbidity (p = 0.02). On multivariate analysis, low birth weight (AOR = 3.21; 95% CI: 1.47–7.03, p = 0.003), cesarean delivery (AOR = 2.14; 95% CI: 1.09–4.23, p = 0.026), and maternal diabetes (AOR = 2.58; 95% CI: 1.01–6.53, p = 0.048) were identified as independent predictors of neonatal respiratory morbidity.

Conclusion: It is concluded that low birth weight is significantly associated with increased risk of respiratory morbidity among full-term infants. Cesarean delivery and maternal diabetes further elevate this risk.

Keywords: Birth weight, Neonatal respiratory morbidity, Full-term infants, Transient tachypnea of the newborn

INTRODUCTION

Birth weight stands as one of the most critical indicators of neonatal well-being, serving as a direct reflection of intrauterine growth, maternal health, placental function, and fetal nutrition. It is a multifactorial outcome influenced by both genetic and environmental factors, including maternal age, parity, pre-pregnancy body mass index, socioeconomic status, and obstetric conditions[1]. Clinically, birth weight not only determines an infant's ability to adapt to extrauterine life but also has profound implications for short-term neonatal complications and long-term health trajectories[2]. One of the most significant and immediate concerns associated with abnormal birth weight either low or high is neonatal respiratory morbidity, which continues to represent a major cause of neonatal intensive care admissions worldwide. Respiratory complications in neonates such as transient tachypnea of the newborn (TTN), respiratory distress syndrome (RDS), meconium aspiration syndrome (MAS), and persistent pulmonary hypertension of the newborn (PPHN) are largely influenced by the degree of lung maturity and perinatal adaptation[3]. Low birth weight infants often suffer from pulmonary immaturity, reduced surfactant production, and weak respiratory musculature, predisposing them to hypoxia and prolonged oxygen dependency[4]. Conversely, infants with macrosomia are at risk of birth trauma, delayed absorption of lung fluid, and cesarean section delivery, which is independently associated with increased respiratory morbidity due to the absence of thoracic compression during labor. Thus, both extremes of birth weight can disrupt normal respiratory transition mechanisms, albeit through different physiological pathways[5].

The correlation between birth weight and neonatal respiratory outcomes is complex and may also depend on gestational age and maternal health status. While preterm infants are classically prone to RDS, full-term neonates can still develop respiratory distress due to intrauterine growth restriction (IUGR), maternal diabetes, hypertension, or placental insufficiency. These maternal conditions influence fetal oxygenation and growth, leading to structural and biochemical alterations in lung development[6]. Intrauterine exposure to hyperglycemia, for instance, is known to delay surfactant synthesis, while chronic placental hypoxia in IUGR cases accelerates surfactant production prematurely, sometimes at the cost of normal alveolar growth. The resultant mismatch can predispose neonates to respiratory instability even at term gestation[7]. Furthermore, the mode of delivery plays a significant intermediary role in this association. Infants born via elective cesarean section are often deprived of the catecholamine surge and thoracic fluid clearance associated with vaginal delivery, increasing the risk of TTN and respiratory distress[8]. This effect is especially pronounced in larger infants, where elective cesarean deliveries are more common due to cephalopelvic disproportion or suspected macrosomia[9]. From a public health perspective, exploring the association between birth weight and respiratory outcomes provides vital insight for antenatal and perinatal management. In low- and middle-income countries, where access to advanced neonatal care remains limited, early identification of high-risk infants based on birth weight can facilitate targeted interventions such as antenatal corticosteroid administration, maternal glycemic control, and optimization of delivery timing. Preventive measures addressing maternal nutrition, anemia, and infections can further reduce the incidence of abnormal birth weights, thereby indirectly mitigating respiratory complications[10].

Objective: To determine the association between birth weight and neonatal respiratory morbidity among full-term infants.

METHODOLOGY

This was a prospective cohort study conducted at The Children's Hospital, Lahore from December 2022 to May 2023. A total of 195 full-term neonates were included in the study. Non-probability consecutive sampling was employed. All neonates meeting the

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inclusion criteria during the study period were enrolled after obtaining informed parental consent.

Inclusion Criteria:

- Full-term neonates (gestational age 37–42 weeks).
- Singleton births.
- Infants with documented birth weight recorded immediately after delivery.
- Neonates delivered in the hospital and available for postnatal follow-up within the first 72 hours.

Exclusion Criteria:

- Preterm (<37 weeks) or post-term (>42 weeks) infants.
- Neonates with congenital anomalies, chromosomal abnormalities, or structural malformations affecting respiration.
- Infants with perinatal asphyxia or meconium aspiration diagnosed before inclusion.
- Mothers with incomplete antenatal records or uncertain gestational age estimation.

Data Collection: After obtaining ethical approval from the institutional review board and written informed consent from parents, data were collected using a structured proforma. Maternal demographic and clinical data, including maternal age, parity, body mass index, and obstetric history, were recorded. Birth weight was measured using a calibrated digital infant weighing scale immediately after delivery and categorized as low (<2.5 kg), normal (2.5–4.0 kg), or high (>4.0 kg). All neonates underwent a detailed physical examination within one hour of birth, followed by close clinical observation for at least 72 hours. Respiratory morbidity was identified based on the presence of respiratory distress signs, including tachypnea (respiratory rate >60/min), grunting, nasal flaring, retractions, or cyanosis. Diagnostic workup included chest radiography, oxygen saturation monitoring, and arterial blood gas analysis when indicated. Conditions such as transient tachypnea of the newborn (TTN), respiratory distress syndrome (RDS), and persistent pulmonary hypertension of the newborn (PPHN) were diagnosed based on standard clinical and radiological criteria. Perinatal factors including mode of delivery, Apgar scores, and maternal complications (such as gestational diabetes, preeclampsia, or infections) were documented. Neonates requiring respiratory support (nasal CPAP, oxygen supplementation, or mechanical ventilation) were followed until clinical recovery or discharge.

Data Analysis: All data were entered and analyzed using SPSS version 21. Quantitative variables such as birth weight, gestational age, and maternal age were expressed as mean ± standard deviation. Categorical variables such as gender, delivery mode, and presence of respiratory morbidity were presented as frequencies and percentages. The association between birth weight categories and respiratory morbidity was analyzed using the chi-square test, with a p-value <0.05 considered statistically significant.

RESULTS

A total of 195 full-term neonates were included in the study. Among these, 102 (52.3%) were males and 93 (47.7%) were females, with a male-to-female ratio of approximately 1.1:1. The mean gestational age of the study population was 38.6 ± 1.2 weeks, and the mean birth weight was 3.1 ± 0.5 kg. Based on birth weight categories, 38 (19.5%) neonates were classified as low birth weight (<2.5 kg), 134 (68.7%) as normal birth weight (2.5–4.0 kg), and 23 (11.8%) as high birth weight (>4.0 kg). Among maternal complications, gestational diabetes mellitus (GDM) was observed in 21 (10.8%) mothers, and pregnancy-induced hypertension (PIH) in 27 (13.8%).

Table 1: Baseline Characteristics of Study Population (N = 195)

Variable	Frequency (n)	Percentage (%) / Mean ± SD
Total Neonates	195	100
Gender		
Male	102	52.3
Female	93	47.7
Gestational Age (weeks)	—	38.6 ± 1.2
Mean Birth Weight (kg)	—	3.1 ± 0.5
Birth Weight Categories		
Low Birth Weight (<2.5 kg)	38	19.5
Normal Birth Weight (2.5–4.0 kg)	134	68.7
High Birth Weight (>4.0 kg)	23	11.8
Mode of Delivery		
Vaginal	118	60.5
Cesarean Section	77	39.5
Maternal Complications		
Gestational Diabetes Mellitus (GDM)	21	10.8
Pregnancy-Induced Hypertension (PIH)	27	13.8

Out of the total 195 neonates, 47 (24.1%) developed respiratory morbidity, while 148 (75.9%) remained free of any respiratory issues. The most frequent respiratory condition was transient tachypnea of the newborn (TTN), affecting 20 (10.3%) infants, followed by respiratory distress syndrome (RDS) in 14 (7.2%) and meconium aspiration syndrome (MAS) in 8 (4.1%). A smaller subset, 5 (2.6%) neonates, experienced persistent pulmonary hypertension of the newborn (PPHN).

Table 2: Distribution of Neonatal Respiratory Morbidity (N = 195)

Type of Respiratory Morbidity	Frequency (n)	Percentage (%)
No Respiratory Morbidity	148	75.9
Transient Tachypnea of the Newborn (TTN)	20	10.3
Respiratory Distress Syndrome (RDS)	14	7.2
Meconium Aspiration Syndrome (MAS)	8	4.1
Persistent Pulmonary Hypertension of the Newborn (PPHN)	5	2.6

A statistically significant association (p = 0.02) was identified between birth weight and the incidence of respiratory morbidity. Among low birth weight infants, 18 out of 38 (47.4%) developed respiratory distress, compared to 24 out of 134 (17.9%) in the normal birth weight group and 5 out of 23 (21.7%) among high birth weight infants.

Perinatal factors such as mode of delivery and maternal diabetes showed a notable influence on neonatal respiratory morbidity. Gender was not significantly associated (p = 0.54), with nearly equal proportions of males (23.5%) and females (24.7%) developing respiratory distress. However, the mode of delivery exhibited a significant relationship (p = 0.03); cesarean-delivered infants had a higher rate of respiratory morbidity (31.2%) compared to those born vaginally (19.5%). Similarly, maternal diabetes was significantly associated with respiratory morbidity (p = 0.04), as 38.1% of infants born to diabetic mothers developed respiratory distress, compared to 22.2% in non-diabetic mothers.

Low birth weight infants were 3.21 times more likely to develop respiratory complications (AOR = 3.21, 95% CI: 1.47–7.03, p = 0.003). Cesarean delivery also doubled the risk (AOR = 2.14, 95% CI: 1.09–4.23, p = 0.026), while maternal diabetes increased the likelihood by more than two and a half times (AOR = 2.58, 95% CI: 1.01–6.53, p = 0.048). Male gender was not a significant predictor (AOR = 1.12, p = 0.54).

Table 3: Association Between Birth Weight and Respiratory Morbidity

Birth Weight Category	Total (n)	Respiratory Morbidity Present n (%)	Respiratory Morbidity Absent n (%)	p-value
Low Birth Weight (<2.5 kg)	38	18 (47.4%)	20 (52.6%)	
Normal Birth Weight (2.5–4.0 kg)	134	24 (17.9%)	110 (82.1%)	
High Birth Weight (>4.0 kg)	23	5 (21.7%)	18 (78.3%)	0.02

Table 4: Association of Perinatal Factors with Respiratory Morbidity

Variable	Respiratory Morbidity Present n (%)	Respiratory Morbidity Absent n (%)	p-value
Gender			
Male	24 (23.5%)	78 (76.5%)	0.54
Female	23 (24.7%)	70 (75.3%)	
Mode of Delivery			
Cesarean Section	24 (31.2%)	53 (68.8%)	
Vaginal Delivery	23 (19.5%)	95 (80.5%)	0.03
Maternal Diabetes			
Present	8 (38.1%)	13 (61.9%)	0.04
Absent	39 (22.2%)	135 (77.8%)	

Table 5: Logistic Regression Analysis for Predictors of Neonatal Respiratory Morbidity

Predictor Variable	Adjusted Odds Ratio (AOR)	95% Confidence Interval (CI)	p-value
Low Birth Weight (<2.5 kg)	3.21	1.47 – 7.03	0.003
Cesarean Section	2.14	1.09 – 4.23	0.026
Maternal Diabetes	2.58	1.01 – 6.53	0.048
Male Gender	1.12	0.59 – 2.12	0.54

DISCUSSION

This study explored the association between birth weight and neonatal respiratory morbidity among full-term infants, revealing a significant relationship between low birth weight and the risk of developing respiratory complications within the first 72 hours of life. Out of 195 neonates, approximately one-fourth experienced some form of respiratory morbidity, with transient tachypnea of the newborn (TTN) and respiratory distress syndrome (RDS) being the most prevalent conditions. These findings emphasize that even among full-term infants, abnormalities in fetal growth both restriction and excess can critically influence pulmonary adaptation at birth. The current study demonstrated that 47.4% of low birth weight infants developed respiratory morbidity compared to 17.9% of normal birth weight and 21.7% of high birth weight infants. This pattern is consistent with previous research showing that infants with low birth weight, even when born at term, have an increased risk of respiratory distress due to structural and biochemical immaturity of the lungs. Low birth weight often reflects intrauterine growth restriction (IUGR), which is associated with reduced alveolar surface area, inadequate surfactant production, and delayed fluid clearance from the lungs. These physiological limitations predispose neonates to conditions like RDS and TTN, explaining the higher morbidity rates observed in this subgroup[11].

Interestingly, high birth weight infants (macrosomic) also exhibited a moderately increased risk of respiratory morbidity. This aligns with earlier observations that infants of diabetic mothers who frequently have higher birth weights tend to experience delayed surfactant synthesis due to hyperinsulinemia. In this study, neonates born to mothers with gestational diabetes had a 38.1% rate of respiratory distress, further supporting this association. Hyperglycemia-induced fetal hyperinsulinemia suppresses type II pneumocyte maturation and surfactant production, increasing the likelihood of respiratory complications even at term gestation[12]. These results underscore the dual burden of both ends of the birth weight spectrum, where underdeveloped and overgrown infants face distinct yet convergent risks of respiratory morbidity. Cesarean section delivery was another significant independent predictor of neonatal respiratory morbidity. Infants born via cesarean section had a 31.2% incidence of respiratory distress compared to 19.5% among those delivered vaginally[13]. The absence of mechanical compression of the thoracic cavity during vaginal delivery delays the clearance of fetal lung fluid, predisposing these infants to TTN. This finding is well documented in literature, which highlights elective cesarean deliveries particularly those performed before 39 weeks as major contributors to respiratory compromise in newborns. In the present study, cesarean delivery remained an independent risk factor after logistic regression, indicating its strong physiological impact beyond confounding maternal or fetal factors[14]. The study also found no significant difference in respiratory morbidity between male and female neonates, a result that slightly diverges from some previous findings suggesting higher susceptibility among males[15]. This discrepancy might reflect differences in population genetics, sample size, or the relatively balanced gender distribution in this cohort. However, the consistent influence of maternal diabetes and mode of delivery reinforces that extrinsic and modifiable perinatal factors exert greater predictive value than gender alone in determining neonatal respiratory outcomes[16]. From a clinical perspective, these findings carry meaningful implications for obstetric and neonatal care. Identifying low birth weight and macrosomic infants as high-risk groups allows healthcare providers to implement anticipatory monitoring and early respiratory support. For instance, low birth weight infants can benefit from proactive thermal regulation, gentle ventilation strategies, and avoidance of fluid overload, while infants of diabetic mothers may require early glucose control and observation for delayed adaptation. Additionally, limiting elective cesarean deliveries before 39 weeks, unless clinically indicated, could substantially reduce preventable cases of TTN and RDS in full-term neonates[17].

While this study provides valuable insight into the relationship between birth weight and respiratory morbidity in full-term infants, several limitations should be acknowledged. First, it was conducted at a single tertiary care center, which may limit generalizability to broader populations. Second, although confounding factors such as gestational age, mode of delivery, and maternal comorbidities were adjusted for, other factors such as antenatal steroid exposure or intrauterine infections were not analyzed. Lastly, the sample size, though adequate for statistical analysis, may not capture less common respiratory conditions or subtle intergroup differences. Despite these limitations, the findings contribute meaningfully to the growing body of evidence that birth weight remains a crucial determinant of neonatal respiratory health. The strong statistical association between low birth weight and respiratory morbidity reinforces the need for targeted perinatal strategies focusing on fetal growth monitoring and delivery planning.

CONCLUSION

It is concluded that birth weight has a significant association with neonatal respiratory morbidity even among full-term infants. Low birth weight emerged as the strongest predictor of respiratory complications, primarily due to delayed pulmonary maturation and inadequate surfactant production. However, high birth weight infants also demonstrated a notable risk, especially in the presence of maternal diabetes and cesarean delivery. The study further established that cesarean section and maternal diabetes act as independent risk factors contributing to early respiratory distress, highlighting the influence of modifiable perinatal conditions on neonatal outcomes.

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