

## Original Research Article

## Chest X-ray Findings in Neonatal Respiratory Distress Syndrome in a Tertiary Care Hospital

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Received: 07.02.2026

Accepted: 02.04.2026

Published: 06.04.2026

**Journal homepage:**<https://www.easpublisher.com>**Quick Response Code**

**Abstract: Background:** Neonatal respiratory distress syndrome is a major cause of morbidity and mortality, particularly in preterm infants. This condition results from surfactant deficiency and structural immaturity of the lungs, leading to impaired gas exchange. Chest X-ray remains an important diagnostic tool for confirming respiratory distress syndrome and assessing disease severity, especially in resource-limited settings. This study aimed to evaluate the chest X-ray findings in neonatal respiratory distress syndrome and determine the association between gestational age and disease severity. **Methods:** This cross-sectional observational study was conducted in the Department of Radiology and Imaging, Bangladesh Shishu Hospital, Dhaka, Bangladesh, from June 2024 to July 2025. A total of 110 neonates with clinically suspected respiratory distress syndrome were included. Data were collected prospectively using structured forms to record the demographic characteristics and radiological findings. Chest X-ray images were evaluated to identify characteristic patterns and severity grading. Statistical analysis was performed using SPSS version 25.0. **Results:** Most neonates were preterm and had a low birth weight. The most common radiological finding was a ground-glass or reticulogranular pattern (83.6 %), followed by an air bronchogram (70.9%) and reduced lung volume (66.4%). Grade II severity was the most frequently observed (37.3%). A significant association was found between gestational age and severity of respiratory distress syndrome ( $p=0.002$ ), with severe disease being more common in neonates less than 34 weeks of gestation. **Conclusion:** Chest X-ray demonstrates characteristic radiological patterns that help diagnose and assess the severity of neonatal respiratory distress syndrome. Early identification of imaging features may facilitate timely management and improve the neonatal outcomes.

**Keywords:** Neonatal respiratory distress syndrome, chest X-ray, preterm neonates, radiological grading.

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## INTRODUCTION

Neonatal respiratory distress syndrome (RDS) remains one of the leading causes of morbidity and mortality among preterm infants worldwide. The condition primarily results from surfactant deficiency and structural immaturity of the lungs, leading to impaired gas exchange and progressive respiratory failure [1]. Despite advances in neonatal intensive care, RDS continues to pose a major clinical challenge, particularly in low and middle-income countries where access to advanced diagnostic and therapeutic facilities may be limited [2].

The pathophysiology of RDS involves inadequate production of pulmonary surfactant, resulting in increased alveolar surface tension, reduced lung compliance and atelectasis [3]. Immaturity of the pulmonary epithelium and impaired lung development contribute significantly to disease severity [4]. Preterm birth remains the most important risk factor, with incidence inversely related to gestational age [5]. Additional maternal and neonatal risk factors such as maternal diabetes, lack of antenatal steroid exposure and low birth weight have also been associated with increased risk of RDS [6].

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Early diagnosis of RDS is essential for timely intervention and improved clinical outcomes. Imaging plays a crucial role in confirming diagnosis, assessing severity and guiding treatment decisions. Chest X-ray remains the most widely used imaging modality in neonatal intensive care units for evaluation of respiratory distress [7]. Typical radiographic features include ground-glass appearance, reticulogranular pattern, air bronchogram, reduced lung volume and diffuse bilateral opacities [8]. Severity of RDS can also be graded based on radiological findings, which helps guide therapeutic interventions such as surfactant therapy and respiratory support [9].

Several studies have highlighted the importance of chest radiography in diagnosing neonatal respiratory disorders and differentiating RDS from other causes of respiratory distress [10]. Chest X-ray findings not only support clinical diagnosis but also provide important information regarding disease progression and complications such as pneumothorax, pleural effusion and pulmonary hemorrhage [11]. Radiological grading systems have been shown to correlate with disease severity and clinical outcomes in preterm neonates [12].

Although lung ultrasound has emerged as a promising alternative imaging modality, chest X-ray continues to be widely used due to its accessibility, familiarity and diagnostic reliability, particularly in resource-limited settings [13]. Previous research has demonstrated that radiographic findings play an essential role in determining the severity of disease and guiding management strategies [14]. Identification of characteristic imaging patterns may facilitate early intervention, reduce complications and improve neonatal survival [15].

In developing countries, the availability of diagnostic imaging and neonatal intensive care resources may be limited, which highlights the importance of optimizing the use of conventional chest radiography [16]. Studies have emphasized the need for evidence-based evaluation of radiological findings in neonatal respiratory distress syndrome to improve clinical decision-making [17]. Understanding the distribution of radiographic patterns and their relationship with gestational age may contribute to better risk stratification and treatment planning [18].

Despite the clinical importance of imaging in neonatal respiratory distress syndrome, limited data are available regarding radiological patterns and severity grading in the local population. This study aimed to evaluate chest X-ray findings in neonates diagnosed with respiratory distress syndrome in a tertiary care hospital and to determine the association between gestational age and severity of disease. The findings of this study may contribute to improved diagnostic accuracy and clinical management of neonatal respiratory distress syndrome.

## MATERIALS & METHODS

This cross-sectional observational study was conducted in the Department of Radiology and Imaging, Bangladesh Shishu Hospital, Dhaka, Bangladesh. The study was carried out over a period from June 2024 to July 2025. The study population consisted of neonates clinically suspected of respiratory distress syndrome who underwent chest X-ray examination during the study period. A total of 110 neonates fulfilling the eligibility criteria were included in the study.

### Selection Criteria

#### Inclusion Criteria

- Neonates clinically diagnosed with respiratory distress syndrome
- Neonates who underwent chest X-ray examination during the study period
- Neonates admitted to the study hospital within the specified period
- Both preterm and term neonates presenting with respiratory distress

#### Exclusion Criteria

- Neonates with congenital lung malformations
- Neonates with congenital heart disease affecting pulmonary circulation
- Neonates with incomplete clinical or radiological information

#### Data Collection Procedure

Data were collected prospectively from neonates clinically suspected of respiratory distress syndrome who underwent chest X-ray examination during the study period. Demographic and clinical characteristics including gestational age, birth weight, sex, mode of delivery and antenatal steroid exposure were recorded systematically using a structured data collection form. Clinical information was obtained directly from the patient's medical records, admission notes and neonatal assessment charts at the time of presentation.

All chest radiographs were performed using standard neonatal imaging protocols with appropriate positioning and radiation safety precautions to ensure optimal image quality while minimizing radiation exposure. Chest X-ray examinations were conducted using calibrated radiographic equipment under the supervision of qualified radiology personnel. Radiographs were interpreted independently by experienced radiologists to ensure consistency and diagnostic reliability.

Radiological features suggestive of respiratory distress syndrome including ground glass appearance, reticulogranular pattern, air bronchogram, reduced lung volume, bilateral diffuse opacities, consolidation, pleural effusion, pneumothorax and white-out lung appearance were carefully documented. Severity of respiratory distress syndrome was graded into four categories based

on standard radiological classification criteria ranging from mild reticulogranular pattern to extensive bilateral opacification. Clinical and radiological data were recorded immediately after imaging to maintain accuracy and reduce information bias. Patient confidentiality was strictly maintained.

**Statistical Analysis:** Data were analyzed using SPSS version 25.0. Descriptive statistics were applied to summarize demographic variables and radiological

findings. Categorical variables were presented as frequency and percentage. The association between gestational age and severity of respiratory distress syndrome was evaluated using the chi-square test. A p-value less than 0.05 was considered statistically significant.

## RESULTS

**Table 1: Baseline Characteristics of Neonates with Respiratory Distress Syndrome (n = 110)**

Variable	Category	Frequency (n)	Percentage (%)
Gestational age	<32 weeks	34	30.9
	32–34 weeks	38	34.5
	35–37 weeks	26	23.6
	>37 weeks	12	10.9
Birth weight	<1.5 kg	29	26.4
	1.5–2.49 kg	51	46.4
	≥2.5 kg	30	27.3
Sex	Male	64	58.2
	Female	46	41.8
Mode of delivery	Vaginal	48	43.6
	Caesarean section	62	56.4
Antenatal steroid exposure	Yes	44	40.0
	No	66	60.0

Table 1 shows the baseline characteristics of neonates diagnosed with respiratory distress syndrome. Most neonates were born between 32–34 weeks of gestation (34.5%), followed by <32 weeks (30.9%). Low birth weight was common, with 46.4% weighing 1.5–

2.49 kg and 26.4% weighing less than 1.5 kg. Male neonates comprised 58.2% of cases. Caesarean section was the predominant mode of delivery (56.4%). Antenatal steroid exposure was reported in 40.0% of mothers.

**Table 2: Distribution of Chest X-ray Findings in Neonatal RDS (n = 110)**

Chest X-ray finding	Frequency (n)	Percentage (%)
Ground glass / reticulogranular pattern	92	83.6
Air bronchogram	78	70.9
Reduced lung volume	73	66.4
Bilateral diffuse opacities	69	62.7
Consolidation	31	28.2
White-out lung appearance	18	16.4
Pleural effusion	9	8.2
Pneumothorax	6	5.5

Table 2 presents the distribution of chest X-ray findings among neonates with respiratory distress syndrome. The most frequent radiological feature was ground glass or reticulogranular pattern observed in 83.6% of cases. Air bronchogram was present in 70.9% and reduced lung volume in 66.4% of neonates. Bilateral

diffuse opacities were noted in 62.7% of cases. Consolidation was observed in 28.2% of neonates, while white-out lung appearance was present in 16.4%. Pleural effusion and pneumothorax were less common findings, seen in 8.2% and 5.5% of cases respectively.

**Table 3: Severity Grading of RDS Based on Chest X-ray Findings (n = 110)**

Radiological grade	Description	Frequency (n)	Percentage (%)
Grade I	Mild reticulogranular pattern	27	24.5
Grade II	Ground glass appearance with air bronchogram	41	37.3
Grade III	Diffuse alveolar opacity with reduced lung expansion	29	26.4
Grade IV	White-out lung / severe bilateral opacification	13	11.8

Table 3 shows the severity grading of respiratory distress syndrome based on chest X-ray findings. Grade II severity was most common, accounting for 37.3% of cases. Grade III was observed

in 26.4% of neonates, followed by Grade I in 24.5%. Severe Grade IV radiological findings were present in 11.8% of cases.

**Table 4: Association Between Gestational Age and Severity of RDS (n = 110)**

Gestational age	Mild–Moderate RDS (Grade I–II) n (%)	Severe RDS (Grade III–IV) n (%)	Total	p-value
<34 weeks	36 (50.0)	36 (50.0)	72	0.002
≥34 weeks	32 (84.2)	6 (15.8)	38	
<b>Total</b>	<b>68</b>	<b>42</b>	<b>110</b>	

Table 4 describes the association between gestational age and severity of respiratory distress syndrome. Among neonates with gestational age less than 34 weeks, 50.0% had mild to moderate disease and 50.0% had severe disease. In contrast, among neonates with gestational age ≥34 weeks, 84.2% had mild to moderate disease and only 15.8% had severe disease. The association between gestational age and severity of respiratory distress syndrome was statistically significant (p = 0.002).

## DISCUSSION

Neonatal respiratory distress syndrome remains a major contributor to neonatal morbidity, particularly among preterm infants with immature pulmonary structure and inadequate surfactant production. The present study evaluated chest X-ray findings and severity grading of respiratory distress syndrome in neonates and demonstrated that classical radiographic patterns remain highly prevalent and clinically relevant. The findings highlight the continued importance of chest radiography as a primary imaging modality in diagnosing and assessing disease severity in neonatal respiratory distress syndrome.

In the present study, a higher proportion of neonates were born between 32 and 34 weeks of gestation, followed by those born less than 32 weeks. The predominance of preterm neonates is consistent with the known epidemiology of respiratory distress syndrome, where decreasing gestational age is strongly associated with increased disease risk. Rubarth *et al.*, reported that structural and functional immaturity of the lung significantly contributes to impaired respiratory adaptation in preterm neonates [1]. Similarly, Walani described preterm birth as a major contributor to neonatal mortality globally, emphasizing the vulnerability of premature lungs to respiratory complications [2]. The distribution of low birth weight in the present study further supports the association between pulmonary immaturity and increased risk of respiratory distress syndrome.

Male predominance observed in this study is comparable to findings reported by Alfarwati *et al.*, who demonstrated a higher incidence of respiratory distress syndrome among male neonates [18]. Previous studies

suggest that delayed lung maturation in male fetuses may contribute to increased susceptibility to respiratory distress syndrome [19]. Caesarean section was the most common mode of delivery in this study, which is consistent with findings by Li *et al.*, who reported an increased risk of respiratory complications among neonates delivered by operative methods due to delayed clearance of fetal lung fluid [6]. Reduced antenatal steroid exposure observed in the present study may also have influenced disease severity, as antenatal corticosteroids are known to accelerate fetal lung maturation and improve surfactant production [20].

The most frequent chest X-ray finding in this study was ground glass or reticulogranular pattern, followed by air bronchogram and reduced lung volume. These radiographic features are widely recognized as classical findings of respiratory distress syndrome. Jain *et al.*, described reticulogranular pattern and air bronchogram as hallmark radiographic features associated with surfactant deficiency and alveolar collapse [8]. Similarly, Mehta *et al.*, reported that diffuse bilateral opacities and reduced lung expansion are common imaging characteristics that support the diagnosis of respiratory distress syndrome [7]. The high frequency of bilateral diffuse opacities in this study further confirms the typical radiological presentation of the disease.

White-out lung appearance was observed in a smaller proportion of neonates, representing severe pulmonary involvement. Tagliaferro *et al.*, demonstrated that early radiological evidence of extensive opacification is associated with severe disease and increased likelihood of respiratory support requirement [9]. The relatively lower frequency of pleural effusion and pneumothorax observed in this study is comparable to findings reported by Vibede *et al.*, who described pneumothorax as an important but less frequent complication in neonatal respiratory distress syndrome [11]. Identification of these complications through chest radiography plays a crucial role in timely clinical intervention.

Severity grading based on chest X-ray findings showed that Grade II respiratory distress syndrome was the most common category, followed by Grade III and Grade I disease. Similar distribution patterns have been

reported in previous radiological studies evaluating neonatal respiratory distress syndrome severity. Sun *et al.*, reported that moderate disease severity is commonly observed among preterm neonates receiving supportive care [12]. Radiological grading is clinically important because it helps guide therapeutic decisions, including surfactant administration and respiratory support [21].

The present study demonstrated a statistically significant association between gestational age and severity of respiratory distress syndrome. Neonates with gestational age less than 34 weeks showed a higher proportion of severe disease compared to those born at or beyond 34 weeks. This finding is supported by Sardesai *et al.*, who reported that surfactant deficiency is more pronounced in extremely preterm neonates, leading to increased disease severity [3]. De Luca emphasized that precision-based neonatal care relies heavily on early assessment of disease severity to optimize respiratory management strategies [22].

Although lung ultrasound has recently gained attention as a diagnostic tool in neonatal respiratory distress, chest X-ray remains widely used due to its accessibility and established diagnostic criteria. Hiles *et al.* demonstrated that chest radiography continues to play a fundamental role in confirming respiratory distress syndrome in clinical settings [13]. Silveira Neves *et al.* also emphasized that chest X-ray remains particularly valuable in low-resource environments where access to advanced imaging modalities may be limited [17]. Radiographic evaluation allows clinicians to assess disease progression and monitor response to treatment, which is essential for improving neonatal outcomes.

The findings of this study are consistent with previous literature indicating that chest X-ray findings provide valuable diagnostic and prognostic information in neonatal respiratory distress syndrome. Understanding the distribution of radiological patterns and their association with gestational age contributes to improved clinical decision making. Early identification of characteristic imaging features may facilitate timely intervention, optimize respiratory support strategies and improve neonatal outcomes.

#### Limitations and Recommendations

The study was conducted in a single center with a limited sample size. Multicenter studies with larger populations are recommended. Future research should compare chest X-ray findings with lung ultrasound to improve diagnostic accuracy and reduce radiation exposure in neonates.

## CONCLUSION

Chest X-ray remains an essential diagnostic tool for evaluating neonatal respiratory distress syndrome, demonstrating characteristic radiological patterns that correlate with disease severity. Ground-glass appearance, air bronchograms and reduced lung volume

were the most frequent findings. A significant association between gestational age and severity of respiratory distress syndrome was observed, with more severe disease in preterm neonates. Early radiological assessment may improve clinical decision-making, optimize treatment strategies and contribute to better neonatal outcomes.

**Conflicts of interest:** There are no conflicts of interest.

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**Cite This Article:** Mohammad Mahbub Hossain, Mahmuda Monowara, Mst. Meherun Nesa (2026). Chest X-ray Findings in Neonatal Respiratory Distress Syndrome in a Tertiary Care Hospital. *EAS J Radiol Imaging Technol*, 8(2), 55-60.

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