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Original article

Prevalence, Clinical Characteristics, Etiologies, and Outcomes of Newborns with Respiratory Distress in Zawia Medical Center, Libya

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Abstract
Respiratory distress (RD) is one of the most common causes of admission to neonatal intensive care units (NICUs), and early recognition is essential for timely management and improved neonatal outcomes. This study aimed to determine the prevalence, associated maternal and neonatal characteristics, etiologies, and outcomes of neonatal respiratory distress among neonates admitted to the NICU at Zawia Medical Center, Libya. A retrospective observational study was conducted using medical records of neonates admitted between 1 January and 31 December 2025. Of 5,300 deliveries during the study period, 2,600 neonates were admitted to the NICU, and 220 were diagnosed with RD. The prevalence of RD was 4.2% among all deliveries and 8.5% among NICU admissions. RD was more common among male neonates (54.1%) than female neonates (45.9%). More than half of affected neonates were term infants (56.8%), 54.5% had normal birth weight, and 60.9% were delivered by cesarean section. Most mothers had no documented illness (79.5%); urinary tract infection, diabetes mellitus, and hypertension were reported in 5.9%, 4.1%, and 3.2% of mothers, respectively. The most common cause of RD was transient tachypnea of the newborn (39.1%), followed by respiratory distress syndrome (31.8%), sepsis (15.5%), and meconium aspiration syndrome (6.8%). Most neonates were discharged in good condition (95%), while mortality was 5%. Neonatal RD remains an important clinical problem at Zawia Medical Center. Improved antenatal care, appropriate timing of elective cesarean section, early recognition, and strengthened neonatal respiratory support may help reduce RD-related morbidity and mortality.
Keywords. *Neonates, Respiratory Distress, Respiratory Distress Syndrome, Neonatal Intensive Care Unit.*

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Introduction

Respiratory distress (RD) is among the most frequent clinical problems encountered in newborn infants during the first 48–72 hours after birth [1]. It occurs in up to 7% of term neonates, with a higher incidence observed as gestational age decreases, even among infants with mild to moderate prematurity [2]. The clinical features of neonatal respiratory distress are variable and may include tachypnea, defined as a respiratory rate of 60 breaths per minute or more, apnea, intercostal or subcostal retractions, expiratory grunting, nasal flaring, and cyanosis [3]. Prompt recognition of these signs, followed by timely and cause-specific management, is associated with better neonatal outcomes [4]. Conversely, delayed diagnosis or inadequate treatment of the underlying etiology may result in serious early and late complications, including respiratory failure, chronic lung disease, and mortality [5].

Neonatal respiratory distress may represent the clinical presentation of a wide spectrum of neonatal disorders [6]. Pulmonary causes are the most common and include transient tachypnea of the newborn (TTN), meconium aspiration syndrome, neonatal pneumonia, pneumothorax, persistent pulmonary hypertension of the newborn, congenital airway abnormalities, and delayed cardiopulmonary transition. However, respiratory distress may also arise secondary to extrapulmonary conditions. These include congenital heart disease, neonatal sepsis, metabolic disorders, neurological abnormalities, hematological disorders, and other systemic illnesses that may compromise oxygenation or respiratory function [7]. The diagnosis of neonatal respiratory distress is primarily clinical and depends on careful assessment of respiratory signs, perinatal history, and associated maternal and neonatal characteristics. Additional investigations, including arterial blood gas analysis and chest radiography, are often used to support the diagnosis and assess severity. Arterial blood gas findings may demonstrate hypoxemia, hypercapnia, or respiratory acidosis, depending on the underlying condition and disease severity.

Chest radiography may show variable findings according to the cause; in respiratory distress syndrome, typical features include diffuse reticulogranular or ground-glass lung opacities, air bronchograms, and reduced lung volumes [8]. However, radiological findings do not always closely reflect the clinical severity of respiratory compromise [9]. Respiratory distress in neonates can be life-threatening and may lead to both immediate and long-term adverse

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outcomes. These complications may result from hypoxemia, respiratory failure, the underlying disease process, or complications related to oxygen therapy and respiratory support. Reported consequences include neurodevelopmental impairment and intellectual disability [10], visual impairment, thrombotic events, pulmonary hemorrhage, intraventricular hemorrhage, bronchopulmonary dysplasia, pneumothorax, sepsis, and acute kidney injury [11].
Although respiratory distress is a common reason for neonatal admission, its prevalence and associated maternal and neonatal characteristics differ considerably across populations, institutions, and levels of neonatal care. Identifying these local patterns is important for improving early detection, prevention strategies, and risk-based management of affected newborns. Evaluating the burden of neonatal respiratory distress and its contributing factors can also support better allocation of NICU resources and the development of evidence-based neonatal care protocols. Therefore, this study aimed to assess the prevalence, associated maternal and neonatal characteristics, etiologies, and outcomes of neonatal respiratory distress among newborns admitted to the Neonatal Intensive Care Unit at Zawia Medical Center.

Methods

Study design

A retrospective observational study was carried out in the Neonatal Intensive Care Unit (NICU) at Zawia Medical Center (ZMC), Libya, using medical records of neonates admitted between 1 January and 31 December 2025. Ethical approval was obtained from the Biosafety and Bioethics Committee under approval number 08.H224.59.

Study population

The study included all neonates admitted to the NICU who developed clinical features of respiratory distress during the early hours of life. Neonates with major congenital anomalies incompatible with life were excluded from the study.

Definition and assessment of respiratory distress

Respiratory distress was defined clinically according to the presence of one or more recognized respiratory signs, as described by Yadav and Lee.[9] These signs included tachypnea, defined as a respiratory rate greater than 60 breaths per minute, expiratory grunting, nasal flaring, intercostal or subcostal chest retractions, and cyanosis.

Data collection

Data were retrieved retrospectively from neonatal medical records using a structured data collection form. Maternal variables included maternal age, pregnancy-related complications, chronic medical illnesses, and mode of delivery. Neonatal variables included gestational age, birth weight, Apgar scores, and clinical presentation at admission. Information regarding respiratory support and treatment was also collected, including the use of continuous positive airway pressure (CPAP), mechanical ventilation, and surfactant therapy. Clinical outcomes assessed included duration of hospital stay, survival status, and recorded complications. Clinical evaluation was performed by trained neonatal staff at the time of admission, with initial assessment documented within the first 30 minutes, followed by regular reassessment during the first 48 hours of hospitalization. Vital signs were monitored continuously as part of routine NICU care. Relevant investigations, including chest radiography and arterial blood gas analysis, were also reviewed when available.

Statistical analysis

Data were analyzed using SPSS version 27 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used as appropriate. Results were presented as frequencies and percentages for categorical variables. Associations between categorical variables and RDS diagnosis were assessed using the chi-square test or Fisher's exact test, as appropriate. A p-value of less than 0.05 was considered statistically significant.

Results

During the study period, 5,300 neonates were delivered at Zawia Medical Center (ZMC). Of these, 2,600 were admitted to the neonatal intensive care unit (NICU), and 220 were diagnosed with respiratory distress (RD). The prevalence of RD was 4.2% among all deliveries and 8.5% among NICU admissions. More than half of RD cases were term neonates (56.8%), and the majority were males (54.1%). Most neonates had normal birth weight (54.5%) and were delivered by cesarean section (134, 60.9%). Most mothers of affected neonates were healthy (175, 79.5%), while recorded maternal

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conditions included urinary tract infection, diabetes mellitus, hypertension, oligohydramnios, polyhydramnios, hypothyroidism, and anemia (Table 1). Detailed demographic and maternal characteristics are presented in (Table 1).

Table 1. Demographic and maternal characteristics of neonates with respiratory distress

Gestational age (n = 220)	**Count**	**%**
Term (≥37 weeks)	125	56.8
Late/moderate preterm (32–<37 weeks)	76	34.5
Very preterm (28–<32 weeks)	15	6.8
Extremely preterm (<28 weeks)	4	1.8
Sex of the baby		
Male	119	54.1
Female	101	45.9
Birth weight		
Normal birth weight (2.5–4 kg)	120	54.5
Low birth weight (<2.5 kg)	77	35.0
Very low birth weight (<1.5 kg)	15	6.8
Extremely low birth weight (<1 kg)	3	1.4
Macrosomia (>4 kg)	5	2.3
Mode of delivery		
C/S	134	60.9
NVD	86	39.1
Maternal conditions		
Healthy	175	79.5
DM	9	4.1
UTI	13	5.9
HTN	7	3.2
Polyhydramnios	4	1.8
Oligohydramnios	5	2.3
Hypothyroidism	3	1.4
Anemia	4	1.8

C/S, cesarean section; NVD, normal vaginal delivery; DM, diabetes mellitus; UTI, urinary tract infection; HTN, hypertension.

Table 2. Distribution of respiratory distress syndrome cases according to gestational age and sex

Variable	**RDS n=70**	**Non-RDS n=150**	**p-value**
Term	22	103	<0.001
Late/moderate preterm	36	40	
Very preterm	8	7	
Extremely preterm	4	0	
Male	37	82	0.663
Female	33	68	

Statistical significance was considered at $p < 0.05$.

Table 3. Etiologies of respiratory distress among neonates

Etiology	**Count**	**%**
TTN	86	39.1
RDS	70	31.8
Sepsis	34	15.5
MAS	15	6.8
Congenital pneumonia	5	2.3
CHD	4	1.8

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PPHN	3	1.4
Pneumothorax	3	1.4

The most common cause of RD was transient tachypnea of the newborn (TTN), accounting for 39.1% of cases, followed by respiratory distress syndrome (RDS) in 31.8%, neonatal sepsis in 15.5%, meconium aspiration syndrome (MAS) in 6.8%, congenital pneumonia in 2.3%, congenital heart disease (CHD) in 1.8%, persistent pulmonary hypertension of the newborn (PPHN) in 1.4%, and pneumothorax in 1.4% (Table 3). Percentages may not total exactly 100% because of rounding. The vast majority of neonates with RD were discharged home in good condition (95%), while 5% died. Among neonates diagnosed with RDS (n=70), late/moderate preterm infants represented the largest proportion (36/70, 51.4%), followed by term infants (22/70, 31.4%), very preterm infants (8/70, 11.4%), and extremely preterm infants (4/70, 5.7%). In the non-RDS group (n=150), most neonates were term infants (103/150, 68.7%), whereas late/moderate preterm infants accounted for 40 cases (26.7%), very preterm infants for 7 cases (4.7%), and no extremely preterm infants were observed. The association between gestational age category and RDS diagnosis was statistically significant ($p < 0.001$). Regarding sex distribution, males represented 52.9% (37/70) of the RDS group and 54.7% (82/150) of the non-RDS group, while females accounted for 47.1% (33/70) and 45.3% (68/150), respectively. No statistically significant difference was observed between the two groups regarding sex distribution ($p = 0.663$), as shown in Table 2.

Discussion

The Neonatal Intensive Care Unit (NICU) at Zawia Medical Center (ZMC) is considered one of the key tertiary neonatal care units in Libya and functions as a major referral center for the western region of the country [13]. Given the large number of high-risk pregnancies managed at ZMC, the unit frequently receives critically ill neonates, including newborns presenting with respiratory distress (RD) [12]. Respiratory distress remains one of the leading indications for NICU admission [14]. In the current study, RD accounted for 4.2% of all deliveries and 8.5% of NICU admissions. These findings are broadly comparable with reports from neighboring and regional countries. Studies from Iraq and Iran reported RD prevalence rates of 2.5% and 3.4%, respectively [15,10], whereas a considerably higher prevalence of 36.1% was documented in Syria [16]. The variation between studies may be explained by differences in antenatal care coverage, referral patterns, availability of neonatal services, socioeconomic conditions, and the criteria used to define or record respiratory distress. Although RD overall was more frequently observed among term neonates in the present study, RDS specifically was more common among preterm infants. This distinction is clinically important because TTN is commonly seen in term and late-preterm infants, whereas RDS is strongly related to prematurity and surfactant deficiency [17].

In general, the risk of surfactant-deficiency-related respiratory morbidity declines with advancing gestational age as fetal lung maturation progresses, particularly during the third trimester. Nevertheless, gestational age alone does not fully explain the occurrence of neonatal RD. Other maternal and perinatal factors, including mode of delivery, perinatal asphyxia, maternal illness, and intrapartum events, may also influence neonatal respiratory outcomes. Therefore, careful respiratory assessment should be applied to all neonates, regardless of gestational age. Transient tachypnea of the newborn (TTN) was the most frequently identified cause of RD in the present study, followed by respiratory distress syndrome (RDS) and neonatal sepsis. This pattern is consistent with the findings of Edwards et al. [6], who also reported TTN as a common cause of respiratory morbidity during early neonatal life. TTN is usually seen in term and late-preterm infants and is mainly attributed to delayed absorption of fetal lung fluid after birth [18]. Incomplete clearance of lung fluid, particularly among infants delivered by elective cesarean section, may result in transient respiratory symptoms. The predominance of TTN in the present study may partly reflect the gestational age profile of the admitted neonates, with a relatively high proportion of term and near-term infants. In addition, improvements in antenatal and perinatal care, including the appropriate use of antenatal corticosteroids, may have contributed to a lower frequency of severe surfactant-deficiency-related RDS [19]. These findings are also in agreement with a previous Libyan study by Alwaqqaa et al. [30], in which TTN was reported as the leading cause of neonatal RD. In contrast, a recent Egyptian study by Alabasy et al. [21] identified RDS as the most common etiology, followed by TTN, neonatal pneumonia, and meconium aspiration syndrome (MAS). Such differences may be related to variations in population characteristics, gestational age distribution, antenatal steroid exposure, cesarean section rates, referral practices, and local protocols for neonatal respiratory support.

In line with previous studies [22,23], male neonates in the current study were more frequently affected by RD than females. This sex-related difference may be biologically plausible. Prenatal hormonal factors have been suggested to influence fetal lung development, with testosterone potentially delaying surfactant production through its effect on type II pneumocyte maturation. Conversely, estrogen is believed to promote surfactant synthesis and support alveolar development [24]. Female fetuses are also reported to have relatively earlier pulmonary maturation, including earlier surfactant production and more rapid structural lung development [23]. These mechanisms may partly explain the greater vulnerability of male neonates to respiratory morbidity. With regard to mode of delivery, most neonates with RD in this study were delivered by cesarean section. This finding agrees with previous reports showing a higher frequency of respiratory morbidity among infants born by cesarean delivery compared with vaginal delivery [20]. The association may be explained by delayed clearance of fetal lung fluid, reduced functional residual capacity, and lower catecholamine-mediated surfactant release in infants delivered by cesarean section.

During vaginal birth, thoracic compression and hormonal stress responses facilitate lung fluid absorption and promote postnatal respiratory adaptation [25,26]. Most mothers in the present study had no major medical problems. However, some maternal conditions associated with adverse neonatal respiratory outcomes were documented. Urinary tract infection was present in 5.9% of mothers, diabetes mellitus in 4.1%, hypertension in 3.2%, and oligohydramnios in 2.3%. Although these proportions were relatively low, each of these conditions may increase the risk of neonatal respiratory compromise through inflammatory, metabolic, placental, or perinatal mechanisms. Compared with the Egyptian study by Baseer et al. [14], the frequency of maternal complications in the current study was lower. In that study, premature rupture of membranes was reported in 22.07%, diabetes in 17.2%, hypertension in 6.2%, and oligohydramnios in 13.8% of cases. These differences may reflect variation in maternal health status, antenatal care utilization, diagnostic criteria, referral patterns, and population characteristics across different settings.

The survival rate among neonates with RD in the current study was high, reaching 95%. This favorable outcome is comparable to findings from Saudi Arabia reported by Alfarwati et al. [29], where a similarly high survival rate was observed. This favorable outcome may reflect timely clinical assessment and available neonatal respiratory support at ZMC during the study period; however, interpretation should consider the retrospective design and lack of severity stratification. Nevertheless, mortality related to neonatal RD remains substantially higher in many resource-limited settings, where shortages in equipment, trained staff, timely referral, and advanced respiratory support may adversely affect outcomes. For example, a mortality rate of 60% was reported among neonates with RD in Bangladesh [27] while a Nigerian study documented a mortality rate of 21.5% [28]. Similarly, Baloch et al. [31] reported an overall mortality rate of 26.84%, with RDS and sepsis being the main causes of death. In Libya, Alwaqqaa et al. [30] reported an RD-related mortality rate of 11% over a three-month period at Tripoli Medical Center. Although higher than the rate observed in the present study, that figure remains lower than mortality rates reported in several other low-resource settings. Differences in mortality across studies may be attributed to variation in NICU capacity, availability of respiratory support, staff expertise, referral systems, disease severity at presentation, and socioeconomic factors. This study has some limitations. As it was conducted in a single NICU, the findings may mainly reflect the clinical practices, available resources, equipment, and patient profile of ZMC. Therefore, the results may not be fully generalizable to other hospitals or regions with different levels of neonatal care.

Despite this limitation, the study provides useful local data on the burden, associated characteristics, etiologies, and outcomes of neonatal respiratory distress. The findings also emphasize the continuing disparities in neonatal outcomes between healthcare settings and highlight the importance of timely recognition, adequate respiratory support, trained neonatal staff, and appropriate allocation of NICU resources. Strengthening neonatal care systems and improving access to essential respiratory support may contribute substantially to reducing RD-related morbidity and mortality.

Conclusion

This study demonstrates that neonatal respiratory distress remains an important clinical problem affecting newborns across different gestational age categories, with transient tachypnea of the newborn being the most frequently identified cause. Male sex, cesarean delivery, and selected maternal conditions were frequently observed among affected neonates; however, further analytical studies are required to confirm their independent contribution. Despite these observed characteristics, the survival rate among affected neonates at Zawia Medical Center was high, suggesting effective perinatal care, timely clinical assessment, and appropriate neonatal management. In comparison with reports from other regional and resource-limited settings, the findings of this study reinforce the importance of early

recognition, prompt intervention, adequate NICU infrastructure, and trained neonatal healthcare providers in improving outcomes. Further strengthening of maternal healthcare services, careful optimization of delivery practices, and continued improvement of respiratory support protocols are recommended to reduce the burden of neonatal respiratory distress and enhance neonatal survival.

Authors' Contributions
Ridha Itrunbah, Baha Ettrmal, Zenab Elfzzani, and Hatem Omar contributed to the conception and design of the study, data acquisition, analysis and interpretation of results, drafting and critical revision of the manuscript, and approval of the final version for submission. All authors agree to be accountable for all aspects of the work.

Data Availability
The data supporting the findings of this study are available from the corresponding author upon reasonable request, subject to institutional and ethical approvals.

Ethical Approval
Ethical approval was obtained from the Biosafety and Bioethics Committee under approval number 08.H224.59.

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None.

Conflict of Interest
The authors declare that they have no conflicts of interest.

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