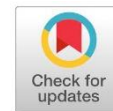


Research Article

⁶Open Access

Neonatal Respiratory Distress: A Retrospective Analysis of Frequency, Etiology, and Short-Term Outcomes at Al Bayda Medical Center



Wafa J. Saed^{1*}, Elham M. Keeshar² and Emad I.M. Ahmaida³

***Corresponding author:**
wafa.saed@omu.edu.ly Department of Pediatrics, Faculty of Medicine, Omar Al-Mukhtar University, Libya

^{2, 3} Department of Pediatrics, Faculty of Medicine, Omar Al-Mukhtar University, Libya

Received:
29 June 2026

Accepted:
24 August 2026

Publish online:
02 September 2026

Abstract

Neonatal respiratory distress (NRD) is a global leading cause of neonatal intensive care admission and mortality. This study evaluates the frequency, etiology, and predictors of short-term mortality among newborns with NRD at Al Bayda Medical Center, Libya. A retrospective observational study reviewed medical files of neonates (n=139) admitted with NRD over a 5-month period (August- December 2023). Demographic, maternal, and clinical variables were analyzed using Chi-square, Fisher's exact, and multivariable logistic regression v20.0. The cohort comprised 57.6% males and 42.4% females. Transient tachypnea of the newborn (TTN) was the most frequent etiology (51.8%), followed by respiratory distress syndrome (RDS, 28.8%). Low birth weight, prematurity, and maternal problems were strongly associated with RDS ($p < 0.001$), whereas TTN correlated significantly with full-term elective cesarean deliveries ($p < 0.001$). The overall fatality rate was 16.5%, heavily driven by RDS (69.6% of deaths). Using Firth's penalized logistic regression to account for the low events per variable ratio (32 deaths, 4 predictors), severe distress (aOR: 6.45, 95% CI: 1.59–26.13, $p=0.009$) and neonatal complications ((aOR: 4.03, 95% CI: 1.27–12.76, $p=0.018$) isolated as the only independent predictors of mortality.

Keywords: Libya; Mortality; Respiratory Distress; Transient Tachypnea

INTRODUCTION

Neonatal respiratory distress (RD) is a critical emergency characterized by tachypnea, grunting nasal flaring, and chest retractions. It contributes substantially to neonatal intensive care unit (NICU) morbidity and mortality worldwide. Prompt clinical recognition and timely intervention are essential to prevent progressive hypoxemia and subsequent respiratory failure (Sweet et al., 2023).

The global burden of neonatal respiratory failure is significant, with recent scoping reviews indicating varying prevalence rates heavily influenced by regional healthcare resources and maternal-fetal risk factors (Tochie et al., 2024). Consequently, mapping local epidemiology is essential for optimizing care pathways and allocating resources effectively, particularly in resource limited setting.

The etiology of NRD is multifactorial, encompassing pulmonary and systemic conditions. TTN



and RDS are widely established as the primary culprits (De Luca et al., 2022). Other critical causes include meconium aspiration syndrome (MAS) frequently associated with perinatal asphyxia in term or post-term infants (Monfredini et al., 2021), neonatal pneumonia, and congenital heart disease (CHD).

Several maternal and neonatal risk factors predispose infants to respiratory complications. Prematurity, low birth weight (LBW), and male sex are strongly linked to RDS and adverse short-term outcomes (Legesse et al., 2023; Wondie et al., 2023).

Analyzing the institutional epidemiological and clinical profile of RD is vital for identifying modifiable risk factors and improving neonatal care. Therefore, this study aims to evaluate the frequency, underlying etiologies, associated risk factors, and independent predictors of short-term mortality among neonates admitted with RD to NICU of Al Bayda Medical Center, Libya, over a 5-month period in 2023.

MATERIALS AND METHODS

This retrospective observational study was conducted at NICU of Al Bayda Medical Center, a regional referral hospital providing specialized neonatal care. Data were extracted from medical files of all neonates (n=139) admitted with a primary diagnosis of RD over a 5-month period (August to December 2023).

A structured data extraction form captured: (1) Neonatal anthropometric data (sex, admission age, birth weight, gestation number, and maturity); (2) Delivery parameters (mode and place of delivery); (3) clinical variables (onset time, severity (mild, moderate, severe), and primary etiology); and (4) Maternal/Outcome data (maternal problems, associated neonatal complications, hospitalization duration, and discharge/death outcome).

Statistical analysis was performed using IBM SPSS version 20.0 (Armonk, NY: IBM Corp). Categorical variables were presented as frequencies and percentages, and evaluated using the Chi-square test, applying Monte Carlo or Fisher's exact corrections when expected cell counts fell below 5. Continuous variables were tested for normality and expressed as mean $\pm$ standard deviation (SD) and median (range). One-way ANOVA (F-test) was used to compare continuous parameters across multiple groups.

Given the anticipated limited number of deaths - low events per variable ratio- Firth's penalized logistic regression used to identify independent predictors of mortality with variables statistically significant in bivariate analysis were entered into the model. Results are reported as Odd Ratios (OR) and adjusted Odd Ratios (aOR) with 95% Confidence Interval (CI). Statistical significance was defined as $p < 0.05$.

RESULTS

The cohort comprised 139 neonates: 80 males (57.6%) and 59 females (42.4%). The vast majority (97.15%) were admitted on day 1 of life (median age: 1 day; range: 1–15 days). The mean birth weight was 2.67 ± 0.83 kg, with 91.4% singletons and 71.9% full-term infants. Deliveries primarily occurred via C/S (66.2%) and within a hospital setting (64.7%). Maternal medical conditions (predominantly diabetes and hypertension) were documented in 26.6% of cases. Clinical distress severity was mostly moderate (53.2%) or severe (45.3%). TTN was the most frequent etiology (51.8%), followed by RDS (28.8%), MAS (7.9%), pneumonia (7.2%), and CHD (4.3%). Clinical complications developed in 14.4% neonates (Table1).

Table:(1). Socio-demographic clinical characteristics of the study sample (N=139)

Characteristic		No. (%)
Gender	Male	80 (57.6%)
	Female	59 (42.4%)
Age at admission (days)	≤ 1 Day	135 (97.1%)
	> 1 Day	4 (2.9%)
	Median (Min. – Max.)	1 (1 – 15)
Weight (kg)	Mean $\pm$ SD.	2.67 $\pm$ 0.83
	Median (Min. – Max.)	2.80 (0.60 – 4.50)
Number of gestations	Single	127 (91.4%)
	Twin	12 (8.6%)
Maturity	Pre-term	39 (28.1%)
	Full term	100 (71.9%)
Mode of delivery	NVD	47 (33.8%)
	C/S	92 (66.2%)
Place of delivery	Hospital	90 (64.7%)
	Clinic	48 (34.5%)
	In the car	1 (0.7%)
Onset of RD	First 24 hrs.	135 (97.1%)
	48 Hrs.	0 (0.0%)
	72 Hrs.	1 (0.7%)
	> 72 Hrs.	3 (2.2%)
Duration (days)	≤ 5 Days	98 (70.5%)
	> 5 Days	41 (29.5%)
	Mean $\pm$ SD.	4.51 $\pm$ 2.19
	Median (Min. – Max.)	4 (1 – 10)
Cause of RD	TTN	72 (51.8%)
	RDS	40 (28.8%)
	MAS	11 (7.9%)
	Pneumonia	10 (7.2%)
	CHD	6 (4.3%)
Degree	Mild	2 (1.4%)
	Moderate	74 (53.2%)
	Severe	63 (45.3%)
Outcome	Discharge	116 (83.5%)
	Died	23 (16.5%)
Associated complication		20 (14.4%)
Maternal problems		37 (26.6%)

SD: Standard deviation

The overall mortality rate was 16.5% (23 deaths). Outcomes differed significantly by RD etiology ($p < 0.001$), with RDS exhibiting the highest mortality (16 deaths, 69.6% of all fatalities; $\chi^2 = 22.371$, $p < 0.001$), followed by TTN (5 deaths, 21.7%; $\chi^2 = 9.974$, $p = 0.002$) (Table 2).

Table:(2). Relation between neonatal outcome and etiology of RD (N=139)

Etiology	Discharged	Died	χ^2	p
TTN	67 (57.8%)	5 (21.7%)	9.974*	0.002*
RDS	24 (20.7%)	16 (69.6%)	22.371	<0.001*
MAS	11 (9.5%)	0 (0.0%)	2.368	^{FE} p =0.211
Pneumonia	10 (8.6%)	0 (0.0%)	2.136	^{FE} p =0.214
CHD	4 (3.4%)	2 (8.7%)	1.280	^{FE} p =0.259

χ^2 : Chi square test FE: Fisher Exact *: Statistically significant at $p \leq 0.05$

RDS infants had the lowest mean birth weight (1.74 ± 0.65 kg; $F = 36.250$, $p < 0.001$) and occurred predominantly in preterm infants (92.5%; $\chi^2 = 117.79$, $p < 0.001$). TTN cases were largely delivered via C/S (88.9%; $\chi^2 = 44.142$, $p < 0.001$). Maternal problems were significantly higher in neonates complicate by RDS (45.0%) and pneumonia (40.0%) ($\chi^2 = 12.723$, $p = 0.007$).

Table:(3). Relation between cause of RD and different parameters (N=139)

	TTN (n = 72)	RDS (n = 40)	MAS (n = 11)	Pneumonia (n = 10)	CHD (n = 6)	Test of Sig.	p
Weight (kg)							
Mean $\pm$ SD.	3.03 $\pm$ 0.56	1.74 $\pm$ 0.65	3.29 $\pm$ 0.65	2.86 $\pm$ 0.44	3 $\pm$ 0.52	F=	
Median (Min. – Max.)	3(1.90 – 4.50)	1.7(0.6 – 2.9)	3.3(2.3 – 4.5)	2.9(1.9 – 3.3)	3(2.4 – 3.8)	36.250*	<0.001*
Maturity							
Pre-term	1 (1.4%)	37 (92.5%)	0 (0.0%)	1 (10.0%)	0 (0.0%)	$\chi^2 =$	^{MC} p
Full term	71 (98.6%)	3 (7.5%)	11 (100.0%)	9 (90.0%)	6 (100.0%)	117.79*	<0.001*
Mode of delivery							
NVD	8 (11.1%)	18 (45.0%)	8 (72.7%)	9 (90.0%)	4 (66.7%)	$\chi^2 =$	^{MC} p
C/S	64 (88.9%)	22 (55.0%)	3 (27.3%)	1 (10.0%)	2 (33.3%)	44.142*	<0.001*
Associated complication							
No	63 (87.5%)	34 (85.0%)	11 (100.0%)	7 (70.0%)	4 (66.7%)	$\chi^2 =$	^{MC} p=
Yes	9 (12.5%)	6 (15.0%)	0 (0.0%)	3 (30.0%)	2 (33.3%)	5.691	0.167
Maternal problems							
No	61 (84.7%)	22 (55.0%)	8 (72.7%)	6 (60.0%)	5 (83.3%)	$\chi^2 =$	^{MC} p=
Yes	11 (15.3%)	18 (45.0%)	3 (27.3%)	4 (40.0%)	1 (16.7%)	12.723*	0.007*

MC: Monte Carlo; F: ANOVA; χ^2 : Chi square test ; *: Statistically significant at $p \leq 0.05$

A multivariable analysis using Firth's penalized logistic regression was used (Table4); sever distress (aOR = 6.45, 95%CI: 1.59-26.13, $p = 0.009$) and the presence of neonatal complications (aOR = 4.03, 95%CI: 1.27 -12.76, $p = 0.018$) remained the only statistically significant independent predictors of neonatal mortality.

Table:(4). Bivariate and multivariable logistic regression analysis for mortality

Variable / Contrast	Bivariate OR (95%CI)	P value	Multivariable aOR (95%CI)	P value
Birth weight (Normal ≥ 2.5 kg VS. LBW < 2.5 kg)	0.24 (0.07-0.79)	0.018	0.29 (0.07-1.24)	0.095
Maturity (Term VS. Preterm)	0.29 (0.09-0.96)	0.043	0.53 (0.13-2.20)	0.378
Mode of delivery (Vaginal VS. Cesarean)	1.72 (0.52-5.70)	0.376	-	-
Duration (>5 days VS. ≤ 5 days)	0.14 (0.04-0.53)	0.004	-	-
Cause group (Others VS. High -risk)	0.19 (0.06-0.62)	0.006	-	-
Degree of distress (Sever VS. Mild/Moderate)	8.59 (1.81-40.73)	0.007	6.45 (1.59-26.13)	0.009
Complications (Yes VS. No)	4.40 (1.34-14.43)	0.014	4.03 (1.27-12.76)	0.018

OR: Odd Ratio; aOR: adjusted Odd Ratio; CI: Confidence Interval; significant at $p \leq 0.05$; Multivariable estimates were obtained using Firth's penalized logistic regression to mitigate bias from the low events-per-variable ratio (23 deaths / 4 predictors; EPV $\approx$ 5.75, below the recommended threshold of 10); Significant at $p \leq 0.05$.

DISCUSSION

This retrospective analysis provides essential epidemiological insights into NRD at Al Bayda Medical Center. TTN was identified as the primary driver of NICU respiratory admissions (51.8%), closely linked to full-term infants (98.6%) and C/S deliveries (88.9%). This confirms well-documented pathophysiology, where the absence of natural labor processes suppresses fetal alveolar fluid reabsorption, positioning TTN as the most common, yet mostly benign, cause of term neonatal morbidity (Alhassen et al., 2021; Neri et al., 2025).

In contrast, the actual mortality burden was heavily driven by RDS, which accounted for 69.6% of all fatalities. Structural pulmonary immaturity and surfactant deficiency in preterm infants explain this high lethality, reinforcing that while TTN is highly prevalent, RDS requires immediate protocol-driven interventions to safeguard survival (De Luca, 2021; De Luca et al., 2022). Mirroring findings by Legesse et al. (2023) and Wondie et al. (2023), who isolated prematurity as a chief arbiter of poor neonatal outcomes. Furthermore, maternal medical problems were significantly higher in the RDS group (45.0%), aligning with evidence that maternal diabetes and hypertensive emergencies delay surfactant production and increases respiratory morbidity (Li et al., 2019; Stylianou-Riga et al., 2021; Zhu et al., 2023).

The multivariable model conclusively demonstrated that severe distress (aOR: 6.45) and the development of neonatal complications (aOR:4.03) are the strongest independent predictors of mortality. This emphasizes the vital need for immediate, lung-protective management pathways, including the early initiation of continuous positive airway pressure (CPAP) and Less Invasive Surfactant Administration (LISA) in high-risk preterm cohorts (Boel et al., 2022; Silveira et al., 2024). Adherence to standardized European Consensus Guidelines is critical to reducing these preventable fatalities (Sweet et al., 2023; Hibberd et al., 2024). Furthermore, the shorter duration of stay observed among deceased neonates reflects early, and rapid clinical deterioration.

This study is constrained by its single-center, retrospective design, a modest sample size ($n=139$), and a 5-month window, which may limit wider generalizability. Nonetheless, it serves as a baseline for future multi-center prospective study in Libya.

CONCLUSION

While TTN represents the most frequent cause of NRD predominantly affecting term infants delivered via C/S, the actual mortality burden is fundamentally driven by RDS and prematurity. Enhancing regional antenatal screening, optimizing elective delivery timing, and ensuring immediate access to advanced non-invasive ventilation (CPAP) and surfactant therapy are paramount to reducing neonatal mortality.

ETHICS

Approved by the Al-Mukhtar Committee for Biosafety and Bioethics (Reference: NBC: 007.H26.74).

Duality of interest: No duality of interest associated with this manuscript.

Author contributions: Author 1 developed the theoretical formalism, collect the data, performed

the analytic calculations and write the manuscript. Both 1.2 and 3. authors contributed to collect the data.

Funding: The authors did not receive any funding for the work reported in their manuscript.

REFERENCES

- Alfarwati, T. W., Alamri, A. A., Alshahrani, M. A., & Al-Wassia, H. (2019). Incidence, Risk factors and Outcome of Respiratory Distress Syndrome in Term Infants at Academic Centre, Jeddah, Saudi Arabia. *Medical archives (Sarajevo, Bosnia and Herzegovina)*, 73(3), 183–186. <https://doi.org/10.5455/medarh.2019.73.183-186>
- Alhassen, Z., Vali, P., Guglani, L., Lakshminrusimha, S., & Ryan, R. M. (2021). Recent Advances in Pathophysiology and Management of Transient Tachypnea of Newborn. *Journal of perinatology: official journal of the California Perinatal Association*, 41(1), 6–16. <https://doi.org/10.1038/s41372-020-0757-3>
- Aynalem YA, Mekonen H, Akalu TY, Habtewold TD, Endalamaw A, et al. (2020) Incidence of respiratory distress and its predictors among neonates admitted to the neonatal intensive care unit, Black Lion Specialized Hospital, Addis Ababa, Ethiopia. *PLOS ONE* 15(7): e0235544. <https://doi.org/10.1371/journal.pone.0235544>
- Boel, L., Hixson, T., Brown, L., Sage, J., Kotecha, S., & Chakraborty, M. (2022). Non-invasive respiratory support in preterm infants. *Paediatric respiratory reviews*, 43, 53–59. <https://doi.org/10.1016/j.prrv.2022.04.002>
- Chekole, B., Fetene, T. T., Geze, T. S., Tefera, Z. B., Alebel, G. E. F., Kassaw, A., Gelaw, W. B., Tamene, Z. F., Mira, Y., Mulatu, T., & Deressa, D. (2023). Prevalence and factors associated with neonatal acute respiratory distress syndrome among neonates admitted to the neonatal intensive care units of Gurage zone public hospital, South West Ethiopia. *African health sciences*, 23(3), 159–167. <https://doi.org/10.4314/ahs.v23i3.20>
- De Luca D. (2021). Respiratory distress syndrome in preterm neonates in the era of precision medicine: A modern critical care-based approach. *Pediatrics and neonatology*, 62 Suppl 1, S3–S9. <https://doi.org/10.1016/j.pedneo.2020.11.005>
- De Luca, D., Tingay, D. G., van Kaam, A. H., Courtney, S. E., Kneyber, M. C. J., Tissieres, P., Tridante, A., Rimensberger, P. C., Pillow, J. J., & Neonatal ARDS Project Collaboration Group (2022). Epidemiology of Neonatal Acute Respiratory Distress Syndrome: Prospective, Multicenter, International Cohort Study. *Pediatric critical care medicine : a journal of the Society of Critical Care Medicine and the World Federation of Pediatric Intensive and Critical Care Societies*, 23(7), 524–534. <https://doi.org/10.1097/PCC.0000000000002961>
- Hibberd, J., Leontini, J., Scott, T., Pillow, J. J., Miedema, M., Rimensberger, P. C., & Tingay, D. G. (2024). Neonatal high-frequency oscillatory ventilation: where are we now?. *Archives of disease in childhood. Fetal and neonatal edition*, 109(5), 467–474. <https://doi.org/10.1136/archdischild-2023-325657>
- Kawakita, T., Bowers, K., Hazrati, S., Zhang, C., Grewal, J., Chen, Z., Sun, L., & Grantz, K. L. (2017). Increased Neonatal Respiratory Morbidity Associated with Gestational and

- Pregestational Diabetes: A Retrospective Study. *American journal of perinatology*, 34(11), 1160–1168. <https://doi.org/10.1055/s-0037-1604414>
- Legesse, B. T., Abera, N. M., Alemu, T. G., & Atalell, K. A. (2023). Incidence and predictors of mortality among neonates with respiratory distress syndrome admitted at West Oromia Referral Hospitals, Ethiopia, 2022. Multi-centred institution based retrospective follow-up study. *PloS one*, 18(8), e0289050. <https://doi.org/10.1371/journal.pone.0289050>
- Li, Y., Wang, W., & Zhang, D. (2019). Maternal diabetes mellitus and risk of neonatal respiratory distress syndrome: a meta-analysis. *Acta diabetologica*, 56(7), 729–740. <https://doi.org/10.1007/s00592-019-01327-4>
- Monfredini, C., Cavallin, F., Villani, P. E., Paterlini, G., Allais, B., & Trevisanuto, D. (2021). Meconium Aspiration Syndrome: A Narrative Review. *Children*, 8(3), 230. <https://doi.org/10.3390/children8030230>
- Neri, C., Sartorius, V., & De Luca, D. (2025). Transient tachypnoea: new concepts on the commonest neonatal respiratory disorder. *European respiratory review : an official journal of the European Respiratory Society*, 34(175), 240112. <https://doi.org/10.1183/16000617.0112-2024>
- Silveira, R. C., Panceri, C., Munõz, N. P., Carvalho, M. B., Fraga, A. C., & Procianoy, R. S. (2024). Less invasive surfactant administration versus intubation-surfactant-extubation in the treatment of neonatal respiratory distress syndrome: a systematic review and meta-analyses. *Journal de pediatria*, 100(1), 8–24. <https://doi.org/10.1016/j.jpmed.2023.05.008>
- Stylianou-Riga, P., Boutsikou, T., Kouis, P., Kinni, P., Krokou, M., Ioannou, A., Siahianidou, T., Iliodromiti, Z., Papadouri, T., Yiallourous, P. K., & Iacovidou, N. (2021). Maternal and neonatal risk factors for neonatal respiratory distress syndrome in term neonates in Cyprus: a prospective case-control study. *Italian journal of pediatrics*, 47(1), 129. <https://doi.org/10.1186/s13052-021-01086-5>
- Sweet, D. G., Carnielli, V., Greisen, G., Hallman, M., Ozek, E., Te Pas, A., Plavka, R., Roehr, C. C., Saugstad, O. D., Simeoni, U., Speer, C. P., Vento, M., Visser, G. H. A., & Halliday, H. L. (2019). European Consensus Guidelines on the Management of Respiratory Distress Syndrome - 2019 Update. *Neonatology*, 115(4), 432–450. <https://doi.org/10.1159/000499361>
- Sweet, D. G., Carnielli, V. P., Greisen, G., Hallman, M., Klebermass-Schrehof, K., Ozek, E., Te Pas, A., Plavka, R., Roehr, C. C., Saugstad, O. D., Simeoni, U., Speer, C. P., Vento, M., Visser, G. H. A., & Halliday, H. L. (2023). European Consensus Guidelines on the Management of Respiratory Distress Syndrome: 2022 Update. *Neonatology*, 120(1), 3–23. <https://doi.org/10.1159/000528914>
- Tochie, J. N., Sibetchu, A. T., Arrey-Ebot, P. E., & Choukem, S. P. (2024). Global, Regional and National Trends in the Burden of Neonatal Respiratory Failure and essentials of its diagnosis and management from 1992 to 2022: a scoping review. *European journal of pediatrics*, 183(1), 9–50. <https://doi.org/10.1007/s00431-023-05238-z>
- Wondie, W. T., Legesse BT, Mekonnen GB et al. (2023). Incidence and predictors of respiratory distress syndrome among low birth weight neonates in the first seven days in Northwest

Ethiopia Comprehensive Specialized Hospitals, 2023: A retrospective follow-up study. *BMJ Open*, 13(11), e079063. <https://doi.org/10.1136/bmjopen-2023-079063>

Zu, J., Zhao, Y., An, P., Zhao, Y., Li, S., Zhou, J., Zhao, H., Zhou, Q., Li, X., & Xiong, Y. (2023). Antenatal Corticosteroid Treatment During the Late-Preterm Period and Neonatal Outcomes for Twin Pregnancies. *JAMA network open*, 6(11), e2343781. <https://doi.org/10.1001/jamanetworkopen.2023.43781>