Patient Safety & Quality Improvement Journal
http://psj.mums.ac.ir
PSQI

Incidence and Risk Factors of Bronchopulmonary Dysplasia in Premature Infants Below 32 Weeks of Gestation

*Kamaran Omara Hama karim[1], Alan abdulla abdurahman[2]

1.Clinical Science Branch, College of Medicine, University of Sulaimani, Kurdistan Region of Iraq.
2.Associate Professor, Clinical Science Branch, College of Medicine, University of Sulaimani, Kurdistan Region of Iraq.

ARTICLEINFO

Article type:
Original Article

***Article History*:**
Received: 05 Sep 2025
Accepted:21 Sep 2025

Keywords:
Apnea, Bronchopulmonary Dysplasia, Infant, Intensive Care Unit

ABSTRACT

Abstract

Introduction:

Bronchopulmonary dysplasia (BPD) remains a major cause of morbidity in preterm infants, particularly those born at <32 weeks of gestation. This study aimed to determine the incidence and severity of BPD and identify associated risk factors in a high-risk neonatal population in Sulaimaniyah, Iraq.

Materials and Methods:

A retrospective observational study was conducted over 12 months (January–December 2025) across two tertiary NICUs. Preterm infants born at <32 weeks and admitted within 24 hours of birth were included. Data were extracted from medical records, and BPD was diagnosed and graded at 36 weeks' postmenstrual age.

Results:

Twenty preterm infants were included. Most were male (70%) and had a birth weight between 500–999 g (70%). BPD incidence was 100%, with 16 (80%) cases classified as severe and 4 (20%) as moderate. Recurrent apnea was experienced by 10 (50%) infants and was the only factor significantly associated with BPD severity (p=0.043). Other factors, including gestational age, birth weight, mechanical ventilation, and antenatal steroid administration, showed no significant association. Logistic regression revealed no statistically significant predictors of BPD severity.

Conclusion:

The study found a high incidence of severe BPD among infants born before 32 weeks. Recurrent apnea was significantly associated with severe BPD, indicating a need for early detection and targeted interventions. Larger multicenter studies with extended follow-up are needed to validate these findings and better understand the multifactorial etiology of BPD.

► ***Please cite this paper as:***
Omara Hama karim K, Abdurahman AA. Incidence and Risk Factors of Bronchopulmonary Dysplasia in Premature Infants Below 32 Weeks of Gestation. Journal of Patient Safety and Quality Improvement. 2026; 14(1):41-49.
Doi: 10.22038/psj.2025.90997.1488

Corresponding Author:
Clinical Science Branch, College of Medicine, University of Sulaimani, Kurdistan Region of Iraq.
E-mail:kamaranomar156@gmail.com

Introduction

Prematurity remains a significant global health challenge, with infants born before 32 weeks of gestation facing heightened risks of morbidity and mortality due to physiological immaturity . Among the most serious complications in this population is bronchopulmonary dysplasia (BPD), a chronic lung disease that continues to pose substantial threats to both short- and long-term health outcomes (2). Originally described as a consequence of aggressive mechanical ventilation and oxygen therapy in preterm infants, BPD has evolved in its clinical and pathological presentation, now reflecting a complex interplay of disrupted lung development, inflammation, and environmental exposures (3). The definition of BPD has shifted over time, with current criteria emphasizing oxygen dependency at 36 weeks' postmenstrual age and the presence of radiographic abnormalities, which better capture the spectrum of disease severity in extremely preterm infants (4). Despite advances in neonatal care, including the introduction of surfactant therapy and gentler ventilation strategies, the incidence of BPD has not declined, particularly among infants with extremely low birth weight (5). The pathogenesis of BPD is multifactorial, involving prenatal factors such as maternal smoking, chorioamnionitis, and intrauterine growth restriction, as well as postnatal exposures like mechanical ventilation, sepsis, and nutritional deficits (2,6). These factors collectively disrupt alveolarization and vascular development, leading to chronic respiratory morbidity and increased risk of neurodevelopmental impairment (4).

While numerous studies have identified individual risk factors for BPD, there remains a critical gap in integrating these variables into comprehensive predictive models that account for the complex interactions between prenatal, perinatal, and postnatal influences (7,8). Most existing research is limited by single-center designs or a focus on isolated clinical parameters, which restricts the generalizability and clinical utility of their findings. The present study addresses this gap by systematically evaluating the incidence and multifactorial risk factors of BPD in preterm infants born below 32 weeks' gestation, aiming to inform targeted prevention strategies and improve long-term outcomes. The main aim of this study was to determine the incidence of BPD and elucidate its associated risk factors in this high-risk population.

Methods and Materials

Study design and setting

The research was conducted over a 12-month period, from January 1, 2025, to December 31, 2025, in two tertiary-level neonatal intensive care units (NICUs) in Sulaimaniyah, Iraq: the Obstetric Hospital NICU and Dr. Jamal A. Rashid Pediatric Teaching Hospital NICU.

Participants

The study population consisted of all preterm infants born at <32 weeks of gestational age and admitted to either of the two participating NICUs within 24 hours of birth during the study period. Potential participants were identified through admission logs and electronic health records (EHRs). A total of 20 preterm infants meeting the inclusion criteria were consecutively enrolled using a convenience sampling method. Recruitment was non-randomized but comprehensive, ensuring that all eligible infants were included during the defined period regardless of sex, birth weight, or clinical condition at admission. A convenience sampling method was employed.Inclusion criteria were as follows: infants born before 32 weeks of gestation confirmed by either early obstetric ultrasound or the Ballard scoring system, admitted to the NICU within 24 hours of delivery, and having complete documented medical records, including antenatal, perinatal, and postnatal details. Exclusion criteria comprised neonates with major congenital anomalies diagnosed antenatally or postnatally (e.g., significant congenital heart disease, neural tube defects, or chromosomal syndromes such as trisomy 21), neonates with congenital respiratory conditions not related to prematurity (e.g., congenital diaphragmatic hernia), and those who died within the first 28 days of life to reduce survivorship bias. (Fig.1)

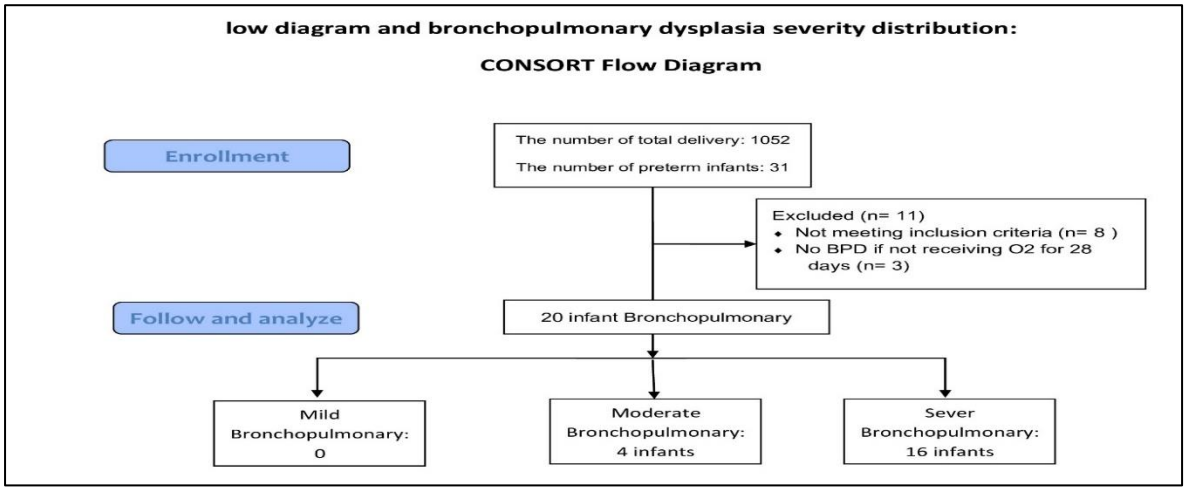

Figure.1: Study cohort population flow diagram (bronchopulmonary dysplasia severity)

Data Collection

Data were extracted from electronic and physical neonatal and maternal medical records using a structured data collection form developed specifically for the study. The form captured information on maternal demographics, antenatal history, complications during pregnancy, mode of delivery, and administration of antenatal corticosteroids. Neonatal data included gestational age, birth weight, sex, Apgar scores, requirements for respiratory interventions (such as mechanical ventilation and surfactant therapy), and development of neonatal morbidities including BPD, sepsis, patent ductus arteriosus (PDA), necrotizing enterocolitis (NEC), and apnea of prematurity.

BPD was defined based on The National Institute of Child Health and Human Development (NICHD) consensus definition in 2001 as follows: no BPD if not receiving O2 for 28 days; mild BPD if receiving oxygen (O2) support for ≥ 28 days but not at 36 weeks postconceptional age; moderate BPD if receiving O2 for ≥ 28 days plus treatment with < fraction of inspired oxygen (FiO2) 30% at 36 weeks postconceptional age, and severe BPD if receiving O2 for ≥ 28 days plus treatment with ≥ FiO2 30% or positive pressure at 36 weeks postconceptional age (9).

Detailed daily progress notes and respiratory support logs were reviewed to track the oxygen requirements. Data collectors included trained pediatric residents and neonatal staff under the supervision of a neonatologist, ensuring consistency and accuracy of data abstraction.

Ethical Considerations

Ethical approval was obtained from the Institutional Review Board (IRB) of the University of Sulaimani (Reference No: 12-2022). Given the retrospective nature of the study, a waiver of informed consent was granted, provided that all patient identifiers were removed prior to analysis. Data confidentiality was maintained by anonymizing records with unique study codes and restricting access to password-protected databases. All research personnel signed confidentiality agreements.

Statistical Analysis

Data were entered and analyzed using IBM Statistical Package for the Social Sciences (SPSS) version 26. Descriptive statistics, including frequencies, percentages, and means, were used to summarize demographic and clinical characteristics. Bivariate analysis was conducted using the Chi-square test or Fisher's exact test to evaluate associations between independent variables and the severity of BPD. A binary logistic regression model was applied to identify predictors of BPD severity. Odds ratios (ORs) with corresponding 95% confidence intervals (CIs) were reported. A p-value of ≤0.05 was considered statistically significant.

Results

Gestational age at birth was 24–25 weeks in 4 (20%) infants, 26–27 weeks in 9 (45%) infants, 28–29 weeks in 5 (25%) infants, and 30–31 weeks in 2 (10%) infants. Birth

weight was between 1000–1499 grams in 6 (30%) infants, while 14 (70%) infants weighed between 500–999 grams at birth. Regarding sex, 6 (30%) infants were female and 14 (70%) were male. The mean age of mothers was as follows: 12 (60%) mothers were between 20–29 years, 6 (30%) were between 30–39 years, 1 (5%) was over 40 years, and 1 (5%) was under 20 years (Table 1).

Table 1. Demographics characteristics in Premature Infants.

Demographics characteristics		**Frequency (percent)**
Gestational age (in weeks) at birth	24-25	4 (20%)
	26-27	9 (45%)
	28-29	5 (25%)
	30-31	2 (10%)
Birth weight (in grams)	1000-1499 g	6 (30%)
	500-999 g	14 (70%)
Sex of infant	Female	6 (30%)
	Male	14 (70%)
Maternal age (in years)	20-29	12 (60%)
	30-39	6 (30%)
	40 or more	1 (10%)
	Less than 20	1 (10%)

Maternal complications and diseases during pregnancy are presented in Table 2. Placenta previa or abruption was the most common complication, observed in 4 (20%) mothers. Each of the following complications (chorioamnionitis, multiple pregnancies (twins, triplets), and rupture of membranes) was reported in 2 (10%) mothers. Other complications were each observed in one mother.

Table 2. Problems and illnesses of the mother during pregnancy with premature infants.

Problems of mothers		**Frequency (percent)**
Problems of mothers during pregnancy	Chorioamnionitis	2 (10%)
	Chorioamnionitis, rupture membrane	1 (5%)
	Gestational diabetes	1 (5%)
	Hyper viscosity	1 (5%)
	Hypertension or preeclampsia	1 (5%)
	Hypertension or preeclampsia, Placenta previa or abruption	1 (5%)
	Multiple pregnancies (twins, triplets)	1 (5%)
	Multiple pregnancies (twins, triplets), Placenta previa or abruption, Chorioamnionitis	1 (5%)
	Multiple pregnancies (twins, triplets), rupture membrane	2 (10%)
	Placenta previa or abruption	4 (20%)
	Rupture membrane	2 (10%)
	Thrombosis (coagulation defect)	1 (5%)

Vaginal delivery was the predominant mode of delivery among mothers of preterm infants, with 17 (85%) undergoing vaginal delivery and 3 (15%) delivering via cesarean section. Antenatal corticosteroids, administered to promote fetal lung maturation, were not given to 7 (35%) mothers, while 13 (65%) mothers received them. Congenital anomalies were absent in 19 (95%) infants, with only 1 (5%) infant presenting with a specific congenital anomaly. Following birth, 9 (45%) infants required mechanical ventilation, whereas 11 (55%) did not. Surfactant therapy was administered to 18 (90%) infants, while 2 (10%) did not receive this treatment. None of the infants required high-frequency ventilation. The maximum oxygen requirement during the neonatal period was between 51–70% in 19 (95%) infants, and between 31–50% in only 1 (5%) infant (Table 3).

Table 3. Maternal delivery methods and interventions performed on mothers and infants to improve the health of premature infants.

Variable		Frequency (percent)
Mode of delivery	Cesarean section	3 (15%)
	Vaginal delivery	17 (85%)
Steroids given to the mother before birth to help the fetus's lungs mature	No	7 (35%)
	Yes	13 (65%)
Birth of a baby with a specific congenital abnormality	No	19 (95%)
	Yes	1 (5%)
Placing the infants on a mechanical ventilator	No	11 (55%)
	Yes	9 (45%)
Receiving the infants surfactant therapy	No	2 (10%)
	Yes	18 (90%)
Placing the infants on high-frequency ventilation	No	20 (100%)
	Yes	0
Maximum oxygen requirement during neonatal period	31-50%	1 (5%)
	51-70%	19 (95%)

Postnatal complications in the infants are illustrated in Figure 2. The most prevalent complications were respiratory distress syndrome (RDS), necrotizing enterocolitis (NEC), PDA, sepsis, and apnea of prematurity, each observed in 3 (15%) preterm infants. The following combinations of complications were each observed in 2 (10%) infants: RDS with apnea of prematurity; RDS with PDA; RDS with NEC and apnea of prematurity; RDS with PDA, NEC, and sepsis; and RDS with PDA, sepsis, and apnea of prematurity. Each of the following complications was observed in 1 (5%) infant: RDS; RDS with NEC and apnea of prematurity; RDS with NEC and sepsis; RDS with NEC, sepsis, and apnea of prematurity; RDS with PDA, NEC, sepsis, and apnea of prematurity; and RDS with sepsis and apnea of prematurity.

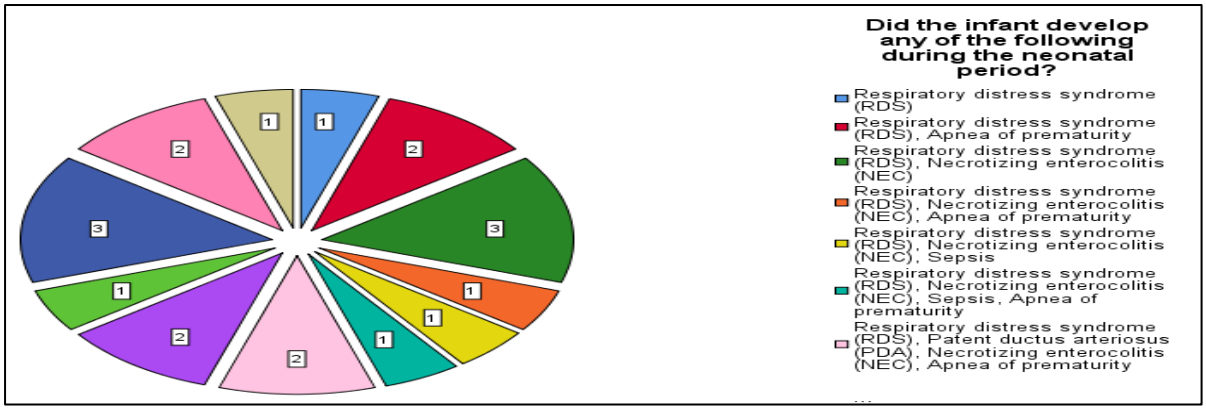

Figure 2. Neonatal problem during the neonatal period

Among the preterm infants, 10 (50%) had a history of prolonged or recurrent apnea, while the remaining infants did not experience this issue. The majority of preterm infants, 16 (80%), had a NICU stay of 30–60 days, 3 (15%) stayed for 61–90 days, and 1 (5%) stayed less than 30 days.

The severity of BPD was classified as severe in 16 (80%) preterm infants and moderate in 4 (20%) infants. None of the infants required supplemental oxygen at home following hospital discharge.

The most common treatments administered in the NICU were corticosteroids and diuretics, received by 10 (50%) preterm infants. Diuretics and vitamin A supplementation were each administered to 3 (15%) infants. A combination of corticosteroids, diuretics, and vitamin A supplementation was given to 2 (10%) infants. Corticosteroids alone and corticosteroids with vitamin A supplementation were each administered to 1 (5%) infant. A family history of respiratory diseases (such as asthma, cystic fibrosis, etc.) was present in 5 (25%) infants (Table 4).

Table 4. Information on BPD and hospital treatment strategies for premature infants.

Variable		Frequency (percent)
History of prolonged or frequent episodes of apnea	No	10 (50%)
	Yes	10 (50%)
Duration of NICU stay	Less than 30 days	1 (5%)
	30-60 days	16 (80%)
	61-90 days	3 (15%)
Severity of BPD in the infants	Moderate	4 (20%)
	Sever	16 (80%)
The need for supplemental oxygen at home after neonatal discharge	No	20 (100%)
	Yes	0
Treatments received by infants during NICU stay	Corticosteroids	1 (5%)
	Corticosteroids, Diuretics	10 (50%)
	Corticosteroids, Diuretics, Vitamin A supplementation	2 (10%)
	Corticosteroids, Vitamin A supplementation	1 (50%)
	Diuretics	3 (15%)
	Vitamin A supplementation	3 (15%)
family histories of respiratory diseases (e.g., asthma, cystic fibrosis.)	No	15 (75%)
	Yes	5 (25%)

Bivariate analysis between the severity of BPD and demographic and clinical variables in premature infants is presented in Table 5. Among the factors influencing BPD severity, only the releationship between a history of prolonged or frequent episodes of apnea and BPD severity was statistically significant (P≤0.043). Specifically, 10 (62.5%) preterm infants with prolonged and recurrent apnea experienced severe BPD. Other variables examined did not demonstrate a statistically significant releationship with BPD severity (Table 5).

Table 5. Bivariate Analysis of the Severity of bronchopulmonary and demographic and clinical variable in infants premature.

Variable		Severity of bronchopulmonary		P-value
		Moderate	Sever	
Gestational age (in weeks) at birth	24-25	0	4 (25%)	0.482
	26-27	2 (50%)	7 (43.8%)	
	28-29	2 (50%)	3 (18.8%)	
	30-31	0	2 (12.5%)	
Birth weight (in grams)	1000-1499 g	1 (25%)	5 (31.3%)	0.657
	500-999 g	3 (755)	11 (68.8%)	
Sex of infant	Female	1 (25%)	5 (31.5%)	0.657
	Male	3 (75%)	11 (68.8%)	
Maternal age (in years)	20-29	4 (100%)	8 (50%)	0.523
	30-39	0	6 (37.5%)	
	40 or more	0	1 (6.3%)	
	Less than 20	0	1 (6.3%)	
Problems of mothers during pregnancy	Chorioamnionitis	1 (25%)	1 (6.3%)	0.271
	Chorioamnionitis, rupture membrane	0	1 (6.3%)	
	Gestational diabetes	0	1 (6.3%)	
	Hyper viscosity	0	1 (6.3%)	
	Hypertension or preeclampsia	0	1 (6.3%)	
	Hypertension or preeclampsia, Placenta previa or abruption	0	1 (6.3%)	
	Multiple pregnancies (twins, triplets)	0	3 (18.8%)	
	Multiple pregnancies (twins, triplets) , Placenta previa or abruption, Chorioamnionitis	0	1 (6.3%)	
	Multiple pregnancies (twins, triplets), rupture membrane	2 (50%)	0	
	Placenta previa or abruption	0	4 (25%)	
	Rupture membrane	1 (25%)	1 (6.3%)	
	Thrombosis (coagulation defect)	0	1 (6.3%)	
Mode of delivery	Cesarean section	0	3 (18.8%)	0.491
	Vaginal delivery	4 (100%)	13 (81.3%)	
Steroids given to the mother before birth to help the fetus's lungs mature	No	0	7 (49.8%)	0.148
	Yes	4 (100%)	9 (56.3%)	
History of prolonged or frequent episodes of apnea	No	4 (1005)	6 (37.5%)	0.043
	Yes	0	10 (62.5%)	
family histories of respiratory diseases (e.g., asthma, cystic fibrosis..)	No	2 (50%)	13 (81.3%)	0.249
	Yes	2 (50%)	3 (18.8%)	
P-value based on Chi-square test and fisher exact test				

According to the results of logistic regression analysis in a sample of 20 preterm infants, none of the variables were identified as statistically significant predictors of BPD severity (Table 6).

Table 6. Predictive factors of bronchopulmonary severity in premature infants

Variable	ß	SE	Wald	P	OR	95%CI
Gestational age				NS		
Birth weight	-0.310	1.274	0.059	0.808	0.733	0.060-8.915
Sex of infant	-0.310	1.274	0.059	0.808	0.733	0.060-8.915
Maternal age				NS		
Problems of mothers during pregnancy				NS		
Mode of delivery				NS		
Steroids given to the mother before birth to help the fetus's lungs mature				NS		
Birth of a baby with a specific congenital abnormality				NS		
Placing the infants on a mechanical ventilator	-0.251	1.120	0.050	0.822	0.778	0.087-6.983
Receiving the infants surfactant therapy				NS		
Placing the infants on high-frequency ventilation				NS		
Maximum oxygen requirement during neonatal period				NS		
Neonatal disorders during the neonatal period				NS		
History of prolonged or frequent episodes of apnea				NS		
family histories of respiratory diseases (e.g., asthma, cystic fibrosis.)	-1.466	1.188	1.525	0.217	0.231	0.023-2.366
P-value based on Binary logistic regression						

Discussion

The BPD remains one of the most serious complications of prematurity, particularly among infants born before 32 weeks of gestation (10). This study aimed to assess the incidence and associated risk factors for BPD in a highly vulnerable subgroup of preterm neonates. The findings revealed a 100% incidence of BPD, with a predominance of the severe form. Importantly, the only variable with a statistically significant association with the severity of BPD was a history of recurrent apnea, suggesting a possible link between repeated hypoxic episodes and pulmonary injury. The remarkably high incidence of BPD in this study contrasts significantly with results reported in other regions. In study Rutkowska et al. (2019) reported a 45.2% incidence of BPD in Polish neonates born before 32 weeks, and only 6% developed severe BPD (11). Similarly, Kwok et al. (2023) described a BPD incidence ranging from 28% to 33% in the UK, with severe cases constituting between 12% and 17% (12). A much lower rate of 11.2% was reported by Konzett et al. (2024) in Austria (13). These discrepancies may be attributed to differences in sample size, NICU practices, diagnostic criteria, or population characteristics. For example, in this study, most infants required high oxygen concentrations during the neonatal period, which may have contributed to the elevated severity classification.

Notably, Xu (2016) reported a 100% incidence of BPD in a study of 42 Chinese neonates, although the distribution of severity differed from the present findings (14). In that study, 35.7% had severe BPD, compared with 80% in this study, further indicating that smaller cohorts involving extremely immature infants may display a higher risk of severe outcomes due to their clinical vulnerability. Conversely, the lack of variation in gestational age and birth weight in this cohort may have limited the ability to detect significant risk differentials between subjects, as all participants were already in high-risk categories.

The only significant clinical variable in the bivariate analysis was a history of prolonged or recurrent apnea. This aligns with the biological mechanism proposed by Solomakha et al. (2018), who emphasized the role of hypoxia-reoxygenation cycles in contributing to lung inflammation and damage (15). Similarly, Cicalò et al. (2023) identified apnea of prematurity as a relevant factor in BPD pathogenesis (16). However, variables commonly cited in previous studies as predictors of BPD, such as male sex (17), mechanical ventilation (18), and PDA (19), did not reach significance in this cohort. These inconsistencies are likely due to the small sample size and ensuing reduction in statistical power.

Several important limitations influenced the outcomes of this study. Most notably, the small sample size of 20 infants limited the ability to generalize findings or identify statistically significant predictors in multivariate models. Additionally, the single-center design restricts broader applicability. The lack of long-term follow-up also prevents assessment of chronic respiratory outcomes beyond the neonatal period, despite severe BPD often being associated with long-term respiratory morbidity

Conclusions

In conclusion, this study highlights an alarmingly high incidence of BPD, with a predominance of severe cases, among preterm infants born before 32 weeks of gestation. Although many known clinical and demographic risk factors showed no statistically significant association with BPD severity (likely due to the small sample size) a significant relationship was identified between recurrent apnea and severe BPD, indicating a potential area for early intervention. The absence of predictive variables in the logistic regression model underlines the limitations inherent in small, single-center studies and underscores the need for larger, multicenter investigations with extended follow-up. These findings emphasize the urgent need for enhanced monitoring, prevention strategies, and individualized care protocols for high-risk neonates to mitigate the growing burden of severe BPD.

Acknowledgments

We express our sincere gratitude to everybody who devoted their time, effort, and expertise to assure the success of this study.

Conflict of interest:

All authors declare no conflict of interest.

Data availability:

The study data may be acquired from the relevant author upon a reasonable request.

Authors' contributions:

Each author made an equal contribution to this research work.

Funding: Not applicable

References

1. Blencowe H, Hug L, Moller A-B, You D, Moran AC. Definitions, terminology and standards for reporting of births and deaths in the perinatal period: International Classification of Diseases (ICD-11). International Journal of Gynecology & Obstetrics. 2025;168(1):1-9. https://doi.org/10.1002/ijgo.15794.
2. Dankhara N, Holla I, Ramarao S, Kalikkot Thekkeveedu R. Bronchopulmonary Dysplasia: Pathogenesis and Pathophysiology. Journal of clinical medicine. 2023;12(13):4207. https://doi. org/10. 3390/jcm12134207.
3. Hilgendorff A. Bronchopulmonary Dysplasia 2016 [Available from: https:// obgynkey.com/bronchopulmonary-dysplasia-5/.
4. Sahni M, Mowes AK. Bronchopulmonary Dysplasia. StatPearls. Treasure Island (FL) ineligible companies. Disclosure: Anja Mowes declares no relevant financial relationships with ineligible companies.2025.
5. Jensen EA, Schmidt B. Epidemiology of bronchopulmonary dysplasia. Birth defects research Part A, Clinical and molecular teratology. 2014;100(3):145-57. https://doi.org/10. 1002/bdra.23235.
6. González-Luis GE, van Westering-Kroon E, Villamor-Martinez E, Huizing MJ, Kilani MA, Kramer BW, et al. Tobacco Smoking During Pregnancy Is Associated With Increased Risk of Moderate/Severe Bronchopulmonary Dysplasia: A Systematic Review and Meta-Analysis. Frontiers in pediatrics. 2020;8:160. https://doi.org/ 10.3389/ fped.2020.00160.
7. Dik PB, Gualdron YN, Galletti MF, Cribioli CM, Mariani GL. Bronchopulmonary dysplasia: incidence and risk factors. Arch Argent Pediatr. 2017;115(5):476-82.
8. Sucasas Alonso A, Pértega Diaz S, Sáez Soto R, Avila-Alvarez A. Epidemiology and risk factors for bronchopulmonary dysplasia in preterm

infants born at or less than 32 weeks of gestation. Anales de Pediatría (English Edition). 2022; 96(3):242-51. https:// doi.org/10. 1016/j. anpede. 2021. 03.006.
9. Jobe AH, Bancalari E. Bronchopulmonary dysplasia. Am J Respir Crit Care Med. 2001; 163(7): 1723-9.10.1164/ajrccm.163.7.2011 060.
10. Thébaud B, Goss KN, Laughon M, Whitsett JA, Abman SH, Steinhorn RH, et al. Bronchopulmonary dysplasia. Nat Rev Dis Primers. 2019;5(1):78. 10.1038/s41572-019-0127-7.
11. Rutkowska M, Hożejowski R, Helwich E, Borszewska-Kornacka MK, Gadzinowski J. Severe bronchopulmonary dysplasia - incidence and predictive factors in a prospective, multicenter study in very preterm infants with respiratory distress syndrome. J Matern Fetal Neonatal Med. 2019;32(12):1958-64. 10.1080/ 14767058. 2017.1422711.
12. Kwok TC, Poulter C, Algarni S, Szatkowski L, Sharkey D. Respiratory management and outcomes in high-risk preterm infants with development of a population outcome dashboard. thorax. 2023; 78(12):1215-22.
13. Konzett K, Riedl D, Blassnig-Ezeh A, Gang S, Simma B. Outcome in very preterm infants: a population-based study from a regional center in Austria. Front Pediatr. 2024;12:1336469. 10.3389/ fped.2024. 1336469.
14. Xu YP. Bronchopulmonary Dysplasia in Preterm Infants Born at Less Than 32 Weeks Gestation. Glob Pediatr Health. 2016; 3: 2333794x16668773. 10.1177/ 2333794 x16668773.
15. Solomakha AY, Petrova NA, Ivanov DO, Sviryaev YV. Apnea within the first year of life in premature infants with bronchopulmonary displasia and pulmonary hypertension. Pediatr. 2018;9(3):16-23. 10.17816/ped9316-23.
16. Cicalò MI, Mellino ML, Pintus R, Marcialis MA, Fanos V. Bronchopulmonary dysplasia: the more we learn, the less we know. Journal of Pediatric and Neonatal Individualized Medicine (JPNIM). 2023;12(1):e120113. 10.7363/120113.
17. Qian X, Townsend M, Tan KWJ, Grenyer B. Sex differences in borderline personality disorder: A scoping review. PLOS ONE. 2022;17:e0279015. 10.1371/journal.pone.0279015.
18. Dou C, Yu YH, Zhuo QC, Qi JH, Huang L, Ding YJ, et al. Longer duration of initial invasive mechanical ventilation is still a crucial risk factor for moderate-to-severe bronchopulmonary dysplasia in very preterm infants: a multicentrer prospective study. World J Pediatr. 2023; 19(6):577-85. 10.1007/ s12519-022-00671-w.
19. Nawaytou H, Hills NK, Clyman RI. Patent ductus arteriosus and the risk of bronchopulmonary dysplasia-associated pulmonary hypertension. Pediatr Res. 2023; 94(2):547-54. 10.1038/s41390-023-02522-4.